

**A RANDOMISED COMPARATIVE CLINICAL TRIAL OF
UDUMBARA TWAK KWATHA PARISHEKA FOLLOWED BY
MANJISTHADI LEPA WITH DICLOFENAC GEL APPLICATION FOR
SHOTHAHARA ROLE IN THE MANAGEMENT OF ANKLE SPRAIN**

A Thesis

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TILAK MAHARASHTRA VIDYAPEETH PUNE
FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
IN AYURVEDA - SHALYATANTRA**

Under the Board Of Ayurveda Studies



BY

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AUGUST – 2018

CERTIFICATE OF THE SUPERVISOR

It is certified that work entitled – “**A Randomised Comparative Clinical Trial of Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa with Diclofenac Gel application for Shothahara role in the Management of Ankle Sprain**” is an original research work done by **Dr Pallavi A. Hegde** Under my supervision for the degree of **Doctor of Philosophy in Ayurveda (Shalyatantra)** to be awarded by Tilak Maharashtra Vidyapeeth, Pune. To best of my knowledge this thesis.

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TABLE OF CONTENTS

SL. NO.	CONTENTS	PAGE NO.
1)	INTRODUCTION	1-5
2)	AYURVEDIC REVIEW	6-38
3)	MODERN REVIEW	39-84
4)	DRUG REVIEW	85-106
5)	RESEARCH METHODOLOGY	107-117
6)	OBSERVATIONS & RESULTS	118-154
7)	DISCUSSION	155-176
8)	CONCLUSION	177-178
9)	BIBLIOGRAPHY	179-188
10)	ANNEXURE I) CASE PROFORMA II) CASE STUDY III) MASTER CHART IV) ARTICLES	189-196 197-204 205-224 225-240

LIST OF FIGURES

SL. NO.	LIST OF FIGURES	PAGE NO.
01	Figure- Bones of the Foot and Ankle	45
02	Figure of Ligaments of the Ankle	46
03	Figure of Structures in relation to Ankle	49
04	Figure of Ankle joint motions	51
05	Figure of Mode of injury to Ankle	53
06	Figure of Grades of Ankle Sprain	55
07	Figure of Talar tilt test	64
08	Figure of Anterior Drawer test	64
09	Figure of Plantarflexion	67
10	Figure of Dorsiflexion	67
11	Figure of schematic drawing of Anterior drawer test	68
12	Figure of Talar tilt stress radiograph	68
13	Figure of Rehabilitation Exercise	75

14	Figure of Rehabilitation Exercise	75
15	Figure of Rehabilitation Exercise	75
16	Figure of Stretch Exercise	75
17	Figure of Stretch Exercise	75
18	Figure of Stretch Exercise	76
19	Figure of Stretch Exercise	76
20	Figure of Stretch Exercise	76
21	Figure of Stretch Exercise	76
22	Figure of Strengthen Exercise	77
23	Figure of Strengthen Exercise	77
24	Figure of Strengthen Exercise	77
25	Figure of Strengthen Exercise	77
26	Figure of Strengthen Exercise	77
27	Figure of Strengthen Exercise	77
28	Figure of Proprioceptive Exercises for Balance, Coordination & Agility	78

29	Figure of Proprioceptive Exercises for Balance, Coordination & Agility	78
30	Figure of Proprioceptive Exercises for Balance, Coordination & Agility	78
31	Figure of Proprioceptive Exercises for Balance, Coordination & Agility	78
32	Figure of Skin	80
33	Figure of Udumbara	86
34	Figure of Manjistha	87
35	Figure of Yastimadhu	89
36	Figure of Shali	90
37	Figure of Raktachandana	91
38	Figure of Shatadhoutaghrita	93
39	Figure of Udumbarakwatha Churna	95
40	Figure of Jala with Udumbarakwatha Churna	95
41	Figure of boiling Udumbarakwatha Churna	95

42	Figure of filtering the Kwatha	95
43	Figure of prepared Udumbarakwatha	95
44	Figure of Manjisthadi Lepa	96
45	Figure of Dharapatra	100
46	Figure of Dharapatra with jala	100
47	Figure of Structural formula of Diclofenac sodium	102
48	Figure of adverse effect of diclofenac gel	105
49	Figure of Volini gel	106
50	Figure of weighing of gel	106
51	Figure of Diclofenac measuring card	106

LIST OF CHARTS

SL.NO.	LIST OF CHARTS	PAGE NO.
01.	Samprapti of Gulpha Marmabhighata	18
02.	Ligaments of ankle joint	47
03.	Blood supply of the lower limbs	49
04.	Nerve supply of the lower limbs	50
05.	Pain path way	60
06.	Skin classification	81
07.	Jala	98
08.	Probable mode of action of cold water irrigation, Diclofenac gel and Udumbara Twak Kwatha Parisheka, Manjisthadi Lepa	176

LIST OF TABLES

SL.NO.	NAME OF TABLES	PAGE NO.
01	Snayu Bheda according to different Acharya's	07
02	Marma Bheda based on Ashraya	10
03	Classification of Gulpha and Kurchasira Marma	14
04	Distribution of vital structures in different parts of the body	16
05	Agantuja Karana according to different authors	16
06	Different layers of skin	20
07	Procedure of Kwatha preparation according to different Acharya's	21
08	Types of decoction according to Acharya Harita	22
09	Oral dose of Kwatha according to different Acharya's	22
10	Table showing Pathya	37
11	Table showing Apathya	38
12	Table showing different grades of Ankle Sprain	55
13	Table showing properties of ingredients in Manjisthadi	94

	Lepa	
14	Chemical constituents of water	101
15	Presentation and Price of Volini gel	104
16	Composition of Volini Gel	104
17	Distribution of patients of Ankle Sprain according to Age	118
18	Distribution of patients according to Gender	118
19	Distribution of patients according to religion	118
20	Distribution of patients according to Socio-economic status	120
21	Distribution of patients according to Occupation	121
22	Distribution of patients according to Habitat	121
23	Distribution of patients according to Diet	122
24	Distribution of patients according to Prakruti	123
25	Distribution of patients according to Nidra	123
26	Distribution of patients according to Vyayamashathi	124
27	Distribution of patients according to Satva	125

28	Table showing the Mode of injury	125
29	Table showing the Mechanism of injury	126
30	Table showing the side of involvement	127
31	Distribution of patients according to grades of ankle sprain	128
32	Distribution of patients according to Discoloration of Ankle	128
33	Distribution of patients according to severity of ankle sprain	129
34	Table showing different parts of ankle joint affected by swelling	130
35	Effect of Udumbara Kwatha Parisheka followed by Manjisthadi Lepa application on Pain in Ankle sprain	131
36	Effect of Udumbara Kwatha Parisheka followed by Manjisthadi Lepa application on Tenderness of Ankle sprain	132
37	Effect of Udumbara Kwatha Parisheka followed by Manjisthadi Lepa application on swelling of upper 1/3rd part of Ankle Joint	132

38	Effect of Udumbara Kwatha Parisheka followed by Manjisthadi Lepa application on Swelling of mid part of Ankle Joint	133
39	Effect of Udumbara Kwatha Parisheka followed by Manjisthadi Lepa application on Swelling of lower 1/3rd part of Ankle Joint	133
40	Effect of Udumbara Kwatha Parisheka followed by Manjisthadi Lepa application on Loss of Function of Ankle Joint	134
41	Effect of Udumbara Kwatha Parisheka followed by Manjisthadi Lepa application on Discoloration of Ankle sprain	134
42	Effect of Udumbara Kwatha Parisheka followed by Manjisthadi Lepa application on Dorsiflexion of Ankle Joint	135
43	Effect of Udumbara Kwatha Parisheka followed by Manjisthadi Lepa application on Plantarflexion of Ankle Joint	135
44	Effect of Udumbara Kwatha Parisheka followed by Manjisthadi Lepa application on Inversion of Ankle Joint	136

45	Effect of Udumbara Kwatha Parisheka followed by Manjisthadi Lepa application on Eversion of Ankle Joint	136
46	Effect of Udumbara Kwatha Parisheka followed by Manjisthadi Lepa application on Abduction of Ankle Joint	137
47	Effect of Udumbara Kwatha Parisheka followed by Manjisthadi Lepa application on Adduction of Ankle Joint	137
48	Effect of cold water irrigation followed by Diclofenac gel application on Pain of Ankle sprain	138
49	Effect of cold water irrigation followed by Diclofenac gel application on Tenderness of Ankle sprain	139
50	Effect of cold water irrigation followed by Diclofenac gel application on swelling of upper 1/3rd part of Ankle Joint	139
51	Effect of cold water irrigation followed by Diclofenac gel application on Swelling of mid part of Ankle Joint	140
52	Effect of cold water irrigation followed by Diclofenac gel application on Swelling of lower 1/3rd part of Ankle Joint	140

53	Effect of cold water irrigation followed by Diclofenac gel application on Loss of Function of Ankle Joint	141
54	Effect of cold water irrigation followed by Diclofenac gel application on Discoloration of Ankle sprain	141
55	Effect of cold water irrigation followed by Diclofenac gel application on Dorsiflexion of Ankle Joint	142
56	Effect of cold water irrigation followed by Diclofenac gel application on Plantarflexion of Ankle Joint	142
57	Effect of cold water irrigation followed by Diclofenac gel application on Inversion of Ankle Joint	143
58	Effect of cold water irrigation followed by Diclofenac gel application on Eversion of Ankle Joint	143
59	Effect of cold water irrigation followed by Diclofenac gel application on Abduction of Ankle Joint	144
60	Effect of cold water irrigation followed by Diclofenac gel application on Adduction of Ankle Joint	144
61	Table showing results of clinical features of Trail group after one week treatment	145
62	Table showing results of degrees of movement with Udumbara Kwatha Parisheka followed by Manjisthadi	146

	Lepa after one week	
63	Table showing results of clinical features of Control group after one week	146
64	Table showing results of degrees of movement with cold water irrigation followed by diclofenac gel application after one week	147
65	Table showing comparative results of both groups after one week	148
66	Table showing comparative results of both groups during follow up	149
67	Table showing complete recovery in signs & symptoms day wise in Trail group	151
68	Table showing complete recovery in signs & symptoms day wise in Control group	152
69	Table showing overall effect of both groups after one week	153
70	Table showing overall effect of both groups during follow up	153

LIST OF GRAPHS

SL. NO.	LIST OF GRAPHS	PAGE NO
1.	Graph- Age wise distribution	118
2.	Graph - Sex wise distribution	119
3.	Graph – Distribution religion wise	120
4.	Graph – Economic Status wise distribution	120
5.	Graph – Occupation wise distribution	121
6.	Graph - Habitat wise distribution	122
7.	Graph – Diet wise distribution	122
8.	Graph – Prakruti wise distribution	123
9.	Graph – Nidra wise distribution	124
10.	Graph – Vyayamashakthi wise distribution	124
11.	Graph – Satva wise distribution	125
12.	Graph – Mode of injury wise distribution	126
13.	Graph – Mechanism of injury distribution	127
14.	Graph – Dominant side involved	127

15.	Graph – Grade of Ankle Sprain	128
16.	Graph – Discoloration of Ankle	129
17.	Graph – Severity of Swelling wise distribution	129
18.	Graph – Part of joint affected by swelling	130
19.	Graph – Comparative result after one week- both groups	150
20.	Graph – Follow up result of both groups	150
21.	Graph – Overall result of both groups after one week	154
22.	Graph - Overall result of follow up of both groups	154

LIST OF PHOTOGRAPHS

SL.NO.	LIST OF PHOTOS	PAGE NO
01.	Udumbra Kwatha preparation	95
02.	Manjisthadi Lepa ingredients	96
03.	Dharapatra with Jala	100
04.	Adverse reaction after diclofeac gel application	105
05.	Diclefenac sodium with measurement	106
06.	Case report No. 01.	189
07.	Case report No. 02.	190
08.	Case report No. 03.	191
09	Case report No. 04.	192
10	Case report No. 05.	193
11	Case report No. 06.	194
12	Case report No. 07.	195
13	Case report No. 08.	196

Lt	Liter
Mg	Milligram
i.e	That is
%	Percentage
B.T	Before Treatment
A.T	After Treatment
SE	Standard error
P	Significance
Cl	Clearance
Imp	Improvement
OPD	Outpatient department
GDS	Getting down the steps
SI	Sports Injury
Wlk	Fast walking
Jmp	Jumping down
Slip	Slip of leg
Fall	Fall from slip
DT	Direct trauma
HH	High heeled foot wear

TABLE OF CONTENTS

SL. NO.	CONTENTS	PAGE NO.
1)	INTRODUCTION	1-5
2)	AYURVEDIC REVIEW	6-38
3)	MODERN REVIEW	39-84
4)	DRUG REVIEW	85-106
5)	RESEARCH METHODOLOGY	107-117
6)	OBSERVATIONS & RESULTS	118-154
7)	DISCUSSION	155-176
8)	CONCLUSION	177-178
9)	BIBLIOGRAPHY	179-188
10)	ANNEXURE I) CASE PROFORMA II) CASE STUDY III) MASTER CHART IV) ARTICLES	189-196 197-204 205-224 225-240

INTRODUCTION

The skill of managing the illness began thousands of years ago with the modernization to the ancient man trying to provide relief to those ailments and distress motivated by feeling of compassion and kindness. The awareness was enthused from the Vedas-Rigveda, Atharvaveda and Upanishads. The great philosophers dedicated their life for the maintenance of health, longevity and disease free life.

The incidence of trauma began from the time, existence of the fittest. Sushruta Samhita is a treatise of ancient age, which assemble surgical aspects in systematic outline.¹

Ayurveda science always aimed at prevention of disease for happy and long life and later management for the diseased. Summarizing the vast knowledge in short way is well documented in Ashtanga Ayurveda. ‘The Father of Indian Surgery’ Acharya Sushruta developed the surgical principles nearly five thousand years ago, which hold good even told when compared with allied science.

The rate of trauma is rising due to aggressive & excited lifestyle. When going the classification of trauma, acute musculo-skeletal injuries and sprains are ranked high. In 75% of ankle injuries most common is Ankle sprain. In young athletes 10-30% of sports related injuries are acute ankle trauma. Acute ankle injuries make nearly one million people consult the doctors. More than 40% of ankle sprain have the potential to cause chronic problems². In the United States it is estimated that 23,000 people per day, necessitate medical care for ankle sprains including athletes and non-athletes. In other form it can be said that, 1 case per 10,000 persons per day visit the physician for care.³

Most common complication of repetitive ankle injuries is post-traumatic osteoarthritis. From one of the study it was noted that posttraumatic osteoarthritis of the hip, knee or ankle also fall under 12% of the overall prevalence of osteoarthritis. \$3.06 billion dollars annually economic encumber is noted to solve the problem.⁴

On time exact and appropriate diagnosis of ankle sprain with proper treatment, raise the incidence of normal and pain-free use of the affected ankle. With appropriate history, focused physical examination and with help of the imaging techniques (X-ray, CT, MRI) the severity of injury, pathological process, acute or chronic, can be determined.⁵

Non operated cases of Tibial plateau fractures (20 cases) underwent Magnetic resonance imaging (MRI) to establish the frequency of soft tissue injuries. The study concluded that 90% (18 of 20cases) of them had significant injuries to the soft tissues, of them 80% (16 of 20) had meniscal tears, and 40% (8 of 20) presented with complete ligament disruptions.⁶

Ankle joint withstands 1.5 times of the body weight when one walks and up to eight times of the body weight when one runs⁷. It is exposed to extreme mechanical conditions during single limb support. It has to bear the total body weight and the kinetic energy generated by the indulgence of force, during walking, running or jumping, when the foot speedily makes stroke with the floor.

Ankle joint is stable joint with tibia medially and fibula laterally. The joint is strongly bound around by tibio-fibular and interosseous ligaments. On the medial side is the strong deltoid ligament and laterally collateral ligaments with its three bands. The ankle joint is the only Syndesmosis fibrous joint which does have a synovial membrane^{7a}.

The stability of ankle joint is moderately depended on the ligaments, as it unstable without ligaments. Inversion or Eversion of foot is the main cause for Ankle Sprain and pain is most common complaint. This form of injury leads to either tear or stretch of one or more ligaments in the ankle joint. When compared to the sprains at different sites in body, it is most likely Ankle ligaments sprained often.

Even though ankle sprain seems to be simple injury, but is most painful and hinder the routine activities of the sufferer. It is characterized by pain, swelling with or without deformity. Ankle sprains presents on either medial or lateral side, but most common being lateral sprain. Twist in ankle is frequent in

sports leading to ankle pain. Apart from ankle sprain, other conditions which present ankle pain as a symptom are arthritis, gout, pseudogout and infections.⁸

In allied science the treatment principle is PRICE i.e pain killers, rest, ice application, compression and elevation of foot.

On going through the literatures, we don't find direct explanation of sprain with its management. Acharya Sushruta while explaining Bhagna Chikitsa in the context of Asthi-Bhagna mentioned the word "Patanabhighatadwa" which can be considered as Patana, Abhighata or both become the main cause for sprain, where the application of Sheeta Parisheka and Sheeta Pradeha to reduce Vedana and Shopha he has been emphasized⁹. Lepa is considered as Adhya Upakrama by Acharya Sushruta .¹⁰

Utility of Lepa in Asthi-Bhagna, Vrana-Chikitsa, for Jatamatra Shopha having Ugra Ruja is very well described by Acharya Sushruta.¹¹ Importance of Lepa is highlighted by a simile as - To extinguish the fired house sprinkling of water is to be carried immediately, similar way to subside the pain application of Lepa has to be done at its earliest.^{11a} Apart from this even Parisheka with Nyagrodhadi Gana Kashaya is recommended to combat the Vedana in context of Asthi-Bhagna by Acharya Sushruta .^{9a}

Research works on Snayu Vikara are very few. Efficacy of Manjisthadi Lepa on Snayu Vikara is not been conducted as per recent research review.¹² Here an attempt is made to study the efficacy of Sheeta Parisheka (Udumbara Twak Kwatha) and Sheeta Pradeha (Manjisthadi Lepa) on Ankle Sprain.

It is comparative clinical study over 200 patients of Ankle sprain. 100 patients of Control group (Diclofenac Group) will receive cold water irrigation followed by application of Diclofenac Gel (Volini Gel).

While 100 patients of Trail group (Manjisthadi Group) – will be treated by Udumbara Twak Kwatha Parisheka followed by application of Manjisthadi Lepa. The above said procedure is carried twice daily for one week and follow up is done on second and fourth week. Assessment of improvement and other changes was observed based on signs and symptoms as-pain, swelling, tenderness, discoloration and loss of function.

The observations are highlighted in tabular and graphical form in percentage. The results of all the symptoms of Ankle Sprain were statistically highly significant in both the groups. Control group undergoing cold water irrigation and diclofenac gel application, while Trail group has Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa.

Conclusion states the principle of cold application in acute injuries is explained in classics five thousand years ago which is also practised by allied science. Ankle Sprain can be correlated with Gulpha Sandhi Marmaghata.

CONTENTS OF THE THESIS

- 1. Part I** – Introduction
- 2. Part II** - Review
- 3. Part III** – Research Methodology
- 4. Part IV** – Analysis and Interpretation.
- 5. Part V** – Oblique findings and Recommended

Morbidity and mortality are increasing with the incidence of Trauma. Oedema and pain are most common complaint of soft tissue injury, often neglected as insignificant. Agony to the patients rises as the condition is considered as simple and often neglected.

An Ankle sprain is commonly encountered in people during walking, running and sports. Due to pain significantly affect a patient's lifestyle. In ankle sprain the ligaments are either partially or completely torn, which destabilizes the joint. Children's usually while playing and adults while stepping on an uneven surface sprain their ankle, about 25,000 people every day do it.¹³

No direct reference on sprain and its management is available in classics. The word "Patanabhighatadwa" is mentioned in the context of Asthi-Bhagna which explains the mode of injury as Patana, Abhighata or both can become the cause for sprain, where application of Sheeta Parisheka and Sheeta Pradeha is emphasized to reduce Vedana and Shopha. In the same context Nyagrodadhi Gana Kashaya for Parisheka and Manjisthadi Lepa for application to combat Vedana and Shopha is explained^{9a}.

Acharya Vriddha Vagbhata, Vagbhata, Cakradatta, Bhavamishra and Yogaratnakara are also of the same opinion.

Research works on Asthi-Bhagna using Manjisthadi Lepa are many but on Snayu Vikara no work is done as per recent research review¹². There is no reference regarding the number of application and duration of application of Lepa. In allied science PRICE (Protection, Rest, Ice, Compression and Elevation) is the line of management for Ankle sprain¹⁴. Hence an attempt is made to evaluate the efficiency of Sheeta Parisheka (Udumbara Twak Kwatha) and Sheeta Pradeha (Manjisthadi Lepa) on Ankle sprain.

AIMS AND OBJECTIVES

Aim -

To evaluate the effect of Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa for Shothahara role in the management of Ankle Sprain.

Objectives -

To compare the effect of Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa with cold water irrigation followed by Diclofenac gel (Volini gel) application as Shothahara in the management of Ankle Sprain.

AYURVEDIC REVIEW

INTRODUCTION

The story of evolution of medicine is long stretching from prehistoric to modern times. Ancient medicine is the mother of science and played pivotal role in the integration of early culture. The story of trauma and its management moves around the tissue injury and its response. Whenever the physiology and anatomy of the tissue tend to be altered, it resists and reacts to the stimulus. This rule is known to be law of inertia.¹⁶

Injury is cry of tissues for want of oxygen giving rise to change in polarity. According to Sushruta there are certain places in the body, where normally the loss of tissue is not amounting to functional loss that further means, its anatomy is not so much altered that the function of the tissue suffers. However the microanatomy of the structures is changed affecting the physiology of the tissues but not amounting to functional abnormalities.

SNAYU SHAREERA

Nirukti :

The word Snayu is derived by adding “*Shna Shouche Dhatu*” to “*Una Praty*” and “*Yuk Aagama*.”¹⁶

Definition :

Snayu is a thin band made of white fibrous structure, which is mainly Upadhatu in form and for domestic purpose the same is used to tie over the bow as string.¹⁷

Utpatti :

Ahara is life of all creatures, one of the Trayopasthamba to lead the life. Similarly our body is dependent on the basic elements Tridosha. Among Tridosha, Vata is the main regulator of all the activities. The food we take under goes Paka to form the Annarasa.

From this Annarasa various Dhatus are formed and take their nutrition by three Nyaya i.e. Khalekapotala Nyaya, Ksheeradhadi Nyaya and Kedarakulya Nyaya. The Sneha Bhaga from Annarasa is utilized for the formation of Meda Dhatu. This Meda Dhatu further undergoes transformation to form Sira by Mrudupaka and Snayu by Kharapaka.¹⁸

Embryology:

Acharya Sushruta while explaining the organogenesis of the body explained that the Sira takes the Sneha Bhaga from Meda Dhatu and forms the Snayu with the aid of Vata Dosha.¹⁹

Types of Snayu:

All the Snayu in the body are basically divided into 4 types.²⁰

Pratanavati Snayu(spread out/broad):

Present in the joints of all extremities. It can be co-related to broad terminal sheets of tendons.

Vritta Snayu (round/cylindrical):

They are big, thick bands considered as Kandara (tendons).

Sushira Snayu (hollow/ring like):

Present at the end of Amashaya, Pakvashaya and Basti Pradesha.

Prthula Snayu (thick/big):

They are present in the back, flank, chest and Shira Pradesha.

Kandara²¹

Acharya Cakrapani considered Sthula Snayu as Kandara, while Acharya Dalhana considered it as Mahasnayu. Kandaras are sixteen in number of which four are in the Pada.

Sampoorna Shareera Snayu Sankya²² :

Table No - 01: Total number of Snayu in the body acc. to different Acharya.

Sl. No	Name of Acharya	No. of Snayu
01.	Caraka	900
02.	Sushruta	900
03.	Vagbhata	900
04.	Bhavamishra	900
05.	Sharangadhara	900

Sthananusara Snayu Sankhya^{22a}

➤ Snayu in Shakha	– Total number in all four limbs is	600
➤ Snayu in Koshta	– Total number in trunk is	230
➤ Snayu in Greeva	– Total number in head and neck is	<u>070</u>
➤ Snayu in Shareera	– Total number in body is	900

Snayu in Shakha^{22a}

In each toe of the foot there are six Snayu. Thus in all digits total number of Snayu is thirty.

▪ In each Padanguli (toe) six Snayu, so 5 x 6	=30
▪ In the Janu	=10
▪ In Uru	= 40
▪ In Vankshna	= 10
▪ In Padatala	= 15
▪ In Padakurca (sole & arch of foot)	= 15
▪ In Gulpha (ankle)	= 15
▪ In Jangha (calves)	= 15
▪ Total (in each Shakha)	<u>=150</u>
▪ All four Shakha	4 x 15 = 600

Snayu Karya²³

The Snayu help in flexion, extension, contraction and relaxation of the joints. It also binds the joints together (Sandhi bandhana).

Importance of Snayu^{20a}

Just as a boat built with wooden planks placed side to side, when fastened tightly by ropes in many ways becomes capable of carrying weight in water, steered by a man (boat man), similarly the human body will be able to carry weight, as long as the joints are fastened tightly by ligaments in many ways.

Thus joints and ligaments are inter-related with each other, as ligaments give support and stability to the joints. Therefore the ligaments help to bear the weight of body and carry its function easily. Injury to the ligaments leads to instability of the joints.

Neither bones, muscles, veins nor joints kill the person when injured just as ligaments do when injured, i.e. they are less painful and troublesome as compared to injury to the ligaments.

Acharya Sushruta has mentioned the significance and relevance of having the knowledge of anatomy of Snayu and said that the surgeon who is well versed about the anatomy of Snayu in different body parts is capable of removing even the deeply situated Shalya (foreign body) and save the life.

Snayu Viddha Lakshana ²⁴

Shortening, debility of body parts, inability to perform their actions, severe (excruciating) pain and delayed wound healing should be understood as caused due to cut or injury to the Snayu (ligaments).

MARMA

Marmas are the vulnerable spots in the body injury to which results in early or late mortality or produces pain, disability of the injured part.

Nirukti: ²⁵

The word Marma is derived from the root word “*Mru*”, “*Maranne*” suffixed with “*Mannin*”. Letter ‘*Ma*’ denotes Prana or Vayu & ‘*Ra*’ denotes seat of Vayu or Prana. Arunadatta the commentator of Ashtangahrdaya says in Sarvangasundari Vyakhya that Marma is derived from “*Mring*” which means one which causes death.

Definition: ²⁶

“*Mamsastisnayudhamaneesirasandhi samagama*” (A.H.Sa 4/38)

Conglomeration point of Mamsa, Sira, Snayu, Asthi & Sandhi is stated as Marma.

All Marma have both structural & functional units. Confluence of Mamsa, Sira, Snayu, Sandhi, Asthi or Dashapranayatana is the structural unit and functional unit refers to Prana. There are totally 107 Marma in the body, which are classified as follows:

Table No – 02: Based on the Ashraya/Rachana Marma Bheda

Sl. No	Type of Marma	Sushruta ²⁷	Vagbhata ^{26a}
01.	Mamsa	11	10
02.	Sira	41	37
03.	Snayu	27	23
04.	Asthi	8	8
05.	Sandhi	20	20
06.	Dhamani	–	9

Based on the **Parinama Bheda/Prognosis** 5 types^{27a}

- (i) Sadhya Pranahara Marma (emergency fatal) – 19
- (ii) Kalantara Pranahara Marma (fatal after a period) – 33
- (iii) Visalyaghna Marma (fatal after extraction of foreign body) – 03
- (iv) Vaikalyakara Marma (disability) – 44
- (v) Rujakara Marma (painful) – 08

According to the **Shadanga Shareera/Avayava Bheda**^{27b}

- (i) Shakha Marma (Marma in limb) (11x4) – 44
- (ii) Koshta Marma (Marma in the abdomen) – 3
- (iii) Uro Marma (Marma in chest) – 9
- (iv) Prishta Marma (Marma in the back) – 14
- (v) Jathrudwa Marma (Marma above neck) – 37

Based on the **Pramana Marma's** are^{27c}

- (i) Ardhangula Marma (half angula) – 56 [1/2]
- (ii) Ekangula Marma (one angula) – 12 [1]
- (iii) Dwi angula Marma (two angula) – 6 [2]
- (iv) Thri angula Marma (three angula) – 4 [3]
- (v) Hastatala Marma (four angula) – 29 [4]

Based on Sankhya Bheda

(i) Eka Sankhya Marma	– 6 [1]
(ii) Dwi Sankhya Marma	– 52 [2]
(iii) Chatur Sankhya Marma	– 36 [4]
(iv) Pancha Sankhya Marma	– 5 [5]
(v) Ashta Sankhya Marma	– 8 [8]

GULPHA MARMA:

Gulpha is the important joint in the leg present at the junction of leg and foot. Gulpha Marma is present at the junction of Pada and Jangha.^{27c}

- According to **Rachana** – It is a Sandhi Marma.
- According to **Pramana** – Acharya Dalhana has specially documented the measurement of this area of two Anguli. This description draws the attention towards Ankle joint.
- According to **Sankhya** – They are two in number, one in each foot.
- According to **Avayavabheda** – It is a Sakthi Marma.
- According to **Parinama** – It is Rujakara Marma and produces the symptoms as Ruja (pain), Stabdha Padata (stiffness of joints) or Khanjata (limping).

पादजन्धयोः सन्धाने गुल्फो नाम, तत्र रुजः स्तब्धपादता खन्जता वा ॥ सु शा ६/२५

All Marmas have Soma, Vayu, Teja Mahabhuta with Satva, Raja and Tama Guna in them. Rujakara Marma has Vayu and Agni Guna predominance, both of which produce pain. According to some Acharya Ruja is having Panchabhoutika qualities.^{27d}

Acharya Arunadatta comments, predominance of Vayu and Agni Guna produces pain, while Soma Guna does the Pranavalambana.^{26b}

Ruja is a defensive phenomenon for the preservation of health of the tissue in post trauma. One of the central mechanisms of pain recovery is immobilization or rest. Commonly soft tissue pain and spasm outlasts the initial traumatic stimuli. When pain becomes chronic, it is mediated by nociceptive

system. A nociceptive system is a biological sensor, found in almost all the tissue, except brain.

Acharya Sushruta interprets that the Gulpha is seat of Ruja. Pain site is constituted by ligaments, tendons, periosteum and apophyseal joints which are rich in nociceptive receptors. Therefore sprain is more intensely painful than bony fractures.^{15a}

Injury to the ankle joint can be studied under three headings namely tendons, ligaments and bones. The ligaments are predominantly injured in sports. Ankle joint is one of the most frequently injured areas of the body, since this being the connecting link between stable leg and mobile foot. This may be the specific observation of Acharya Sushruta. Gulpha Sandhi is subjected to great variety of forces in standing, walking and running. Abnormal or excessive forces produce injury to the bones and ligaments by indirect violence and sports are one of the commonest events where combination of forces producing fracture, dislocation and sprain.

Since the medial and lateral malleolus are attached to the talus by the joint capsule and collateral ligaments, injury to these follow instability of foot. Acharya Sushruta has highlighted this part under Marma.

KURCHASIRA MARMA ^{27c}

This Marma is situated below the Ankle joint, on both sides. Injury to these vital spots produces pain and swelling.

- According to **Avayavabheda** – It is Sakthi Marma
- According to **Rachana** – It is a Snayu Marma.
- According to **Pramana** – Acharya Dalhana has specially documented the measurement of this area as one Angula. This description draws the attention towards retinaculum.
- According to **Sankhya** – They are two in number
- According to **Parinama** – It is Rujakara Marma and produces the symptoms as Ruja (pain) and Shopha (swelling).

गुल्फ सन्धेरध उभयतः कुर्चशीरो नाम, यत्र रुजाशोफै।सु शा ६/२५

The Kurchasira is named because of being fastened up at one end like the brush. The anatomy of the digitorial muscle resembles with the description laid down in classical books.

The splitting of the digitorial muscles may be specially considered as dominant ingredient in the formation of Kurchasira Marma because it is like a head of Kurcha, the retinaculum may be held responsible for covering the tendons of the muscles below the Gulpha Sandhi like closed end of the brush. The structures which may be considered as Kurchasira at the dorsal aspect of foot, are the tendon of extensor digitorum longus along with peroneus tertius tendon surrounded by common synovial sheath as they pass beneath the extensor retinaculum. As Kurchasira Marma is situated below the Gulpha Sandhi only, the inferior retinaculum covers the above two tendons, tendons of extensor hallucis longus, extensor digitorum brevis, dorsal metatarsal ligament and cruciate ligaments along with dorsalis pedis artery.

In the flexor or plantar region of the foot, the structures resembling Kurchasira Marma should include the tendons of flexor digitorum longus, flexor hallucis longus, flexor digitorum brevis bounded by flexor retinaculum. It extends from medial malleolus downwards and backward to be attached to the median surface of the calcaneus.

Importance of Rujakara Marma^{27d}

Injury to Rujakara Marma gives rise to different kinds of pain and if treated by a Kuvaidhya (quack physician) it results in deformity of that part.

Importance of Marma^{26c}

Injury to vital spots, though slight will produce severe pain/sufferings. Similarly the diseases localized in the vital spots. Hence they should be treated with utmost care and effort.

Sandhi Marma Viddha Lakshana^{26d}

In case of injury to the Sandhi Marma, the site feels as though full of thorns, even after healing (of the wound) there is shortening of the limb,

lameness, decrease of strength, movements, emaciation of the body and swelling of the joints.

वस्तु शूकैरिवाकीर्णं रुढे च कुणिखन्जता।

बल चेष्टाक्षयः शोषः पर्वशोफश्च संधिजे ॥ अ ह शा ४/५१

Table No -03: Classification of Gulpha and Kurchasira Marma acc. diff category

Sl. No	Bheda	Gulpha Marma	Kurchasira Marma
1.	Rachana	Sandhi Marma	Snayu Marma
2.	Avayavabheda	Sakthi Marma	Sakthi Marma
3.	Pramana	Two Angula	One Angula
4.	Parinama	Rujakara Marma	Rujakara Marma
5.	Sankhya	Two	Two

Snayu Marma Viddha Lakshana ^{26e}

When Snayu Marma is injured, there will be bending (contractions) of the body, convulsion, severe pain, and inability for riding, sitting etc, distortions or even death.

आयामाक्षेपस्तंभाः स्रवजेऽभ्यधिकं रुजा।

यानस्थानासनासनाशक्ति वैकल्यमयवान्तकः ॥ अ ह शा ४/४८

SANDHI SHRAEERA

Definition: The union of two bony ends is known as Sandhi.²⁸

Gulpha Sandhi²⁹

Synonyms:

Gulpha, Khulaka, Khudaka, Khallaka and Kuduka.

Bhava Sambandhi:

Asthi, Snayu are considered as Pittruja Bhava.

Asthi Sambandhi:

Total number of Ashti in Pada is twenty-six, among them ten Asthi in Talakurcha and one in Parshni. From this description of Sushruta Gulphasthi is

compared to talus and Parshni to calcaneus. Acharya Caraka adds that Gulpha Sandhi is formed by Gulphasthi (talus) below and Janghasthi above.

Sandhi Sambandhi:

Gulpha is *Kora Sandhi* (hinge joint). This is unaixial joint and moves in only one axis. This can also be compared with the movements of the door which moves in only one direction and is also Chesthavanta Sandhi. Acharya Sushruta tells Gulpha Sandhi is present between the Gulphakarna (two malleolus). Acharya Dalhana narrates Gulpha Sandhi is present between Pada and Jangha. Acharya Gananath Sena explains that Gulpha Sandhi is situated below the Janghasthi and also called as *Pada Sandhi*.

Sandhi Viddha Lakshana:

When Sandhi is injured there will be increased swelling, severe pain, splitting type of pain in the small joints, loss of strength, edema and loss of function in joints.

Peshi Sambandhi:

As the Peshi cover the Sira, Snayu, Asthi, Asthi Parva and Sandhi they give strength and stability to them. In the Gulpha Sandhi there are 10 Peshi.

Sira Sambandhi:

The Moola Siras are 10 in number located in the Hrdaya. They transport Rasa and Ojas to the whole body on which the activities of the body depend. They are big at their roots while very small at their tips and appear like the venations (net like). Thus Sira are further divided into four types as- Aruna, Peeta, Shweta and Rakta with 175 divisions in each, totally forming 700 Sira. In the Shakha there are four Avedhya Sira, one of them is Jalandhara and three are deep seated.

Dhamani Sambandhi:

In the body there are twenty-four Dhamanees, which are attached to the Nabhi. They resemble axle hole of a wheel surrounded by spokes. These are spreading as ten upwards, ten downwards and four sideways. Therefore ten are supplying the Adhoshakha.

Dosha Sambandhi: In the context of Vata Vyadhi Gulpha is said to be the site of Vata Dosha. It is mainly Vyana Vayu which is helping to carry out various movements of the joint. It is also having Sleshaka Kapha for the lubrication of Joint.

Table No - 04: Distribution of vital structures in different parts of the body.

Sl.No	Parts	Shakha	Koshta	Jathrudwa	Total
1.	Mamsa	400	66	34	500
2.	Snayu	600	230	70	900
3.	Sandhi	68	59	83	210
4.	Marma	44	26	37	107
5.	Sira	-	-	-	700

ROGA VYAKHYA

Table No - 05: Table showing various Agantuja Karana acc to different authors

Sl. No	Karana	S.S ^{28b}	C.S ³⁰	A.H ³¹	A.S ³²
01.	Purusha	+	-	-	-
02.	Pashu	+	-	-	-
03.	Pakshi	+	-	-	-
04.	Vyala Damsha	+	+	-	+
05.	Sarisrupa	+	-	-	-
06.	Patana	+	-	+	+
07.	Peedana	+	-	-	+
08.	Prahara	+	+	+	+
09.	Agni	+	-	-	+
10.	Kshara	+	-	-	-
11.	Shastra	+	-	-	+
12.	Visha	+	-	-	+
13.	Tikshna Aushadha	+	-	-	-
14.	Shakala	+	-	-	-
15.	Kapala	+	-	-	-
16.	Shrunga	+	-	-	-
17.	Chakra	+	-	-	-
18.	Parashu	+	-	-	-
19.	Bandha	-	+	-	-
20.	Danta Kshata	-	+	-	-
21.	Nakha Hata	-	+	-	-
22.	Akshepa	-	-	-	+
23.	Abhighata	-	+	-	+

Nidana:

Acharya Sushruta has considered two main causes of Vrana that is Shareera and Agantuja. The Shareera Vrana is caused by Tridosha involvement, while Agantuja by various traumatic causes. They are enumerated as follows:

Samprapti:

In all kinds of Agantuja Vrana immediately after trauma, the heat of the assault spreads quickly. This obstructs the path way of Vata, vitiating Rakta which does the Margavarana to normal flow of Vata. This obstructed Vata gets further aggravated producing Ruja, Shopha etc features. For mitigating this, Sheeta measures similar to those for Pitta Shamana are advocated first. After a period of seven days there is involvement of Tridosha and produces the clinical features as that of the predominant Dosha. Therefore in the initial stage of Agantuja Vrana Sheeta Kriya or Sheeta Upachara is advised.^{11a}

The exogenous disorder is preceded by pain and followed disequilibrium of Vata, Pitta and Kapha, while in innate disorder the disequilibrium of Vata, Pitta and Kapha precedes first which later on produces pain.

In Asthanga Hrdaya, Acharya Vagbhata in the context of Jwara Nidana while explaining the Agantuja Jwara Bheda has enumerated, how Doshas get aggravated resulting in Jwara. He narrates when one undergoes Shrama, Abhighata, Kshata etc Vata Dosha gets aggravated, which brings the vitiation of Rakta. This vitiated Rakta further blocks the flow of Vata producing symptoms as Vyatha, Shopha, Vaivarnya. To this Acharya Hemadri comments, by Kshata-Vyatha, Shopha and Vaivarnya are produced while Ruja is result of Shrama.³³

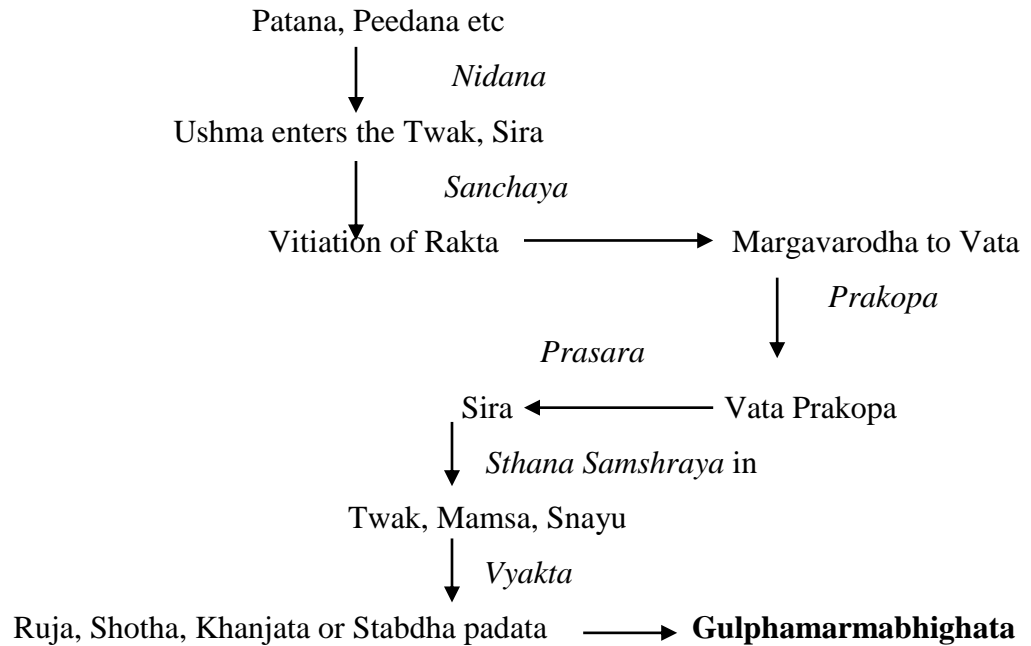
Ekadeshaja Shotha³⁴

According to Sushruta vitiated Doshas reside in between Twak and Mamsa producing swelling at a particular site.

Vagbhata gives importance to Rakta, he says that Raga (discoloration) and Paka (suppuration) are due to Rakta.

Lakshana^{27c}

Ruja, Shotha, Khanjata or Stabdha Padata.

Samprapti:**Diagnosis and management of Shotha³⁰**

Agantuja Shotha are assessed by their Hetu and Lakshana, which makes it separate from Nija Shotha. They are managed by either by Bandhana, Agadaprayoga, Lepa, Nirvapana etc measures.

तेपुनर्यथास्वंहेतुव्यन्जनैरादावुपलम्भन्तेनिजव्यन्जनैकदेशविपरीतैः, बन्धमन्तागदप्रलेपप्रतापनि
र्वापणादिभिश्चोपक्रमैरुपक्रम्यमाणाः प्रशान्तिमापधन्ते ॥ च सु १८/५

Chikitisa

In the event of the vitiation of bodily Dosha generally three types of therapies need to be implemented to treat the disease.

- i) Anta Parimarjana (Internal cleansing)
- ii) Bahi Parimarjana (External cleansing)
- iii) Sashtra Pranidhana (Surgical therapy)

Diseases caused by improper diet are eradicated by medicines meant for internal cleansing. The cleansing therapy, which has its curative effect by external contact with the body such as massage, fomentation, Lepa and

kneading, is the external one. Surgical therapy comprises execution of incision, puncturing etc.

Acharya Sushruta in the context of Bhagna Chikitsa while explaining the Shoonanga Chikitsa narrated - due to fall from height or assault, when any part of the body is found swollen but not having an external wound, then Lepa of the drugs having cold potency and cold to touch should be applied or cold liquids to be poured over the affected region.⁹

Shotha Chikitsa

- i) Alepa is the initial or first line of treatment, which is common to all inflammatory swellings and the most important one.¹¹
- ii) Apatarpana is also considered as first line of management, this is applied generally in all types of inflammatory swelling.³⁵

In Chikitsasthana Sushruta has mentioned Apatarpana as the first line of management. But in Sutra Sthana Alepa is considered as first line of management. Both the statements are correct. So as first line of treatment as Bahi Parimarjana Chikitsa

- ii) Alepa alleviates pain instantaneously
- iii) It is superior to Apatarpana
- iv) It acts locally and gives quick results.

Ekadesha Upakrama of Shophya³⁶

1. Alepa
2. Parisheka
3. Abhyanga
4. Sweda
5. Vimlapana
6. Upanaha
7. Pachana
8. Visravana
9. Sneha
10. Vamana
11. Virechana

TWAK SHAREERA

The word '*Twak*' is derived from the root '*Twacha*' means a protective layer which acts as a covering for Meda, Sonitha³⁷ etc.

“Twachathi samvrnothi medasonithadikanithi”.

The skin is formed in the embryo during the first and second trimester of pregnancy, similar to how milk gets its cream over the surface during boiling.³⁸ The total thickness of the skin is 3 1/2 Vreehi, Angusthodara Pramana Gadha.^{38a} (approximately 0.7 to 1.2mm). This varies in palm, sole and other Mamsala Pradesha but not in Lalata Pradesha. Twak is Upadhatu of Mamsa and is Matrujabhava.

Table No. -06: Layers of skin according to Sushruta ^{38b}

SL.No.	Name	Thickness in vreehi	Diseases
01.	Avabhasini	1/18 th	Sidma, Padmini, Kantaka
02.	Lohitha	1/16 th	Tilakalaka, Nyaccha, Vyanga
03.	Swetha	1/12 th	Charmadala, Ajagallika, Mashaka
04.	Tamra	1/8 th	Kilasa, Kustha
05.	Vedini	1/5 th	Kustha, Visarpa
06.	Rohini	1	Granthi, Apachi, Arbuda, Shleepada, Galaganda
07.	Mamsadhara	2	Bhagandhara, Vidradhi, Arshas

KWATHA KALPANA³⁹**Derivation:** ^{39a}

“ **Kashanat kashaya:**” (k.sa.khi 3/29)

That which is producing scraping sensation is called as kashaya.

Definition: ^{39b}

According to Acharya Caraka, preparations boiled on fire is known as Kashaya. (c.sa.su 4/25)

Synonyms: ^{39c} Srita, Kwatha, Kashaya and Niruhya.

It is third type of Kashaya Kalpana among the Panchavidha Kashaya Kalpana. It is less concentrated than Swarasa and Kalka. In this preparation coarsely powdered drugs are boiled in low flame with definite quantity of water and reduced to 1/4th or 1/8th part then filtered.^{39d}

Table No - 07: Procedure of Kwatha preparation according to different Acharya ^{39e}

Sl.No	Author	Drug quantity	Water quantity	Reduced to
1.	Acharya Sushruta	1 part	8 or 16 part	1/4 th
		1 tula	2 drona	1/4 th
2.	Acharya Sarangdhara	1 pala	16 pala	1/8 th
3.	Acharya vagbhata	Based on nature of drug	Add desired quantity of water	Boil till optimum drug extraction
4.	Acharya Ksharapani	Mrudu Madhyama Kathina	8 part	1/4 th
5.	Acharya Yadavaji	Mrudu	4 part	1/4 th
		Madhyama	8 part	1/8 th
		Kathina	16 part	1/16 th
		1 Karsa to 1 Pala	16 part	1/16 th
		1 Pala to 1 Kudava	8 part	1/8 th
		1 Kudava to 1 Khari	4 part	1/4 th

Table No - 08: Types of decoction according to Acharya Harita^{39f} (ha.sa.3st 1)

Sl. No	Type of Kwatha	Reduction of water quantity	Pharmacological properties
1.	Pacana	½ part	Carminative
2.	Dipana	1/10 th part	Appetizer
3.	Sodhana	½ part	Clears the body waste
4.	Samana	1/8 th	Rogasamana
5.	Tarpana	just boiled	Nourishment
6.	Kledana	1/4 th part	Hrit kledakara
7.	Sosana	1/16 th part	Visosana

Characteristics of best quality of decoction: ^{39g}

According to Acharya Sarangadhara the well prepared decoction should posse's smell of the drug, colour and taste as per the ingredients used.

Table No - 09: Oral dose of Kwatha ^{39h}

Sl.No	Author	Dose
1.	Sarangadhara	2 pala (96gms)
2.	Yadavji	1 pala (48gms)
3.	Vrinda, Vangasena and Ksharapani	4 pala (192gms)

PARISHEKA⁴⁰

Seka synonym: Seka, Pariseka, Secana

Definition: ^{40a}

Seka is pouring lukewarm liquids namely Sneha, Dugdha, Gomutra, Kanji and others. This process is to be done till the subject perspires. (Bhela sa su 22/19).

Acharya Vagbhata compiled all the dispersed references to set a clinical analogous procedures namely Abhyana, Seka, Pichu and Sirovasti, which are

more effective in the successive order and designates these set of procedure as “Murdhnitaila”^{40b}

Types: Based on site of administration Seka is of three types ^{40a}

- i. Sirasseka
- ii. Kayaseka
- iii. Ekangaseka

Indication of Parisheka in various ailments: ^{40c}

The significant feature of Seka is that various formulations namely Kashaya, Takra, Sneha, Ksheera can be used as per necessity. The specific nature of reducing the Dosha or Vyadhi can be brought about by altering the formulation. Thus Seka provide extensive utility for various conditions, hence it is of great importance in the perspective.

Jwara chikitsa evinces that when the Doshas are lodged in Rakta, Seka is administered. In painful conditions of Vatarakta, which is predominant of Vatadosha, Seka with milk processed in Dasamoola or Sukoshna Ghrita is beneficial. Parisheka with four unctuous substances should be done in Vatarakta associated with rigidity, convulsive movements and pain. In diseases of Vata covered by Pitta (Pittavrtavata) Seka is recommended with Madhuyasti taila or Balataila, in combination with ghee, milk etc or with the decoction of Panchamoola or merely cold water, selected as per the need of the disease condition. In Bhagna caused due to extraneous injury Parisheka should be done with decoction of Bala and Ksheera or with the compound of Taila and Sarpi. In Bhagna, Secana should be done with Nyagrodhadi Kashaya and in painful state with Panchamooli Kashaya or Secana with Tilataila is advocated.

In the context of Vranashopa Acharya Sushruta mentions various forms of medicaments in different status of Dosha that can be used for the purpose of Seka. In Vatashopa to pacify pain Seka is advocated with Sarpi(ghee), Taila(oil), Dhanyamla(fermented liquid), Mamsarasa(flesh soup), decoction prepared from drugs that reduce Vata.

Any of these liquids should not be in cold state while performing Seka. In Pittajashopa, Raktaja, Abhighataja and Visaja conditions Seka can be adopted using Ksheera(milk), Ghrita, Madhu(honey), Sarkarodaka(sugar juice), Ikshurasa(sugarcane juice) or decoctions prepared out of Madhura drugs or Ksheerivriksha and the state of liquid used should not be hot. In Kapha predominant states, Seka should be done with Taila, Mutra(Urine), Ksharodaka(alkaline water), Sura(fermented product), Sukta(type of wine) or decoction prepared from drugs that reduce Kapha and the state of liquid should be too hot.

Benefits of Seka: ^{40d}

All the forms of the Snehadravya's (unctuous substances) can be utilised for the purpose of Dhara. The specific Sneha selected should be favourable to the person and be administered lukewarm. The ideal administration of the Snehadhara, will impart vitality (Drdhata) to the essential constituent element of the body (Dhatu). It bestows virility, stabilizes the Dehagni, Varna and Ojas. It enhances the acuity of sense organ; it deters the process of senility and confers longevity. It corrects the fractured bones (here it should also be inferred that the procedure prevents the bones from turning fragile) also reduce the vitiation of body elements.

Seka relieves fatigue, conciliates Vata, promotes rejoining of fractured bones and pacifies the pain caused due to injury, burns, hit or abrasions.

The Dhara done using medicated Ghrita or Taila will enhance ^{40e}

- The firmness of mind and speech.
- Strength of the body
- Inclination to food
- Makes skin healthy
- Enhances sharpness of eyes, virility and Ashruka.
- Promotes Dirghayu.
- It reduces excessive body temperature.
- Induces good sleep & congenial status of mind.

Quantity of Seka Dravya: ^{40f}

- Kayaseka -11/2 Prastha (1152ml)
- Depending on height and weight 1Prastha (768ml), 11/2 Prastha (1152ml) or 11/4 Prastha (960ml) can be used.

Dhara patra: ^{40g}

Dharapatra is wide mouthed, round bottomed vessel having the capacity of 2 Prastha (1536 ml). It should be prepared of metals like gold, silver and others or even clay. The bottom of the vessel should have an opening corresponding to the circumference of middle joint of little finger (Kanishtika anguli). A suitable wick should be suspended from the hole through which the Sneha is made to flow in a continuous stream over the part of the body.

Container used for the purpose of Dhara is with a spout at base on the side, through which the liquid is dripped. The tubular end gradually tapers along the free end. The spout should make an angle of 45⁰ with the axis of the vessel. The force of flow should be regulated at a moderate level.

In similar manner Seka for the part of the body should be done with suitable substance after analysing the Dosha, Roga, Desha and Avastha.

The materials utilised to prepare the Dharapatra are Sphatika, Suvarna, Rajata, Tamra and from the Vruksha. The hard wood trees that are commonly used for preparing the Dharadroni are:- Plaksa, Udumbara, Gandhasara, Varana, Nyagrodha, Devadruma, Punnaga, Kappittha, Coca, Bakula, Asoka, Asana, Dola, Campaka, Bilva, Nimba, Khadira, Amogha, Agnimantha, Arjuna.

The nature of the attendant performing Dhara: ^{40h}

The attendants who perform the procedure should be affectionate, careful, attentive and service minded. They should relieve the patient from the fear of the vessel being dropped over them. In this manner Dhara should be done over the head, limbs, trunk or all over the body as per necessity.

Selection of drugs: ⁴⁰ⁱ

The Sneha substance processed with drugs that cure the respective disease should be utilized for Dhara. In healthy individuals, the combination of Taila

and Ghrita has to be used the same rule has to be implemented even for Abhyanga.

Various Drava Dravya for Dhara: ^{40j}

The Snehas ideal for different states of Doshas should be utilised. In Kevala Vata four types of Sneha Dravya namely – Taila, Ghrita, Vasa and Majja or only Tilataila should be used. In Pitta or Rakta predominant condition or Raktapitta associated with Vataroga – Goghrita and Tilataila in equal proportion is used. In Kapha associated Vata roga- Goghrita 1part and Ttilataila 2 part is used.

The Height for Dhara: ^{40k}

The Dhara over the head should be poured from height of 4 Angula (3 inch approximately) and to the body parts it should be done from a height of 12 Angula (9 inch approximately). The procedures if not followed in prescribed method, the disease get aggravated.

Procedure of Seka: ^{40l}

A square piece of cotton cloth, which can be contained in the fist, is dipped in the warm Sneha Dravya and squeezed directing the liquid to flow along the thumb and fall over the part of the body.

The compound of four Sneha or just Tilataila can be used in Kevalavata conditions. The Dhara should be poured in continuous stream without interrupting the flow it should not be done for greater or lower height and neither in a faster nor in slower mode.

Seka Kala: ^{40m}

In Ruksha or Pitta associated Vata diseases, the treatment should be performed for about 2 muhurta (96 min). In Kapha associated conditions with Snigdha status, the treatment should be done for 1 muhurta (48 min) or else the procedure should be continued till the body perspires. The Sneha pervades through the hair follicles by three hundred Matrakala (2.4min). The Sneha traverses through the seven layers of skin by seven hundred Matrakala (16.8min)

and by further six hundred Matrakala (100.8 min i.e 1 hr & 40.8min) it reaches the Raktadi six Dhatu.

Kayaseka should be performed for half Yama (one and a half hours). Thus in each posture the Seka should be done for fifteen minutes. If the disease demands, the duration can be prolonged upto one Yama (3hours).

Frequency of Dhara: ⁴⁰ⁿ

The patient having good strength, Dhara or Abhyanga can be done daily or alternate days; in moderate strength, it can be done with gap of 2 to 3 days and in low strength with gap of 3 to 5 days.

Milk & other substances should be used freshly. Dhanyamla, Sneha can be utilized for 3 days, and on the 7th day the substance can be used for the initial and later 3 days are mixed and used.

Post therapeutic procedure: ^{40o}

After the Dhara, cold water is sprinkled over the patient and the mouth is washed. He is made to sit in a place of mild breeze. Other measures which relieve the patient are done. The body parts of the patient are mildly squeezed, and are made to take bath in slightly warm water and perfumes are anointed. After all these the water boiled with Dhanyaka beeja and Shunti is given to drink.

Ekangaseka: ^{40p}

Snehadhara should be done by immersing a piece of cotton cloth(which can be grasped in a fist) in the oil and pouring it locally, in conditions like Gulma, Bhagandhara, Vrana, Udavarta, Kotha, Tuni, Sula, Abhigata, Mudhavata, Asthila, Visarpa, Pliha, Adhmana, Vidradhi and Pratituni. In Asrgdara(menorrhagia), if associated with prickly and painful condition local Dhara below Nabhi is done with compound of two Sneha Dravya. Dhara with Yamaka is recommended in the regions below Nabhi in the management of Ashmari, Mutrakrchra. A Tamra or Kansya Patra of greater depth is filled with cold water and the stream of it should be poured over the Nabhi in the conditions of burning sensation in fever.

Complication of improperly performed Dhara:^{40q}

Dhara done from a greater height, lower height, too fast, too slow or for a longer time results in complication like,

- Daha- burning sensation
- Visarpa-skin lesions
- Ruja- pain
- Murccha- fatigue or loss of consciousness
- Angasada-malaise
- Svarasada-sinking of voice
- Sandhi dalana-joint pain
- Chardi-vomiting
- Asrapitta- haemorrhage
- Jwara-fever
- Kotha-skin disorder etc.

Contra indicated time for Dhara:^{40r}

Dhara should never be done in the hot season or when the sun is dull and the climate is cool. It should not be done in diseases where in the vitiation of Dosha is in Alpavastha. It should never be done at noon and midnight.

Pathyapatha:^{40s}

The patient should avoid---

- Vyayama –exercise
- Atapasevana – exposure to sun
- Vegadharana – suppression of urges
- Himadhooma sevana – exposure to moist smoke
- Atiuccha, Atinicha Upadha – usage of excessively high or low pillows
- Divaswapna – day sleep
- Raja pravata – breeze
- Cheerakala aseena – sitting for long time
- Shoka – distress
- Ratrijagarana – wakeful nights

- Padayana – Walking
- Krodha – warth
- Atibhashana – excessive speech
- Ushana jala upachara – use of hot water for all purpose.
- Na-ati bhojana – lessen food quantity

- Bhamcharya – abstinence

Mode of Action: ^{40t}

1. Analogies that explain the satiating effect of these therapies

As new sprouts appear in a tree when the roots are watered, so do the body Dhatus get nurtured by the administration of Sneha Seka. Sushruta in Vrana chikitsa explains that as fire gets extinguished by pouring water, similarly the Doshagni is reduced by the process of Parisheka.

2. The process of suffusion of the medicinal potency through the Dhamani into subtler and deeper structures.

The action of Sneha Avagaha is by the process of satiation through the orifices of Siramukha, Romakupa and Dhamanis. The Siras and the Dhamanis are bound to the Romakupa.

It is through these passages that the Rasadhatu saitates body elements and it leads to perspiration. The potency of the drugs administered through Abhyanga, Seka, Avagaha, Lepana etc traverse into the body, after getting processed by the effect of Bhrajakagni in the skin. All the structural or functional components of the body are mutually related, similar to the existence of oil in Tilataila seeds.

3. The duration of the therapy facilitating the dissemination of the potency of drug and therapy.

The specification in the duration of therapy is to facilitate the dissemination of the medicinal potency. Dharakalpa elucidates the time required for the medicinal potency to traverse through the Dhatu. The medicinal potency, during the course of successive transference, reduces the diseases of Vata, Pitta and Kapha located in the respective body elements.

4. Neurophysiological Mechanism.

Research study on the psycho-physiologic effects of Sirodhara, emerged with three speculation about the mechanism of action.

- a. The relaxing action of essential oils mediated by olfactory nerve.
- b. The pharmacologic action of substances absorbed through the skin or mucosa.
- c. The physiologic effect of the oil dripped on the forehead induced by the somato – autonomic reflex through thermo sensors or pressure sensors in the skin or hair follicles via the trigeminal nerve.

LEPA

Derivation: The word Lepa is derived from Dhatu i.e. Sanskrit root ‘*Lip*’ affixed by ‘*Vang*’ Pratyaya.⁴¹

“Lipyati, Anena Iti Lepamam”

i.e. the one which is used for anointing is lepa.⁴²

- Pralepa – (Pralip + gung) lepa, ubatana
- Pradeha – (Pradeha + gung) lepa
- Lepa – (Lip+gung) smearing, plastering, anointing and unguent ointment
- Lipa – Smearing, anointing, plastering
- Lepa – The act of smearing - anointing + plastering

Definition:

Medicines used for external application in the form of paste is known as Lepa.

Synonyms for Alepa:

Lipta, Lepana, Lepa⁴³

Types of Lepa:

1. **Pralepa** – It is applied thin and cold and made endued with absorbing or non-absorbing property. It is useful in Pittaja and Raktaja Viraka⁴⁴. It is used either warm or cold (to touch and by property), applied in thick layer, mitigates the aggravation of Vata and Kapha. It can be used in wounds or without wounds.⁴⁵

2. Pradeha – It is thick or thin, warm or cold acts as non-absorbent. Pradeha mitigates the aggravated Vata and Kapha, cleanses and heals the wound, relieve swelling and also pain. It is useful for both the wound and swelling without wound.⁴⁴ Acharya Vagbhata has advised to use Sheeta Pradeha on and often, applied in thin layer. It cleanses Pitta, Rakta and Twak.⁴⁵

3. Alepa – Midway between Pralepa and Pradeha is Alepa.⁴⁴

Acharya Caraka has mentioned Lepa as ⁴⁶

1. **Shodhana Pralepa** – It is Twak Shuddhikara.
2. **Ropana Pralepa** – It is used as Twak Grahnanti (binding of torn skin)
3. **Kathinyakara Pralepa** – It is used in Vrana Shaithilyata and in Sukumara. It also has the property of Prasadana.
4. **Mardavakara Pralepa** – It is used in Saruja, Kathina, Stabdha and Nirasrava Vrana.
5. **Savarneekarana Lepa** – This Lepa is used for enhancing colour and complexion.
6. **Varnakara Lepa** – To get the normal colour of skin from healed Vrana, this Lepa can be used.
7. **Roma Sanjanana Lepa** – It is used for the reproduction of Roma, which gets distructed by the Vrana.
8. **Twak Krishnyakara Lepa** – It is used for Krishna Karma in the discolored skin caused by a Vrana.

Acharya Vagbhata has mentioned 10 types of Lepa based on their different actions. ⁴⁷ They are,

1. **Snaihika Lepa** – This is meant for Vata Dosha and is prepared with Snigdha Dravya or Dravya added with more Sneha or only Sneha.
2. **Nirvapana Lepa** – This is meant for Pitta Dosha, Pittaja and Vishaja Shotha, Agni and Ksharadagha. In this Sheeta Dravya are used.
3. **Prasadana Lepa** – This is similar to Nirvapana Lepa and it has Rakta Prasadana property.

4. **Stambhana Lepa** – Apart from having Nirvapana Lepa property it has the additional property of Rakta Stambhana in Rakta Atipravrutti.
5. **Vilayana Lepa** – It is helpful in Sleshma and Meda predominant Shotha which does not undergo Paka because of its Sheetata, Grathita and Rookshata.
6. **Pachana Lepa** – It does the Pachana of Apakva Shotha, by using Rooksha and Ushna Dravyas.
7. **Peedana Lepa** – This can be made use in Sookshma Vrana by application of Rooksha and Picchila Dravyas.
8. **Shodhana Lepa** – It is indicated in Ashuddha Vrana where Shodhana Dravyas can be used.
9. **Ropana Lepa** – As the name indicates it is used for Ropana Shuddha Vrana.
10. **Savarneekarna Lepa** – One can get the normal skin colour from Roodha Vrana by application of this Lepa.

Acharya Sharangadhara has mentioned 3 types of Lepa, they are:

- i. **Doshaghna** – The vitiated Dosha which results in Shotha, Shoola etc are reduced by this type of Lepa. Its thickness is 1/4th Angula.^{43a} Ushna Lepa is advised in Vata and Kapha vitiation. Similarly for Pitta, Sheetala Lepa is advised.⁴⁸
- ii. **Vishaghna** – Vitiation of Dosha may occur either due to Sthavara or Jangama Visha Aushadhi, Lepa can be applied to suppress the effect of such Visha and therefore it is called Vishaghna Lepa. Its thickness is 1/3rd Angula.^{43a} Vishaghna Lepa is said to be Sheetala in nature.⁴⁸
- iii. **Varnya** – Many diseases like Vyanga, Pitika, etc lose normal colour and complexion of the face. The Lepa used for its correction is called Varnya Lepa. It is 1/2 Angula in thickness.^{43a} For Varnya purpose Sheetala Lepa is used.⁴⁸

General rules followed during application of lepa^{44a}

- Always Lepa should be applied in the opposite direction of hairfollicles.
- The Lepa should not be left in situ after drying. It must be removed as soon as it dries up. As the Lepa are wet, helps to cure the disease, as soon as they dry, they lose their potency and irritate the skin. Except in Pralepa which is kept even after drying for Peedana action in Vrana Shotha.

- Lepa should be prepared freshly and used.
- Once used Lepa should not be used again.
- Over the previous Lepa fresh ones should not be applied.
- Lepa should not be applied at night, if applied it causes skin diseases by suppressing local temperature and it increases the Roga Lakshana.
- Do not cover the Lepa with cloth because it causes retention of sweat, which in turn leads to Pidaka, Kandu etc. complications.
- Lepa should neither be too Snigdha nor too Rooksha. Neither solid nor liquid i.e., it should be of medium consistency.
- The thickness of Pradeha should be Ardramaheesha Charmavat like that of wet skin of the buffalo or 1/3rd of angula. (0.25 cm) while that of Pralepa is Chandanavat thickness.

- Ratri Lepa is indicated in Vrana associated with Apaka Shopha, Vata and Sleshma, Kshata, Raktaja Vikara and which is Ati Gambheera. If in Pittaja Shotha Vatapitta Lakshana are present then Shatadhauta Ghrita application is advised.

Sneha Matra for the preparation of Lepa^{44b}

- Vataja shopha – Four parts
- Pittaja Shopha – Six parts
- Kaphaja Shopha – Eight parts of Sneha should be added.

General Indication of Lepa^{44c}

- In Avidagha Shopha
- Uttitamatra Shopha
- In Ugra Rujayukta Vrana, Kandu
- Best in pacifying Daha
- Marma Sthanaja and Guhya Pradeshaja Shopha

Benefits of Lepa^{44d}

- It mitigates Dosha
- Relieves burning sensation, itching and pain
- Makes Twak, Mamsa and Rakta Prasadana

As to extinguish fire in a burning house water is sprinkled, similarly application of Lepa quickly removes the pain. Useful in Prahladana, Shodana, Utsadana and Ropana.⁴⁹

Concept of Peedana Lepa, Kalka and Upanaha ^{44c}

- ✓ **Peedana:** Here Lepa is allowed to dry. When being dried it presses the Pakva Shopha and thus helps to drain out the pus.
- ✓ **Kalka:** Lepa, which is used in open wounds, is called **Kalka or Niruddhalepana**. It is indicated for Shodana and Ropana of Vrana.
- ✓ **Upanaha:** Upanaha means Bhandana. Here medicaments are made into poultice by triturating them into paste and used for Swedana.

THERMAL EFFECT OF LEPA

In health, humans maintain internal and external heat and preserve a constant body temperature by means of a highly efficient thermoregulatory system. The body is usually considered to consist of two thermal compartments, the core or central compartment and the shell or superficial layer. The core temperature is controlled at a constant level by physiological mechanism. The shell, at the interface between body and environment is subjected to, much greater variation in temperature.

Control of body temperature

Thermoregulation is integrated by a controlling system in the central nervous system that responds to the heat content of tissues as signaled by thermo receptors. These receptors are sensitive to heat and cold thermal information arising in the skin, deep tissue and in central nervous system itself. They provide feedback signals to central nervous structures situated mainly in the hypothalamus of the brain in a servo or loop system.

CRYOTHERAPY ⁵⁰

Definition: Application of cold for various therapeutic purposes is known as *Cryotherapy*.

Basic principle: When cold therapy is applied to the tissues, the heat is absorbed from the tissues by the cooling agent. Ice changes its state from solid

to liquid by absorbing heat. A specific amount of energy is required to change the solid form of ice into water which is called **latent heat fusion**.

Physiological effects of Cold Therapy

a) Effect on circulatory system

1. Vasoconstriction: The initial response of the body tissue to cold is to preserve the heat. This is accompanied by an initial phase of Vasoconstriction which helps to reduce the flow of blood thus reducing extravasation of fluid into the interstium, thus limiting the swelling and extent of tissue damage. The chemical and biological processes slow down with decreasing temperature. This effect is enhanced by the reduction in both cell metabolism and vasoactive substances, such as histamine, which are also associated with cooling. It is important to note that the period of vasoconstriction lasts between 10-15 minutes and is then followed by the cycle of Cold Induced Vasodilatation (CIVD).

2. Vasodilatation: When the haemostasis is reached and the body part has become cooled, there follows a phase of vasodilatation.

3. Alternate Vasoconstriction and Vasodilatation: Then it follows alternative constriction and dilatation. This is known as **Lewis hunting reaction**.

b) Effect on nervous system and neural tissue

The rate of conduction of the nerve fibers is reduced by cold. The major effect of ice is to relieve pain. The probable mechanism involved is the stimulation of cold receptors which send back the impulses to pass into the spinal cord via posterior root. It has been demonstrated that peripheral nerve conduction is slowed by cold (Lee, Warren and Mason 1978) and that fibers vary in their diameter and myelination.

The small diameter myelinated fibers which conduct pain are most responsive to cold, thus having analgesic effect. This impulse which arrives attempting to gain access to the cord and thus the pain gate is closed. The cold stimulate the mid brain, which may release Beta Endorphin or Enkephalin into the posterior horn and thus reduce pain. One of the major effects of cold therapy is on the muscle tone. The short, brisk application of cold is thought to enhance

the muscle tone (excitation), while the prolonged use of cold for atleast for 30 minutes decreases the muscle tone (inhibition) to greater extent.

HEAT THERAPY ⁵¹

Physiological effects of Heat Therapy

a) Effect on circulatory system

The temperature elevation has a direct effect on the state of dilatation of arterioles and venules by acting on the smooth muscles of the vessels a good blood supply is essential for healing. If infection is present then the increased number of white cells and fluid exudates available assist in destroying bacteria. Heating to about 38.6⁰c increases oxygen uptake by the muscles. The increase in blood flow means greater number of white cells and more nutrients available for healing process.

b) Effect on nervous system and neural tissue

Increase in metabolism being greatest in the region where most heat is generated. Accelerated cellular metabolism can produce many beneficial therapeutic effects to treat injury or infection. The property of specific tissue may be changed by heating.

For example – the tendon extensibility can be increased by raising the temperature with the result that a stretch of a given intensity will produce greater elongation when heat is applied. Heating results in the reduction of tension over the tissues probably due to gama fiber activity affecting the muscle spindles, resulting in reduction of pain.

Table No. - 10: Pathya according to different authors

SL. No	Pathya	S. S ⁵²	A.H ⁵³	A.S ⁵⁴	Y.R ⁵⁵
01.	Sali	+	+	+	-
02.	Mamsa Rasa	+	+	+	+
03.	Ksheera	+	+	+	+
04.	Sarpi	+	+	+	+
05.	Satina Yusha	+	-	-	-
06.	Bramhana Anna	+	-	-	+
07.	Bramhana Pana	+	-	-	+
08.	Avidahi Ahara	-	+	+	+
09.	Poustika Ahara	-	+	+	+
10.	Matrayukta Ahara	-	+	+	-
11.	Mudga yusha	-	-	-	+
12.	Naglani	-	-	+	-

Table No. -11: Apathya according to different authors

Sl.No	Apathya	S.S ^{52a}	A.H ^{53a}	A.S ^{54a}	Y.R ^{55a}	B.P ⁵⁶
1.	Lavana	+	+	+	+	+
2.	Katu rasa	+	+	+	+	+
3.	Kshara	+	+	+	+	+
4.	Amla	+	+	+	+	+
5.	Ruksha Anna	+	+	-	+	+
6.	Ruksha Aushadha	-	+	+	-	-
7.	Maithuna	+	+	+	+	+
8.	Atapa Sevana	+	+	+	+	+
9.	Vyayama	+	+	+	+	+
10.	Ayasa	-	-	-	-	+

MODERN REVIEW

A cell is a complex collection of compartments each of which carries out a host of bio-chemical reactions that make life possible. However a cell functions as an isolated unit in the body. Instead cells usually work together in groups called tissues. These are having a common embryonic origin and functions together to carry out specialized activity. Tissues of the body develop from the primary germ layer in human embryo as ectoderm, endoderm and mesoderm.

The four basic types are -

- 1) Epithelial tissue.
- 2) Connective tissue
- 3) Muscular tissue
- 4) Nervous tissue.

Connective tissue:⁵⁷

Connective tissue is found every where in the body. It is the most abundant and widely distributed of the primary tissues, but its amount in particular organs varies. Its chief subclasses are connective tissue proper, cartilage, bone and blood.

Its major functions include: –

1. Binding and support
2. Protection
3. Insulation – Fat cushions insulates and protects body organs and provides reserve energy fuel.
4. Transportation of substances within the body.

Common characteristics of connective tissue:^{57a}

1. Common origin:

All connective tissues arise from mesenchyma, an embryonic tissue derived from mesoderm germ layer.

2. Degrees of vascularity:

Unlike epithelium, which is avascular, muscles and nerves have rich vascularity. Connective tissues run the entire gamut of vascularity. Cartilage is

avascular, while dense connective tissue is poorly vascularised and other types have rich supply of blood vessels.

3. Extra cellular matrix:

All primary tissues are composed of cells while connective tissues are composed largely of non living extra cellular matrix, which often widely separates the living cells of the tissue because of this matrix, connective tissue is able to bear weight, withstand great tension and endure abuses, such as physical trauma, abrasion that no other tissue can tolerate.

Structural Elements of Connective tissue: ^{57b}

It has three main elements – ground substance, fibers and cells. Ground substance and fibers together form the matrix. The matrix can be delicate and fragile to form a soft packing around an organ, or it can form ropes (tendons and ligaments) of incredible strength.

Ground substance – It is an amorphous material that fills the space between the cells and contains the fibers. It is composed of interstitial fluid, cell adhesion proteins and proteoglycans. The ground substance holds fluid and functions as a molecular sieve, through which nutrients and other dissolved substances can diffuse between the blood capillaries and the cells.

Fibers – The fibers of connective tissue provide support. Three types of fibers are found.

A. Collagen fibers – They are made of fibrous protein collagen. The basic building block of the collagen fiber is the tropo-collagen molecule. This molecule is a three-polypeptide chain attached together forming a collagen fiber. Collagen fibers are extremely tough and provide high tensile strength (that is ability to resist longitudinal stress) to the matrix. Stress tests show that collagen fibers are stronger than steel fibers of the same size. A single collagen bundle is 1 mm in diameter and can sustain a load of 10-40 kg without breaking.⁵⁸ When fresh, they have a glistening white appearance, so called as white fibers.

B. Elastin fibers – Elastin fibers are formed largely from another fibrous protein, elastin. Elastin has a randomly coiled structure that allows it to stretch and recoil

like a rubber band. They are present in skin, lungs and walls of blood vessels. Since fresh elastic fibers appear yellow, so called yellow fibers.

C. Reticular fibers - Reticular fibers are fine collagenous fibers, which branch extensively, forming delicate network. They surround small blood vessels and support the soft tissue organs.

Types of Connective tissue:

Mainly two types- 1) Mesenchymal tissue 2) Connective tissue proper.

i) Mesenchymal tissue – Formed from mesoderm germ layer. It arises from early embryonic life and differentiates into all other connective tissue.

ii) Connective tissue proper – This is further sub classified into two forms.

a) Loose connective tissue – This includes areolar tissue, adipose tissue and reticular tissue.

b) Dense connective tissue – This includes dense regular connective tissue, dense irregular connective tissue and elastic tissue.

Dense regular connective tissue:

In this variety all have fibers as their predominant element. For this reason, the dense connective tissue is often referred to as dense fibrous connective tissue. They run in the same direction parallel to the direction of pull. This results in a white flexible tissue with great resistance to tension, where tension is exerted in a single direction. Among the crowded collagen fibers are rows of fibroblasts that continuously manufacture fibers and scanty ground substance. Collagen fibers are slightly wavy. This allows the tissue to stretch a little, but once the fibers are straightened; there is no further “give” to this tissue.

With its enormous tensile strength, dense regular connective tissue forms tendons, cords that attach muscles to bones and flat sheet called aponeurosis that attach muscles to other muscles or bones.

Dense regular connective tissue also forms the ligaments that bind bones together at joints. Ligaments are more elastic fibers than tendons and are slightly more stretchable.

Dense irregular connective tissue:

They have same structural element as that of regular. However, the bundles of collagen fibers are much thicker and arranged irregularly, they run in more than one

plane. This type of tissues forms sheath in the body areas where tension is exerted from different directions. It is found in skin as dermis, forms fibrous joint capsules and fibrous coverings that surround some organs such as kidneys, testis, bones, cartilages, muscles and nerves.

LIGAMENTS

Derivation:

Ligament is formed from the word Liga and ment.

Liga = bound or tied + ment = purpose

The principal factor which holds or binds the bones together in a synovial joint.⁵⁹

Definition: A ligament is cord or band of connective tissue uniting two structures, commonly found in association with joints.⁶⁰

Ligaments are composed of dense connective tissues, mainly collagen fibers. The direction of the fibers being related to the stresses they undergo.

Types of ligaments – Mainly two types

1. Fibrous ligaments – In general ligaments are unstretchable, unless subjected to prolonged strain. They are composed of dense connective tissues and prevent excessive movement in a joint. But if the stress is continued for an excessively long period, then fibrous ligaments stretch.

For example – The arches of the feet are supported by ligaments of the individual joints and bear the weight of body. If the tones of the muscles that normally support the arches become impaired by fatigue, then the ligaments will stretch and the arches will collapse, producing flat feet.

Example: Iliofemoral ligament of the hip joint, deltoid ligament of ankle joint.

2. Elastic ligaments – They are made of elastin fibers, which enable them to stretch and regain their original length thereafter. The elastic ligaments and auditory ossicles play an active part in supporting the joints. They assist the return of the bones to their original position after movement.

Example: Ligamentum flavum of vertebral column, Calcaneonavicular ligament of foot.

Ligament Healing: ⁶¹

Ligaments are found outside the joint capsules. They help in strengthening, supporting and limiting the joint movements. Thus stability of a joint to a great extent is dependent on the integrity of the ligaments. Torn ligaments destabilize the joint and predispose it to dislocation. The goal of all therapeutic approaches is to regain Ankle stability and healing time of the ligament must be ascertained. Clayton and Colleagues determined that sutured and unsutured ligaments heal to be stronger than normal osseous ligaments at their juncture, but these were not tested by stress.

Creep is the slow elongation in response to constant or repeated stress. After tearing, changes in the recovery have been experimentally documented. Macrophages occur at the edge of the tear, followed by new born fibroblasts which appear 24-48 hours after leukocytes appear. By 72 hours collagen fibers appear. The clot that appears in the space created by the tear is the site of cellular infiltration. Then the collagen synthesis occurs. The collagen gradually reorganizes into parallel bands, which are thickened by the formation of fibrous scar. Tension applied during these stages of organization aligns the strands into parallel bands, hence the value of elongation exercises during healing is preferred.

Recovery does not imply that there has been no residual permanent damage, or that there has been no permanent elongation. Recovery of one function does not imply recovery of all other function, because micro failure may persist.

Stress is a physical stimulus that plays a significant role in the formation and maintenance of collagen.

A gradual increase in stress increases the production and organization of collagen. Minimal stress decreases collagen production and organization.

Cause of delayed healing of ligaments:

1. The ligaments have poor blood supply; as a result the nutrients, chemicals and cells involved in the tissue repair reach slowly, hence healing also delays. Surgical reconstruction is generally needed for the treatment of a served ligament.⁶²
2. Repeated trauma
3. Immobilization causes loss of strength and flexibility more slowly than loss of strength.

4. Immobilization causes a significant loss of strength. A loss of 80% in dense connective tissue strength, in muscles has been found after 4 weeks, 50% in collateral ligaments and 39% in cruciate ligament of knee after 8 weeks.⁶¹

TENDON:⁶³ A cord of dense regular connective tissue that attaches a muscle to the periosteum of a bone. There are tendon organs at the junction of a tendon and muscle, these prevent damage to tendon and muscle due to excessive tension during tendon reflex.

ANKLE ANATOMY

The human foot combines mechanical complexity and structural strength. The ankle serves as foundation, shock absorber, and propulsion engine. The foot can sustain enormous pressure (several tons over the course of a one-mile run) and provides flexibility and resiliency.

The foot and ankle contain:⁶⁴

- 26 bones (One-quarter of the bones in the human body are in the feet.)
- 33 joints
- More than 100 muscles, tendons (fibrous tissues that connect muscles to bones) and ligaments (fibrous tissues that connect bones to other bones)
- A network of blood vessels, nerves, skin and soft tissue.

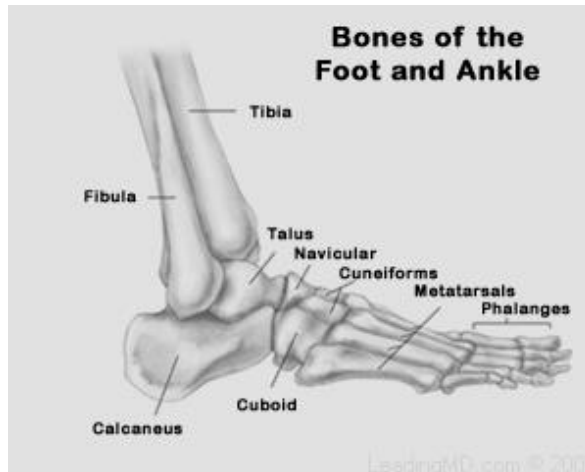
These components work together to provide the body with support, balance and mobility.

A structural flaw or malfunction in any one part can result in the development of problems elsewhere in the body. Abnormalities in other parts of the body can lead to problems in the feet.

Structurally, the foot has three main parts: the forefoot, the midfoot, and the hindfoot. The **forefoot** is composed of the five toes (called phalanges) and their connecting long bones (five metatarsals).

The **midfoot** has five irregularly shaped tarsal bones, forms the foot's arch, and serves as shock absorber. It consists of medial cuneiform, intermediate cuneiform, lateral cuneiform and cuboid. Navicular is interposed between talus and three cuneiform bones.

The **hindfoot** is composed of three joints and links the midfoot to the ankle (talus). The top of the talus is connected to the two long bones of the lower leg (tibia and fibula), forming a hinge that allows the foot to move up and down. The heel bone (calcaneus) is the largest bone in the foot. It joins the talus to form the **subtalar joint**. A layer of fat cushions the bottom of the heel bone.



Bones of the Foot and Ankle (FIG-1)

There are 20 muscles in the foot that give the foot its shape by holding the bones in position and expand and contract to impart movement.

The main muscles of the foot are:

- The **anterior tibial**, which enables the foot to move upward
- The **posterior tibial**, which supports the arch
- The **peroneal tibial**, which controls movement on the outside of the ankle
- The **extensors**, which help the ankle raise the toes to initiate the act of stepping forward
- The **flexors**, which help to stabilize the toes against the ground.

ANKLE JOINT

The Ankle or tibio-talar joint is a complex joint of lower limb. It is a hinge joint and has therefore only one degree of freedom.⁶⁵ This joint has to be stable in order to withstand 1.5 times your body weight when you walk and up to eight times your body weight when you run¹⁵. It is formed medially by tibia and talus and laterally by fibula and talus.

It is tightly interlocked joint exposed to extreme mechanical condition during single limb support. It is then subjected to the entire body weight and to the force

generated by the dissipation of kinetic energy when the foot rapidly makes contact with the ground during walking, running or jumping.

The strong tibio-fibular and interosseous ligaments tightly bind the distal tibio-fibular joint. Structurally Ankle joint has a strong deltoid ligament medially and lateral collateral ligament laterally, with its three bands. The Ankle joint is the only Syndesmosis fibrous joint without a synovial membrane.⁶⁶

There are two joints that allow movement of the ankle:⁶⁷

The true ankle joint (tibio-talar joint) - articulation between the lower end of the tibia, the two malleoli and the body of the talus. This joint allows dorsiflexion and plantar flexion of the ankle.

The subtalar joint - articulation between the talus and calcaneus. This joint allows inversion and eversion of the ankle.

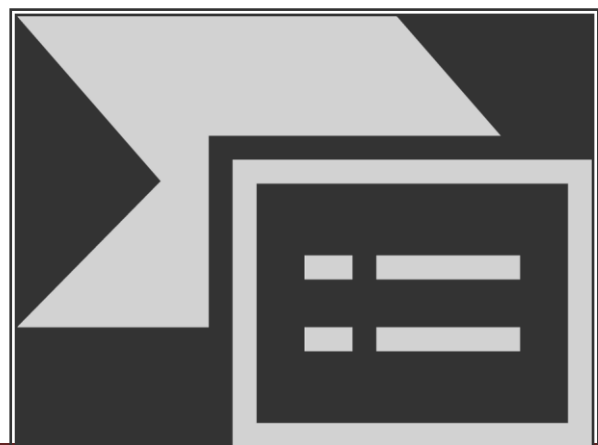
Structures surrounding Ankle⁶⁸

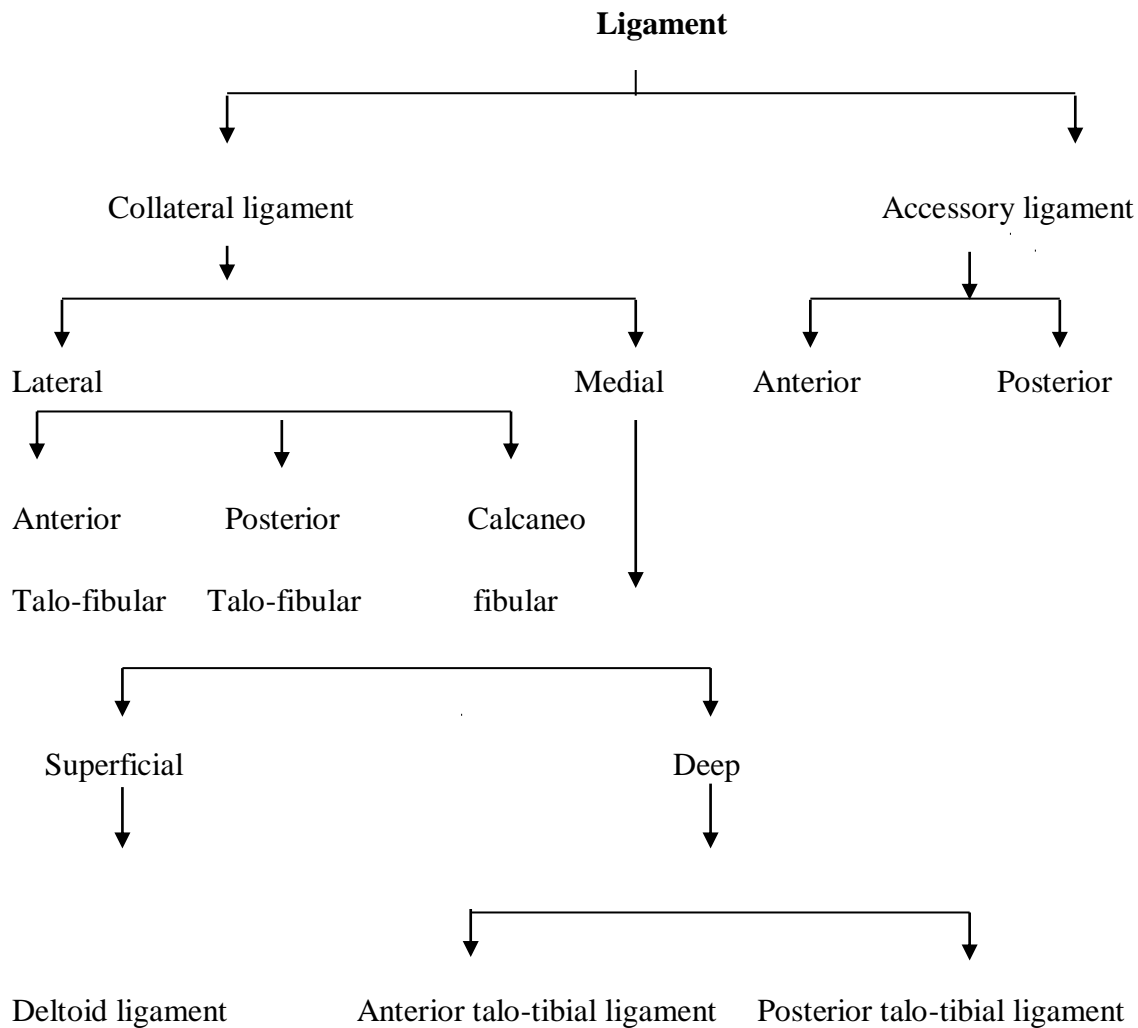
1. **Anteriorly:** In order tibialis anterior, extensor hallucis longus, tibial vessels, nerves, tibialis posterior. These structures are held in position by superior and inferior retinaculae
2. **Posterior-medial:** Tendons of tibialis posterior, flexor digitorum longus, posterior tibial vessels and nerves, behind and below the medial malleolus. Flexor retinaculum holds them in position.
3. **Postero-lateral:** Peroneus longus and brevis held in position by superior and inferior peroneal retinaculae.
4. **Posteriorly:** Tendo-Achilles and plantaris covered by synovial sheath. There is no muscular covering on any side.

Ligaments of Ankle joint^{65a}

These ligaments consist of two main group's i.e. lateral and medial collateral ligament and two accessory group i.e. anterior and posterior ligaments.

Ligaments of the Ankle (FIG-2)





Collateral ligaments:

The collateral ligaments are two powerful fan like investments which are attached above at their apices to the corresponding malleolus and which radiate distally to be inserted into the two posterior tarsal bones.

A) Lateral Collateral Ligament (LCL) made of three separate bands, two attached below to the talus and one to calcaneum.

a) Anterior talo-fibular ligament - It is attached to anterior margin of fibular malleolus, runs obliquely, inferiorly and to be inserted into talus between articular facet and mouth of sinus tarsi.

b) Posterior talo-fibular ligament – Arising from medial surface of lateral malleolus behind the articular facet runs horizontally and inclines medially and slightly posterior to its insertion into posterolateral tubercle of talus.

c) **Calcaneo-fibular ligament** – Arising from the depression in front of the apex of the lateral malleolus, courses obliquely inferior and posteriorly to its insertion into the lateral surface of the calcaneus. The inferior talo-calcanean ligament runs along its inferior border.

B) Medial Collateral Ligament (MCL) – It comprises of two sets of fibers, superficial and deep.

a) Deep fibers-

i) **Anterior talo-tibial ligament** – It runs obliquely, inferiorly and posteriorly to be attached to the medial aspect of neck of calcaneus.

ii) **Posterior talo-tibial ligament** – It runs obliquely, inferiorly and posteriorly to be inserted into deep fossa on medial surface of calcaneus, its most posterior fibers are attached to posteromedial tubercle.

b) **Superficial fibers-** It is triangular in shape, broad and constitute deltoid ligament. It originates at medial malleolus, fans out and is inserted into a continuous line running from the tuberosity of the navicular bone, along the medial margin of the plantar calcaneo-navicular ligament, to the sustentaculum tali of the calcaneus.

Accessory Ligaments –

a) **Anterior inferior tibio-fibular ligament** – These are simply localized thickening of the capsule. It runs obliquely from anterior margin of lower end of tibia to the upper surface of the anterior part of the neck the talus.

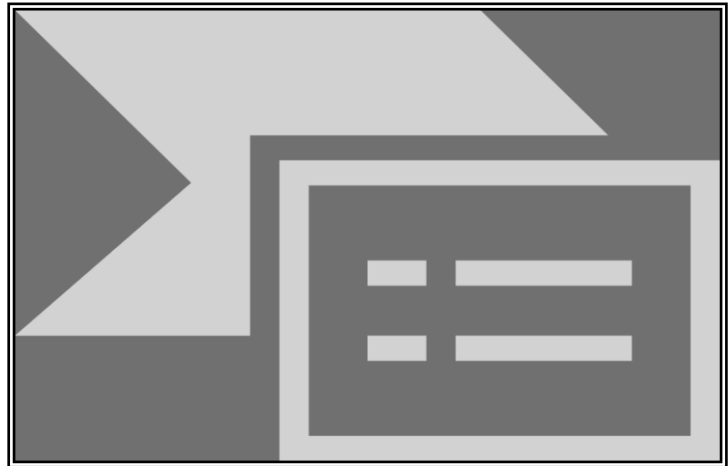
b) **Posterior inferior tibio-fibular ligament** – It consists of fibers, which spring from the tibia and fibula and converge to their insertion into the posteromedial tubercle of the talus. This tubercle, along with the posterolateral tubercle forms the deep groove for the flexor hallucis longus. This groove is seen to proceed distally along the inferior surface of sustentaculum tali.

Relations of Ankle Joint:

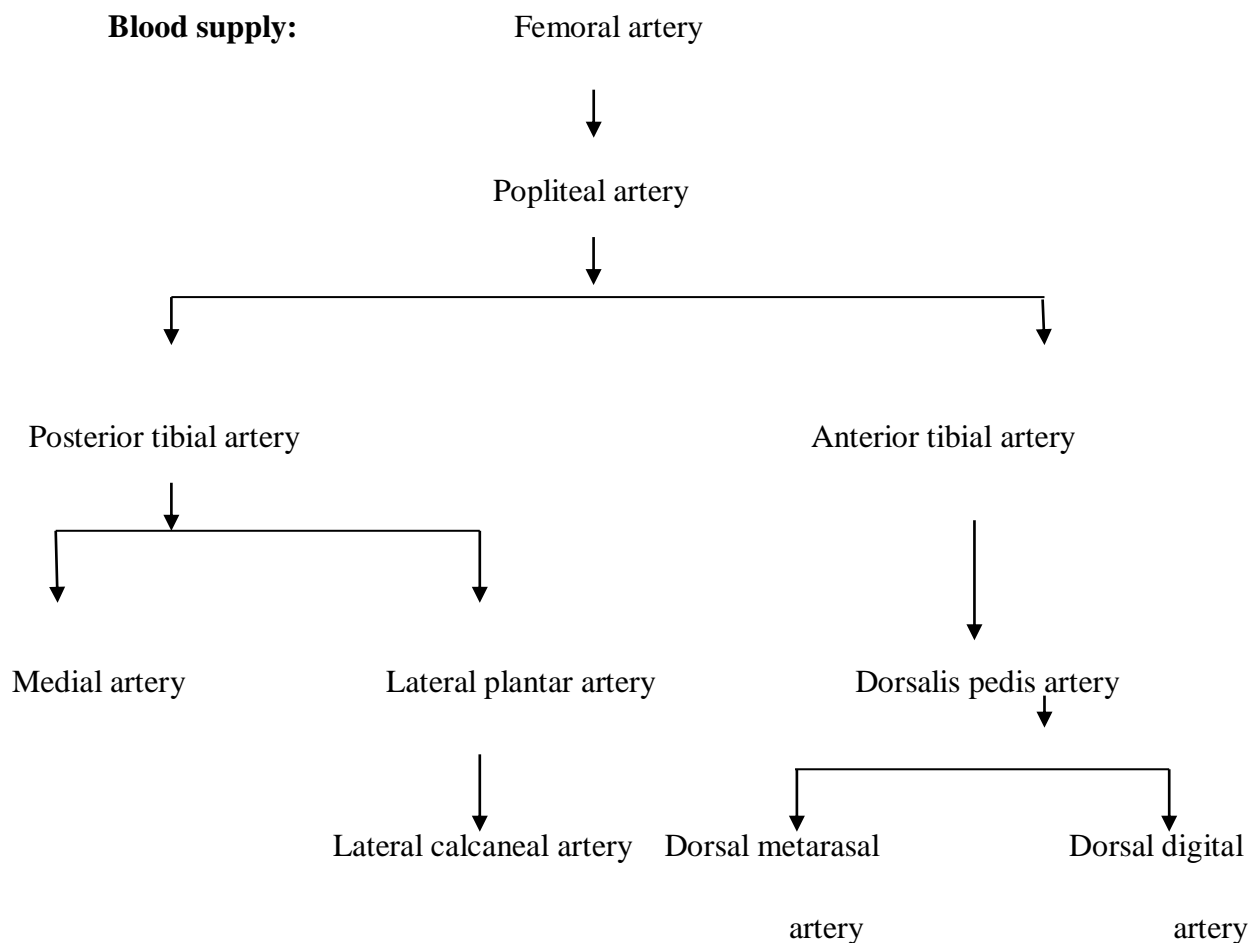
1. Anteriorly from medial to lateral side – there are tibialis anterior, extensor hallucis longus, anterior tibial vessels, deep peroneal nerve, extensor digitorum longus and peroneus tertius.

2. Posteriorly from medial to lateral side – there are tibialis

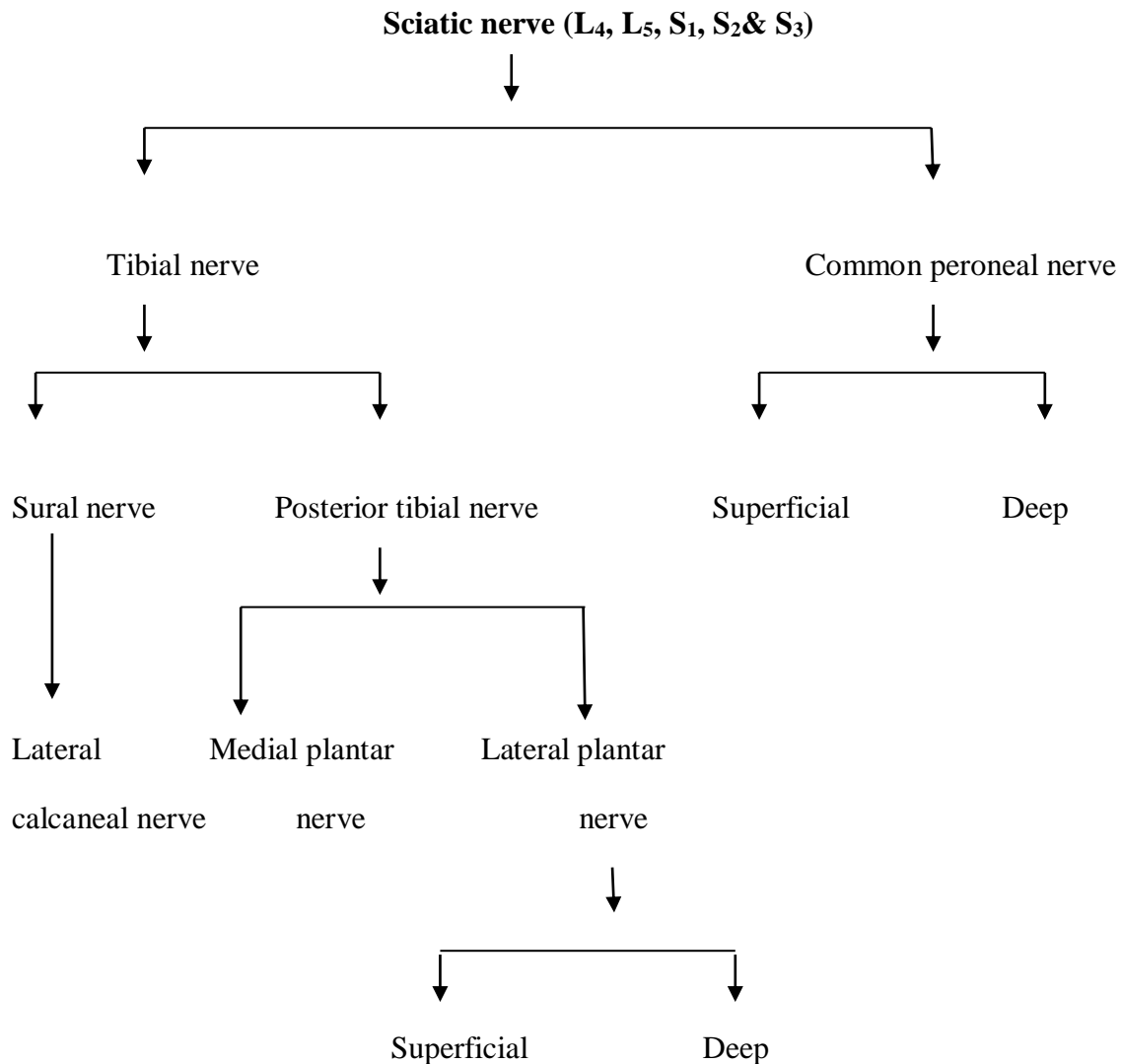
posterior, flexor digitorum longus, posterior tibial vessels, tibial nerve, flexor hallucis longus, peroneus brevis and longus.



Structures in relation to Ankle (FIG – 3)



Nerve supply:



Physiology Of Ankle Joint:⁶⁹

Joint flexibility is defined as the range of motion (ROM) allowed at a joint. A joint's ROM is usually measured by the number of degrees from the starting position of a segment to its position at the end of its full range of the movement. The most common way this is done is by using a double-armed goniometer. A stationary arm holding a protractor is placed parallel with a stationary body segment and a movable arm moves along a moveable body segment. The pin (axis of goniometer) is placed over the joint. When anatomical landmarks are well defined, the accuracy of measurement is greater. If there is softer tissue surrounding the joint area, measurement error can be more frequent.

Range Of Movement⁶⁹ – There are six movements in the Ankle Joint. They are

1. **Plantarflexion** – Ask the patient to actively move the foot downwards. Angle ranges to 35°
2. **Dorsiflexion** - Ask the patient to actively move the foot upwards. Angle ranges to 25°
3. **Adduction** – Hind foot moved towards midline.
4. **Abduction** – Hind foot moved towards laterally.
5. **Inversion/Supination** -Raises medial aspect of foot, heel off the ground.(0-20°)
6. **Eversion/ Pronation** - Raises lateral aspect of foot, heel off the ground.(0-20°)

The Ankle is made of two joints, the Talofibular and Subtalar joints. Flexion and extension of the Ankle automatically call into action the two joints, which are mechanically linked to the ankle. If the medial and lateral surfaces of the body of talus are to be gripped tightly the intermalleolar space must vary within certain limits, i.e. being smallest during extension and greatest during flexion.

During flexion of the Ankle:

The lateral malleolus moves away from medial malleolus, at the same time it is slightly pulled superiorly while the fibers of the tibiofibular, interosseous ligaments tend to become horizontal. Thus fibula is medially rotated.

During Extension of the Ankle:

The lateral malleolus is pulled inferiorly, while the ligaments tend to become vertical and the malleolus is slightly rotated medially. Thus by means of the tibiofibular joint, the ligaments and tibialis posterior can constantly adapt to the changes in width and curvature of the tendon like talus and ensure the transverse stability of the ankle.

Ankle Joint ROM: Determine the amount of dorsal flexion & Plantar flexion.

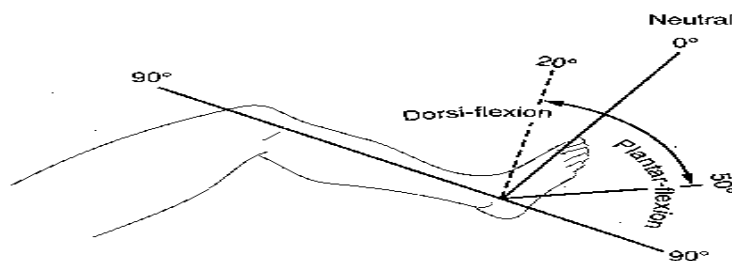


FIG - 4. Ankle Joint Motions (Adapted from Luttgens & Hamilton, 1997)

ANKLE SPRAIN

Introduction:

In 1768 Pott described ankle injuries for the first time.⁶⁸ In 1950 Lauge-Hansen proposed a classification of ankle injuries, which is almost universally accepted. Most of the injuries are mixed bony and ligamentous and treatment of fracture and management of the ligamentous element is all important. There are six groups of ankle injuries:⁶⁵

1. Abduction injuries
2. Adduction injuries
3. External rotation injuries with diastasis of the inferior tibio-fibular joint: pronation – external rotation injuries.
4. External rotation injuries without diastasis of the inferior tibio-fibular joint: supination– external rotation injuries.
5. Vertical compression injuries.
6. Uncommon unclassified injury pattern.

Ankle pain is most often due to an ankle sprain, which is an injury that causes a stretch or tear of one or more ligaments in the ankle joint. Ankle ligaments are probably the most sprained ligaments in the body. Close to 26,000 people sprain their ankles every day. Although most ankle sprains occur on the outside part of the ankle, they can occur on the inside as well. An ankle twist is the most common sports injury to lead to ankle pain. In addition to ankle sprains and other injuries, ankle pain may also be caused by arthritis, gout, pseudogout and infection.⁶⁶

Derivation: The word sprain is derived from the French word **espraindre** which means to wring, i.e. is an injury which occurs to ligaments caused by a sudden over stretching.⁷⁰

Definition:

SPRAIN- A sprain can be a stretch, tear, or complete rupture of one or more of the ligaments that hold the bones of the joint together.⁷¹

ANKLE SPRAIN - An ankle sprain is a common injury and usually results when the ankle is twisted or turned in (inverted) resulting in stretch, tear or complete rupture.⁷²

Causes of Ankle sprain: ⁷³

1. Twisting injury while walking on uneven surface, running etc.
2. Fall from a height – indirect injuries here brought about by displacing talus.

3. **Sports injuries:-**

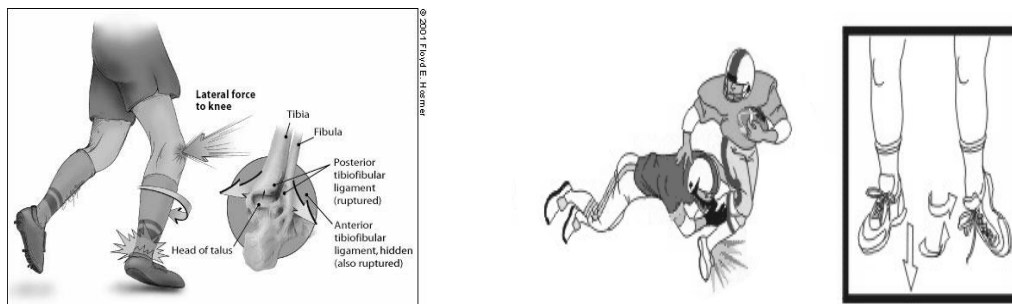
A. Injuries in Volley ball – Ankle Sprain is one of the most common injuries seen in blockers and spikers following an awkward landing from a jump.

B. Broad jump – imperfect landing in the sand pit.

C. Cricket – uneven surface near balling crease and fielding area is responsible for most of Ankle Sprain.

D. Racket sports – tennis, badminton, squash which involves abrupt deceleration and acceleration, obviously ankle, knee and thigh are common sites of injuries.

E. Hurdling – triple chaser can sustain Ankle Sprains and metatarsal fracture following a fall in a water jump.



Mode of injury (FIG – 5)

Types of Ankle Sprain

A) Sprains are classified according to the **severity** of the ligament tear.⁷¹

1. **Acute Ankle Sprain:** The word acute usually means within the past six (6) weeks. This is the most common injury of the foot and ankle and almost 26,000 people sprain their ankle each day.

2. **Chronic Ankle Sprain:** The word chronic usually refers to the fact that either the injury occurred over six (6) weeks ago or it is still painful, or if you have had repetitive injuries to this same ankle.

B) Sprains are classified according to the mechanism of injury.⁷⁴

1. **Supination or Inversion Sprain:** This injury occurs due to sudden adduction inversion force on Ankle. It is a common capsule-ligamentous injury reported to be present in about 85% of all Ankle Sprain. It causes injury to antero-lateral part of joint capsule and one or all lateral ligaments (Talo-fibular, Anterior tibio-fibular & Calcaneo-fibular).

2. **Pronation or Eversion Sprain:** This injury occurs due to abduction eversion force over the foot. Medial ligaments are strong and are rarely torn alone. Usually such injury is associated with avulsion fracture of tibia.

C) Classification of Ankle Sprain based on the ligaments involved^{68a}

1. **Lateral ligament Sprain:** The ankle takes the full weight of the body and the forces that are exerted on it are considerable, particularly in running and jumping. The most common acute ankle injury is a lateral inversion sprain. It is most common musculo-skeletal injury i.e.1/10,000/day. 85% of the cases are due to inversion of supinated plantar flexed foot. Most commonly anterior talo-fibular ligament followed by calcaneo-fibular ligament and rarely posterior talo-fibular ligament.

2. **Medial ligament Sprain:** It is due to pronation eversion injury. The 3 most characteristic mechanisms of injury of the deltoid ligament are pronation-abduction, pronation-external rotation and supination-external rotation of the foot. If mild then only superficial part of deltoid ligament is torn, in severe forms deep part of deltoid ligament is torn resulting in lateral talar tilt.

D) Based on Grades and severity types of Ankle Sprain^{68b}

1. **Grade I/ Minor Sprain:** Minor ligament injury with maintenance of functional integrity. There is mild swelling, tenderness and mild pain on stress, no laxity of joints, with minimal functional loss.

2. **Grade II/ Moderate Sprain:** Nearly complete ligamentous disruption is present. There is diffuse swelling, tenderness, moderate pain and functional loss with difficulty in walking. Anterior drawer and talar tilt test positive.

3. **Grade III/ Severe Sprain:** Complete ligamentous rupture with marked swelling, tenderness, pain and functional disability. Anterior drawer and talar tilt test highly positive.

Grades of Ankle Sprain (FIG – 6)

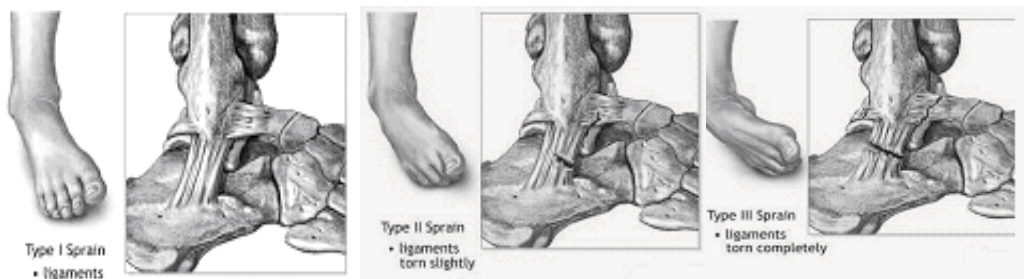


Table No. - 12: Table showing different grades of Ankle Sprain

Sign/ Symptom	Grade I	Grade II	Grade III
Tendon	No tear	Partial tear	Complete tear
Pain	Minimal	Moderate	Severe
Swelling	Minimal	Moderate	Severe
Loss of function	Minimal	Some	Great
Bruising	Usually not	Frequently	Yes
Difficult weight bearing	No	Usually	Almost always

E) Ankle Sprain classification based on level of ligaments involved: ⁷⁵

1. Low Ankle Sprain: They are most common injuries, which occur in sports. The ligaments outside the ankle are being stretched or torn. These types of ankle sprains usually are more stable and can be treated with a programme of taping and rehabilitation once the initial pain and swelling from the injury subside.

2. High Ankle Sprain: The membrane which connects the two leg bones (Syndesmosis) are either stretched or torn by twisting or turning maneuver. This is caused by dorsiflexion and eversion of the ankle with internal rotation of the tibia, eg. during skiing or football. The syndesmotoc ligaments are the combination of the interosseous ligament and lower tibiofibular ligaments which normally stabilize the

mortise joint and fix the fibula in the fibular notch. High Ankle Sprains can be especially problematic for athletes because of delayed healing (six weeks or more) as a result of poor blood supply. Hence they are advised for walk and jog on level ground only, but are limited in terms of their ability to return to activities. Healing takes longer than standard lateral sprains - consider the diagnosis in those with continuing pain >6 weeks after the original injury.

Structures involved in Ankle Sprain. ^{68c}

1. Complete rupture of anterior tibio-fibular ligament (ATFL) – 65%
2. Both anterior tibio-fibular ligament and calcaneo-fibular ligament – 20%
3. Anterior inferior tibio-fibular ligament (high ankle sprain) – 10%
4. Deltoid ligament – 3%

Types of ligament injuries:

The stability of a joint is influenced by both active and passive factors. Muscles maintain active stability while passive stability is by ligaments. When a joint is forced beyond its normal range of movement, ligament injury can occur. A ligament tear may affect a few fibers or entire ligament.

A partial tear involves only a few ligament fibers and does not affect the joint stability.

A complete tear involves most or all of the ligament fibers and affect the joint stability. At times the fragment of bones to which the ligament is attached may have been torn away from the rest of the bone.

Why Ankle Sprain occurs when the foot is plantar flexed? ⁷⁶

The ankle joint is hinge joint between foot and leg. The wedge shaped trochlea of talus fits into socket formed by the medial malleolus and inferior surface of the lower end of the tibia and lateral malleolus of the fibula called ‘tibio-fibular mortise’.

The stability of the ankle joint is maximum in dorsiflexion because during dorsiflexion the wedge shaped trochlear tali is forced posteriorly to be packed tightly in the tibio-fibular mortise “the close-pack position of the ankle joint.”

During plantarflexion, the trochlear tali moves anteroinferiorly and the grip of the malleoli on the trochlea become loose as a result side to side tilting is possible by inversion or eversion.

Why inversion injuries of foot occur more commonly than eversion? ^{76a}

The movement of inversion and eversion take place at subtalar and talo-calcaneo-navicular joints and partly at transverse lateral joint. The eversion injuries are less common than the inversion injuries because the deltoid ligament which attaches the medial malleolus to the talus is very strong. Consequently it is not as prone to rupture as the lateral ligaments.

Why lateral Ankle ligament sprain? ⁷⁷

The main lateral soft tissue stabilizers of the ankle are the ligaments of the lateral ligamentous complex: the anterior talofibular ligament (ATFL), the calcaneofibular ligament (CFL), and the posterior talofibular ligament (PTFL). In the neutral position, especially when coupled with compressive loads during weight bearing, the bony architecture of the ankle joint greatly assists with stability. As the foot goes into plantar flexion, thereby dissociating the bony talar contribution to talocrural stability, the ligamentous structures assume a greater role in providing stability and are more susceptible to injury.

The ATFL is a small thickening of the tibiotalar capsule. When the foot is in plantar flexion, the ligament courses parallel to the axis of the leg.

Because most sprains occur when the foot is in plantar flexion, this ligament is most frequently injured in inversion sprains. The CFL and PTFL are less commonly injured. Rupture of these ligaments typically occurs in more severe injuries, as the inversion force continues posteriorly around the ankle after the ATFL is sprained. Isolated injuries of the CFL can occur when the ligament is under maximum strain with the foot in dorsiflexion but are infrequent. Isolated injuries of the PTFL are extremely rare. Most injuries to the PTFL occur with very severe ankle sprains in which both the ATFL and CFL have been torn, and the forces continue around the lateral aspect of the ankle. Broström found that isolated, complete rupture of the ATFL was present in 65% of all ankle sprains. A combined injury involving the ATFL and the CFL occurred in 20% of his patients.

The extent of tissue damage that occurs during an injury depends on the direction and magnitude of the forces and the position of the foot and ankle during the trauma. Ankle sprains occur significantly more often in athletes who have had previous ankle sprains. Pes cavus, rearfoot varus, tibial varus, and previous trauma

are factors that may contribute to ankle-inversion injury, although none of these have been scientifically verified as contributing factors.

Pathogenesis: ⁶⁰

Ligament tear is often accompanied by bleeding which spreads into the surrounding tissue and frequently seen as bruising. Injury to the ligament is also accompanied by haemorrhage into joint space and damage the articular surface. Joint injuries are common in the ankle, knee, wrist and shoulder. Strong tension in a ligament will bring into action strong proprioceptive impulses which initiate protective muscular contraction. Nerve receptors which inform the position of articular surface, change of joint speed and ligament tension, reflexly affect muscular activity leading to insecurity after ligament injuries.

Stages Of Healing: ⁷⁴

Most of the sprains heal in four to sixteen weeks, the time will vary depending on age and severity of the injury. Immobilizing the joint in the proper position may be recommended so that the ends of the injured ligaments can heal together.

During the immobilized period the body is working to heal together. Special cells fill the gap in the ligament fibers left by the injury.

The body then replaces the torn, damaged tissue with strong, healthy tissue. There are three phases to the healing process, they are-

Phase I – Multipurpose cells enter the injured area. They quickly and randomly fill the gap and clean up the wound by removing injured tissue.

Phase II – These cells become fibroblasts. They line up along the direction of the ligament fibers, forming a bridge and filling the gap temporarily. They begin to produce collagen, the framework for new ligament.

Phase III – Eventually, the new collagen fibers become interwoven with the old collagen in the ligament. Fibroblasts disappear. Over time the structure is strengthened and refined through rehabilitation exercises.

It is important to know that once an Ankle sprain has occurred the joint itself has been weakened and is not as strong as it was before the injury, continued ankle strengthening exercises are very important.

Path way of Pain: ^{59a} The International Association for the Study of Pain (IASP) defines pain as “An unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of damage.”

Receptors:

Nociceptors are the receptors of pain, are free nerve endings found in every tissue of the body except brain. Pain receptors are widely spread in the superficial layers of the skin and certain internal tissues such as periosteum, arterial walls and joint surfaces.

Stimulus:

As soon as acute injury is received, pain is produced but long after the injury the pain may be continued to be felt.

This later pain is due to some endogenous chemicals liberated by the tissues. In the damaged tissues, particularly in the skin, some alogenic substances (AS-pain producing) are released. These come in contact with pain receptors and pain is produced. Possible alogenic substances are bradykinin, prostaglandins, serotonin, potassium ions, acetylcholine etc. All of them can produce pain.

Prostaglandins (PGs) are not very alogenic, but they potentiate the alogenic power of serotonin and bradykinin. Non-opoid analgesics like NSAIDs as well as cortisol related compounds inhibit the synthesis of prostaglandins and thus relieve pain.

Causes of Pain: Tissue damage/distension or stretching, Tissue ischemia, Muscle spasm.

Types of Pain: ⁷⁸

Mainly two types first (fast) and second (slow) pain. The perception of fast pain occurs very rapidly within 0.1 second after the stimulus, because the nerve impulses propagate along medium diameter myelinated A fibers. This type is acute, sharp or pricking in nature. This type of pain is not felt in deeper tissues of the body.

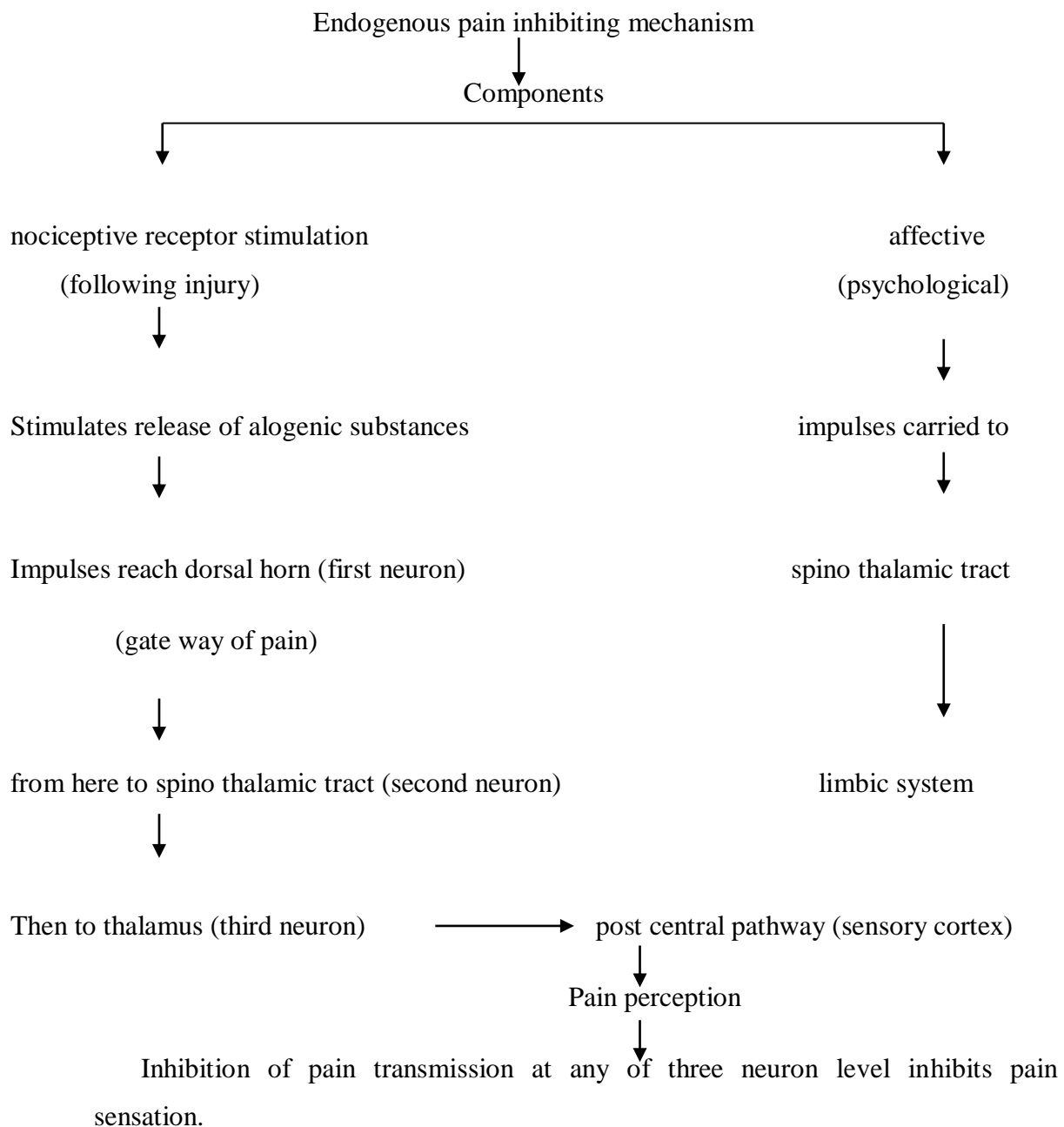
The perception of slow pain begins a second or more after a stimulus is applied. It then gradually increases in intensity. Impulses for slow pain conduct along small diameter unmyelinated C fibers. This type of pain is excruciating, burning, aching or throbbing in nature.

Pain that arises from stimulation of receptors in the skin is called superficial somatic pain, while stimulation of receptors in the skeletal muscles, joints, tendons

and fascia causes deep somatic pain. Visceral pain results from stimulation of nociceptors in the visceral organs. If stimulation is diffuse, visceral pain can be severe.

Path of Pain: ⁷⁸

The tip of dorsal horn is called “Substantia Gelatinosa Rolando” (SGR). A and C fibers terminate at dorsal horn. From SGR the neurons that arise cross to the opposite to form the Spino Thalamic Tract (STT) which ultimately reaches the thalamus. From thalamus next order of neurons arise to end in the sensory cortex situated in the parietal lobe.



Assessment of pain:

The sensation of pain is not directly measurable because pain is a unique personal experience. Pain threshold is defined as the first barely perceptible pain to noxious stimulation (Beecher-1957). Different instruments used for measuring clinical pain are as follows.

1. Scales - three
 - a) Verbal description scale
 - b) Visual analogue scale
 - c) Numerical rating scale
2. Multidimensional measures
 - a) Two component scale
 - b) Mc. Gill questionnaire

Verbal description scale:

Keele was first to devise this. He used single words as ‘none, slight, moderate, severe and agonizing’ to assess the response. The word selected may not accurately reflect patient’s true sensation.

Visual analogue scale:

The patients are asked to mark against the number corresponding to how they feel at that moment. The simplest form is 10 cm long line, the ends of which indicate ‘no pain’ on one side and ‘as bad as it can be’ on other side.

No pain ————— as bad as it can be
10 cms

By measuring the line and charting the length, clinician gets an excellent and reliable longitudinal measure of pain.

Two component scale:

Johnson and Rice separated the experience of pain into a sensory component, using two scales. Subjects related to physical pain were graded as 0-100 and distress caused by sensation was rated on a scale labeled, slightly distressing, moderately distressing, very distressing and just bearable. Researchers did not find relation between sensory and distress components of pain.

Mc. Gill questionnaire rating scale.

Melzack developed a pain rating scale that uses six terms. They are

- 0 – none
- 1 – mild
- 2 – discomforting
- 3 – distressing
- 4 – horrible
- 5 – excruciating

Apart from this other methods are used based on experience and common sense.

Signs and Symptoms: ⁷⁵

- 1. Pain** - The pain is usually very sharp and almost nauseating. Ankle sprain pain is associated with swelling and bruising. The most common location of ankle sprain pain is on the lateral part of ankle over the fibula. Usually, the pain is decreased with time, rest, elevation, ice and compression.
- 2. Swelling** - Swelling is a common finding after an injury, such as an acute ankle sprain. Sometimes this swelling can be severe. People with recurrent ankle sprains can experience swelling to a more mild degree.
- 3. Stiffness** - Usually, the stiffness occurs after resting your foot and ankle. The stiffness is usually temporary and will start to diminish with exercise, proper footwear, cryotherapy and time.
- 4. Tenderness** - Tenderness is present over the affect ligament. In Lateral ligament sprain tenderness is present below the lateral malleolus, while in medial ligament sprain tenderness below the medial malleolus.
- 5. Bruising/ Ecchymosis** - May well indicate more serious damage to the ligaments.
- 6. Instability** - A feeling of instability of foot or ankle after a single or multiple injuries torn ligaments and may be worsened when try to walk on uneven surfaces such as yard or stairs. Some instability is normal after a minor sprain especially in the early phases of recovery. Patients with chronic or recurrent ankle sprains complain of instability.

7. Popping/Snapping - The cracking heard when moving around is snapping and stretching of the tissue lining the joints. Some people with chronic ankle sprains complain of popping in their ankles.

Physical examination: ⁷⁹

1. Swelling - To begin with, lies in the line of the fasciculi of the ligament. In complete ligament tear, swelling is rapid to begin within 2 hours of injury and is egg shaped, placed over the lateral malleolus – Mc Kenzie’s sign.

2. Tenderness - Often diffuse along the ligament.

3. Range of Motion ⁸⁰ - Assessment for ankle range of motion typically begins with an evaluation of active, passive and resistive range of motion. There are four main motions that occur at the ankle joint: dorsiflexion, plantarflexion, inversion and eversion. To assess the passive range of motion, have the patient seated with their foot off the exam table. While stabilizing the lower leg, passively apply pressure to assess soft tissue mobility. Range of motion should always be compared bilaterally and any deficits should be noted. Normal motion for passive dorsiflexion is 10° to 15°, while normal passive plantar flexion is 50 to 70°. Normal passive inversion is approximately 40° and eversion is around 10°. Any pain during passive movement may indicate musculotendinous or ligamentous injury. Limitation of motion may be a result of pain, swelling, or scar tissue from a chronic injury. Finally, resistive range of motion should be tested to assess for any muscular weaknesses or injuries.

4. Test for stability of joint ⁸⁰

A) Talar Tilt Test

Description: The Talar Tilt test is a ligamentous stress test that examines the integrity of the lateral ankle ligaments, particularly the calcaneofibular ligament.

Maneuver: Have the patient in the seated position, with their knee bent and foot in a neutral or slightly dorsiflexed position. Stabilize the distal tibia with one hand while applying an inversion force to the foot.

Positive Findings: Positive findings include any pain in the ankle or increased joint laxity. Depending on the positioning of the ankle, pain may be experienced over either the calcaneofibular ligament or the anterior talofibular ligament.

B) Anterior Drawer test

Description: The anterior drawer test is used to examine the integrity of the anterior talofibular ligament, which is frequently injured during an inversion ankle sprain.

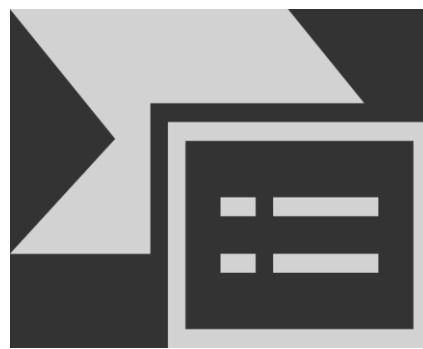
Maneuver: Have the patient seated with their knee bent and their ankle in a neutral position at 0° or 90° to the leg. Stabilize the distal tibia with one hand, while grasping the heel with the other hand. Apply an anterior force to the heel. This test should be performed bilaterally to compare for differences in anterior translation.

Tip: In order to gain a better feel for the translation of the foot in relation to the lower leg, the index finger can be placed behind the heel with the thumb over the front of the ankle. Also a firm, steady load during testing can be more sensitive than a higher, quick load.

Positive Findings: Pain or increased joint laxity in the injured ankle indicates disruption of the anterior talofibular ligament. A dimple may also be visually seen by the clinician while performing this test.



Talar tilt test (FIG – 7)



Anterior Drawer test (FIG – 8)

C) Stress test

- a) Stress test for *anterior talo-fibular* component of lateral ligament. Patient in prone position, press downwards on the heel, looking for anterior displacement of talus which is often accompanied by dimpling of skin on either side of the tendo-calcaneus.
- b) Stress test for *anterior tibio-fibular* ligament. Patient in supine position support the heel on the sand bag and press firmly downwards on the tibia for 30 seconds upto exposure. A gap between talus and tibia > 6mm is regarded as pathological.

c) Stress test for *inferior tibio-fibular* ligament tear – Tenderness is present over the ligament just along the line of the Ankle joint. Grasp the heel and try to move the talus directly laterally in the ankle mortise. Lateral displacement indicates tear of the ligaments.

D) Thompson’s Test

Description: This test is utilized to evaluate the integrity of the heel cord.

Maneuver: Have the patient lying prone on a table with their foot extended off the edge. Squeeze the calf muscle at position slightly distal to the place of widest girth. Examine the movement at the foot.

Positive Findings: A positive test occurs when the calf is squeezed and no plantar movement occurs at the foot. This indicates a heel cord rupture.

E) Compression Test

Description: This test examines the integrity of the distal tibiofibular joint. It can also assess for fractures of the tibia and fibula.

Maneuver: Have the patient sitting supine with their foot on the table. Grasp the mid-calf and squeeze the tibia and fibula together. Gradually move distally towards the ankle while continuing to apply the same amount of pressure.

Positive findings: Any pain in the lower leg may be indicative of a fracture or syndesmotic sprain.

F) External Rotation or Kleiger’s Test

Description: The test is used to help identify syndesmotic injuries.

Maneuver: Have the patient seated with their knee bent on the exam table. Stabilize the distal tibia while externally rotating the foot. External rotation of the talus applies pressure to the lateral malleolus, causing a widening of the tibia-fibular-joint.

Tip: The examiner may be able to feel the talus displace from the medial malleolus, which indicates there may be a disruption of the deltoid ligament.

Positive findings: Increased external rotation of the foot when compared bilaterally, or any pain in the anterolateral ankle joint is considered to be a positive finding.

G) a) Squeezing test

Indication = Instability of the Syndesmosis.

Method = involves squeezing the tibia and fibula together at the mid calf. If pain is experienced more distally or in the ankle, this is a positive test.

b). Interosseous membrane tenderness test: this also looks for syndesmosis injury. Position the patient supine. Palpate between the tibia and fibula from the ankle proximally. Note the length of tenderness.

ANKLE GONIOMETRY⁸¹

Goniometry is the measuring of angles created by the bones of the body at the joints, these are measured by goniometre. The goniometer has moving arm, stationary arm & the fulcrum. The fulcrum or body is placed over the joint being measured & on it is the scale 0 to 180 degree. The stationary part will be aligned with the inactive part of the joint measured, while the moving arm is placed on the joint which is moved in the joints motion.

Performing these tests is important for many reasons. First, the mobility of joints is important for diagnosis and determining the presence or absence of dysfunction. In chronic condition, goniometry can measure the progression of the disorder. An example of this is the progression of rheumatoid arthritis.

Further joint motion measurement can evaluate improvements or lack of progression during rehabilitation. This not only provides motivation for the patient when there are improvements, but also can decipher if modifications need to be made if the treatment is not effective.

Plantarflexion (FIG- 9)

Patient Instructions

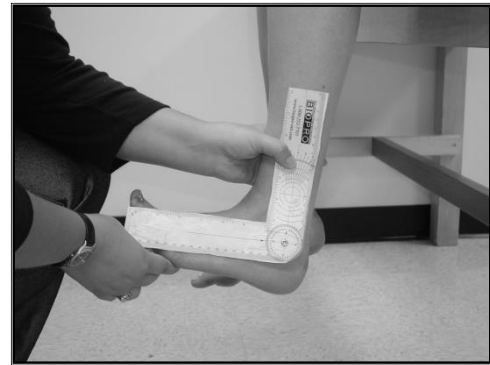
Ask the patient to point their foot down toward the ground.

Patient is sitting with legs off table.

Goniometer alignment is the same as for dorsiflexion.



Plantarflexion(FIG-9)



Dorsiflexion (FIG – 10)

Dorsiflexion (FIG-10)

Patient Instructions:

Ask the patient to bend the ankle and point their toes up towards the ceiling.

Patient is sitting position with legs off the table.

The fulcrum is aligned with the lateral malleolus.

The stationary arm is in line with the midline of the lower leg, use the head of the fibula for reference. The moving arm is parallel to the fifth metatarsal.

INVESTIGATIONS: ⁸²

Radiograph – Radiographic parameters for normal Ankle

- Talo crural angle = $83^{\circ} \pm 4^{\circ}$
- Medial clear space = $\leq 4\text{mm}$
- Tibio-fibular clear space = $< 6\text{mm}$
- Sub chondral bone line between distal tibia and medial surface of lateral malleolus should be continuous.

Ottawa Rules = X- ray in Ankle Sprain is required if –

The Ottawa Rules were introduced in 1992 to reduce the number of unnecessary X-rays, whilst at the same time minimizing the number of fractures missed.

- There is bony tenderness in posterior half of lower end of tibia and fibula.
- Tenderness over 5th metatarsal and navicular bones.
- Inability to bear weight immediately or 10 days after injury.

Radiographs:

- The gap between tibia and talus to talus and medial malleolus must be equal.
- The articular surface of tibia and talus should appear as two congruent circular discs.

- Anterior drawer test – done under local anesthesia, more than 4mm anterior shift of the talus.
- Talar tilt mortise – 5° - 10° tilt is partial tear and $> 10^{\circ}$ is complete tear.
- The mortise view is an AP view with the tibia internally rotated by 15° to 20° . This position allows evaluation of the syndesmosis and assessment of mortise disruption. In the mortise view, the talus should be equidistant from both malleoli.
- Direct lateral shift of talus accompanied by fracture of the fibula indicates tear of inferior tibio-fibular ligament associated with rupture of deltoid ligament.

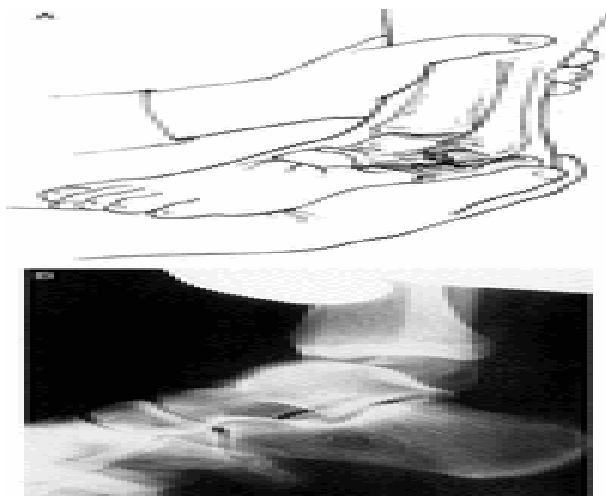


FIG 11 -Anterior-drawer stress test. A, schematic drawing,and B, radiograph.
(Copyright 2002 by the Hughston Sports Medicine Foundation, Inc).

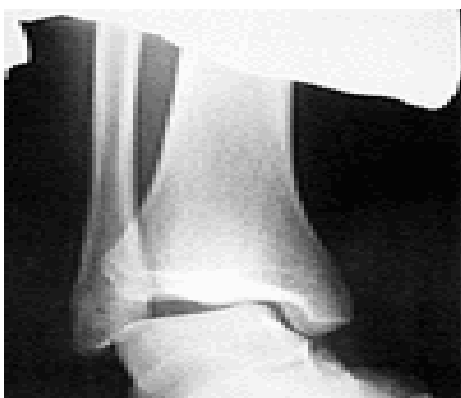


FIG 12 -Talar-tilt stress radiograph. (Copyright2002 by the Hughston Sports
Medicine Foundation, Inc).

Arthrography: For accurate diagnosis of ligament injuries, capsular and intra articular damage. In the ankle escape of dye into the peroneal sheath indicates complete tear of the calcaneo-fibular ligament. Spiegel and Stapes report large number of false negative result. Thus careful clinical examination remains the mainstay of diagnosis.

Arthroscopy: Its main value is in the later stage after the injury in the diagnosis of meniscus and other intra-articular lesions. In acute phase findings may be obscured by haemarthrosis.

DIFFERENTIAL DIAGNOSIS

1. Complete avulsion of the lateral ligament: Complete tear is suspected in violent inversion injury of the ankle joint. There is severe swelling, tenderness and ecchymosis. In a normal foot the lateral surface of the body of talus can be felt just in front of the lateral malleolus and remains in close contact with the malleolus even when the foot is inverted at the subtalar joint. On the other hand, if the lateral ligament is torn, inversion movement occurs at the ankle joint as well as at the subtalar joint. Sometimes it is possible to feel the talus tilt and move away from the malleolus as a well defined sulcus appears between the two bones, deep enough to admit the tip of the examiner's finger. Under regional or general anesthesia radiograph of ankle joint in full inversion is informative. In simple sprain the talus remains stable in the mortise. Increase in talar tilt of 5-15 degree denotes complete tear and 15-30 degree denotes disruption of anterior and middle fasciculi of lateral ligament, where as more than 30 degree in rupture of all three components of lateral ligament.

2. Recurrent subluxation of the ankle joint: Usually results from misdiagnosed and incorrectly managed avulsed lateral ligament. The main complaints are sensation of insecurity, giving way of joint, weakness, impossible to walk with narrow heeled shoes or on heel, uneven surface and have cautious gait. If the heel is forcibly inverted then a well defined sulcus in front of lateral malleolus is diagnostic.

3. Adduction fracture of the lateral malleolus: It may be traction injury of ankle, where fracture line is typically horizontal. As the malleolar fragment bears the attachment to lateral ligaments so causes lateral instability. Patient presents with pain,

gross swelling, and bony tenderness at the base of lateral malleolus with fracture gap when attempted gently. Usually it is avulsion type of fracture.

4. Recurrent sprain of inferior tibio-fibular joint: A partial tear of the anterior tibio-fibular ligament represents supination-external rotation failure and has a reputation to become chronic. It may be differentiated from more common anterior talo-fibular sprain by localization of the tenderness and pain over front of the Syndesmosis.

5. Dislocation of the ankle: This is rare and may be due to forced plantar flexion. There is usually dislocation of inferior tibio-fibular Syndesmosis and fibula may become trapped behind the tibia, diagnosed with the aid of x-ray.

6. Lateral foot fracture / Jones fracture: The same mechanism that causes an ankle sprain can sometimes cause a fifth metatarsal fracture in the foot. This is a fracture that occurs in the outer part of the foot along the long metatarsal bone. These sometimes can be confused with a routine ankle sprain. Typically, however, the pain will be more along the side of the foot than in the ankle area associated with bony tenderness.

7. Anterior ankle joint instability or footballer's ankle: The injury is often sustained by footballers while kicking the ball. There may be separation of capsular fibers from the neck of the talus resulting in traumatic subperiosteal ossification. Each time these patients stepped out the tibia slipped backwards on the body of the talus and then slide forward again as weight was taken off.

Prognosis⁸³ - In a systematic literature review, 36-85% of patients with acute ankle sprains reported full recovery at 2 weeks to 36 months, independent of the initial grade of sprain, with most recovery occurring within the first 6 months. After 12 months, the risk of recurrent ankle sprain returns to preinjury levels. However, 3-34% of patients reported re-sprains at 2 weeks to 96 months after the initial injury. Furthermore, after 3 years, some patients still had residual pain and instability. One risk factor for residual symptoms seems to be participation in competitive sports.

TREATMENT

“It is worse to Sprain an Ankle than to break it” by Watson – Jones. The implication is that Sprains are often neglected and inadequately treated.^{82a} Although ligament

ruptures will repair with conservative treatment provided there is adequate immobilization for sufficient period of time.

I) Management Of Partial Tear/Rupture:

Principle Method⁸⁴ – Conservative Management:

➤ **P- Painkillers/ Analgesics:**

➤ **R – Rest**, do not place weight on foot, if it is very tender. Avoid walking for long distance

➤ **I – Ice therapy**, Ice helps to decrease pain and swelling. Ice therapy is also known as *cryotherapy* or cold therapy. Do not apply ice directly to your skin for more than five minutes for 48 to 72 hours as it can cause burns. Cover the ankle with a wet towel and place a plastic bag full of ice over it. One or two pound package of frozen corn or peas makes an excellent ice pack. A device specially designed to cool foot, ankle and heel (*Polar Care Cub*) can be used for longer periods.

➤ **C- Compression bandage / Jones bandage** - A compressive dressing that applied around your ankle helps to relieve pain and improve function. A patented Air Cast ankle brace that not only provides ankle stability, but also helps to "milk" the fluid out of the ankle as one walks.

➤ **E – Elevate** the ankle above the level of heart to reduce the fluid in the after sprain.

1. Eversion stirrup- This is a strip of non adhesive strapping applied to the inner aspect of foot, then the plantar surface of the heel and the outer aspect of the lower leg, whilst the foot is held everted. Over this is applied a spiral of adhesive elastic bandaging from the base of the toes to the upper third of the calf, the foot being held at right angles. After two weeks this dressing may be removed and a firm crepe bandage worn until all symptoms have been relieved.

2. Local Hyaluronidase infiltration – Lettin has advocated local infiltration to the tender area with 1,500 units of hyaluronidase dissolved in 5 ml of normal saline. The ankle should then be bound with crepe bandage and early active movements with full weight bearing encouraged. Its use is valuable to reduce the pain.

Limitations of local cortisone – Electron microscopy shows that fibrocytes are destroyed, fibrils altered and abundant cortico-steroids crystals persist. These indicate the destruction action of cortisone on active repair tissue and confirm the clinical observation of weakness, sometimes rupture of ligaments after use of cortisone.

II) Management Of Complete Tear/Rupture:

Whether conservative or surgery- depends upon the factors like age, occupation athletic activity and the joint involved.

A) Conservative Management: Elderly, non athletes managed by lightly padded below-knee plaster cast applied with the foot at right angles to the leg, the heel being in the neutral position or slightly everted. It may be necessary to renew the cast after two weeks if loosening occurs and immobilization for not less than six weeks. It should be continued minimum for three weeks in non-weight bearing and six weeks in weight bearing joints. Ligament ruptures allowed to unite conservatively do so with the formation of large amount of fibrous tissue. The amount of scarring varies inversely with efficiency of immobilization.

B) Surgical Management:

Indications⁸²

1. Injuries associated with irreducible joint subluxation.
2. Ligament ruptures with suspected soft tissue interposition.
3. Complete rupture of lateral ligament in young athletes and whose arthrogram show escape of dye into the peroneal sheath. According to Watson-Jones reconstruction of both anterior and middle fasciculi of the lateral ligaments is advised. This is a complex procedure and instability is more.

Tendon Graft Procedure: *Evans* described simple procedure where the peroneus brevis tendon is detached from the muscle belly and threaded from in front backwards through an oblique hole drilled upwards and backwards in the lateral malleolus. The wound is closed and the foot is immobilized in the plaster for eight weeks. Weight bearing is permitted after the change of plaster at the second or third week. This procedure is simple and reliable.

Ligament Tightening Procedure: Chronic ankle instability can happen when the lateral ankle ligaments are stretched or torn and the ankle keeps giving way. Surgery can be done to tighten the stretched ligaments and improve the stability of the ankle. The surgery usually involves the anterior talo-fibular ligament and the calcaneo-fibular ligament.

In this procedure, an incision is made on the skin that lies over the lateral ligaments. These ligaments are cut into halves. Holes are drilled at lateral malleolus of fibula, The two ends of the cut ligament are overlapped and sewn together. The drill holes in the fibula are used to hold the sutures to the bone.

The *ankle retinaculum* holds the tendons in place. The upper edge of the retinaculum is pulled upwards and sewed it into the fibula. This helps to reinforce the reconstructed ligaments.

Late repair: Newer re-construction procedures as use of carbon filaments to replace tendon and ligament. These fibers appear to induce re-growth of the origin collagenous structure and merely act as the basic fabric for the ligaments.

Why should a sprained ligament produce so much trouble for so long after the initial injury? ^{82a}

The probable reason may be, ligament injuries are often regarded as trivial and are therefore imperfectly diagnose and incorrectly treated. Blind allegiance to x- ray is possibly one of the main causes for inadequate diagnosis.

Complications: ^{68c}

1. Adhesion formation - The formation of adhesions in and around a sprained ankle is minimized by preventing swelling with the use of supporting bandage, elevation of limb and early active exercise. If adhesions still develop, then there is pain on lateral side of joint, weakness and giving way.

It is sometimes helpful to raise the outer side of heel of the shoe by 1/8 inch (3mm), or to 'float out' the heel 3/8 inch (1cm), so as to broaden its outer side. Occasionally infiltrate the area with 25mg hydrocortisone acetate and 1,500 units of hyaluronidase made up in 5 ml of 1% lignocaine, this should be followed by the course of active exercise.

2. Joint instability - As a result of temporary loss of function in the proprioceptive nerve endings in the joint capsule. It is seen in 20-40 % of patients.

3. Recurrent Sprain - Due to instability of the joint and improper management.

4. Post traumatic arthritis - There is always some damage to synovial articular surfaces when ligament ruptures and responsible for late on set of arthritis.

REHABILITATION EXERCISES ⁸⁵

Every ligament injury needs rehabilitation. Otherwise sprained ankle might not heal completely and might re-injure. All ankle sprains, from mild to severe, require three phases of recovery:

- Phase I includes resting, protecting and reducing swelling of injured ankle.
- Phase II includes restoring ankle's flexibility, range of motion and strength.
- Phase III includes gradually returning to straight-ahead activity and doing maintenance exercises, followed later by more cutting sports such as tennis, basketball or football.

1. If there are no cast, soak the foot and ankle in warm water and move the foot and ankle in the water for 20 minutes two to three times a day as soon as pain allows, which is usually 3 days after the injury. Movement of the foot should be done in plantarflexion, dorsiflexion, inversion and eversion to prevent stiffness and to keep the muscles working.

2. Stretching exercises for the heel cord should be started as soon as pain allows. Stand about 18 inches away from the wall and push against it. The knee is kept straight and the heel should stay on the floor as you push your weight against the wall. (Fig 13)

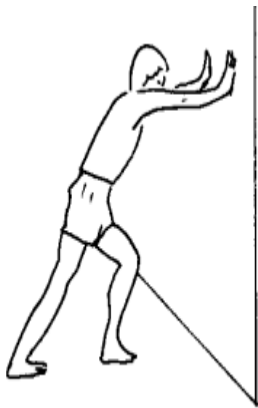
3. After 3 weeks, this exercise can be adopted. Use surgical tubing or an elastic belt or bicycle inner tube.

Work your ankle against resistance as shown, making sure all four groups of muscles are exercised. Pull up and outwards, up and inwards, straight up and push straight down against resistance, holding to a count of 5 seconds. Do sets of 10, three times a day. (Fig 14)

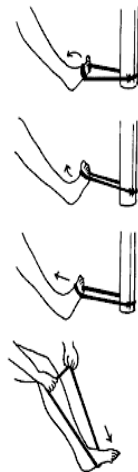
4. After regaining most of the strength in the ankle, one should attempt standing on the injured leg and then raise oneself on toes, holding oneself in that position for a count of 5 seconds. As one gains proficiency, practice doing it with eyes closed to train sense of balance. (Fig 15)

When one can perform all the above exercises with no difficulty, then they can begin jogging, then running, then figure-eights and other sports manouvers. When one can do these proficiently, they are ready to return to sports.

Rehabilitation Exercises



(FIG-13)



(FIG-14)



(FIG-15)

How to Stretch Ankle after a Sprain? ⁸⁶

Perform stretches in stages once the initial pain and swelling have receded, usually within five to seven days. First is restoration of ankle range of motion, which should begin when one can tolerate weight bearing.

Once ankle range of motion has been almost or completely restored, one must strengthen the ankle. Along with strengthening, you should work towards feeling of stability and comfort in the ankle, which Orthopaedic foot and ankle specialists call proprioception.

Consider these home exercises when recuperating from an ankle sprain, perform them twice per day.

While seated, bring the ankle and foot all the way up as much as one can. Do this slowly, while feeling a stretch in the calf. Hold this for a count of 10. Repeat 10 times (Fig 16). From the seated starting position, bring the ankle down and in. Hold this inverted position for a count of 10. Repeat 10 times (Fig 17).



FIG(16)



FIG(17)



Again from the starting position, bring the ankle up and out. Hold this everted position for a count of 10. Repeat 10 times. **FIG (18)**



From the starting position, point the toes down and hold this plantarflexed position for a count of 10. Repeat 10 times. **FIG (19)**



This stretch should be done only when the pain in the ankle has significantly subsided. While standing on the edge of a stair, drop the ankles down and hold this stretched position for a count of 10. Repeat 10 times. **FIG (20)**



Do this stretch only when the pain from the ankle sprain has significantly subsided. Stand 12 inches from a wall with the toes pointing toward the wall. Squat down and hold this position for a count of 10. Repeat 10 times. **FIG (21)**

How to Strengthen Your Ankle after a Sprain

Following an ankle sprain, strengthening exercises should be performed when weight bearing is comfortably and range of motion is near full. There are several types of strengthening exercises. The easiest to begin with are isometric exercises that are done by pushing against a fixed object with your ankle. Once this has been mastered, one can progress to isotonic exercises, which involve using the ankle's range of motion against some form of resistance. The photos below show isotonic exercises performed with a resistance band.



Place the ankle in the "down and in" position against a fixed object such as a couch. Hold this position for a count of 10. Repeat 10 times. **FIG (22)**



Place the ankle in the "up and out" position against the same object. Hold this position for a count of 10. Repeat 10 times. **FIG (23)**



Using a resistance band around the forefoot, hold the ends of the band in the hand and gently push the ankle down as far as one can and then back to the starting position. Repeat 10 times. **FIG (24)**



Tie the resistance bands around a fixed object and wrap the ends around the forefoot. Start with the foot pointing down and pull the ankle up as far as one can. Return to the starting position and cycle your ankle 10 times. **FIG (25)**



Tie the bands around an object to the outer side of the ankle. Start with the foot relaxed and then move the ankle down and in. Return to the relaxed position and repeat 10 times. **FIG (26)**



Tie the ends of the bands around an object to the inside of the ankle and hold the foot relaxed. Bring the foot up and out and then back to the resting position. Repeat 10 times. **FIG (27)**

Proprioceptive Exercises for Balance, Coordination and Agility

Once the motion and strength in the ankle is regained, sporting activities such as gentle jogging and biking can be implemented. After one feels the ankle strength is approximately 80% of other side, then one can begin cutting or twisting sports.



Stand with the affected leg on a pillow. Hold this position for a count of 10. Repeat 10 times. **FIG (28)**



Stand on affected leg with the resistance band applied to the unaffected leg. Bring unaffected leg forward and then back to the starting position. Repeat 10 times. Start slowly and progress to a faster speed for a more difficult workout. **FIG (29)**



Again, start slowly and increase the speed at own pace, moving the unaffected leg forward and then back to the starting position. **FIG (30)**



For a more advanced exercise, swing unaffected leg behind and then back. **FIG (31)**

Don'ts in Ankle Sprain:⁸⁷

- Avoid walking with poorly designed foot wears.
- Avoid walking on uneven surfaces such as beaches, trails and lawns.
- Avoid using the stairs, ladders, or any unprotected heights where one must balance on one foot.
- Avoid allowing the ankle to hang down below the knee as this may increase swelling and pain.

Do's in Ankle Sprain:

- Keep ankle elevated above heart level.
- Keep your ankle stable with an ice wrap.
- Keep the ankle cool with an ice bag, frozen vegetables (peas work best) to reduce swelling.
- After the swelling is reduced, do the exercises instructed to regain ankle stability.
- Wear proper fitting, well-constructed foot wears.
- Have a positive attitude. Remember that most people with acute ankle pain recover within 2-6 weeks.

Prevention of Ankle Sprain:⁸⁸

- Before and after exercising, stretch the calf muscles. Tight muscles pull on the Achilles tendon and can reduce the range of motion of the foot.
- Strengthen the ankles to avoid strains and to rehabilitate them if had an injury.
- Try heel walking, wear flat foot wears, stand on heels and keep the toes high off the ground, walk with toes elevated for three to five minutes.
- Follow a regular exercise programme. Sedentary people are more likely to suffer a sprain than those with strong muscles.
- For active sports, most studies suggest wearing snugly laced, high-topped shoes that are protective - not floppy canvas high-tops, but the padded flexible kind worn by basketball players.
- Avoid platform soles, high heels and any shoes that throw the foot off balance. Open shoes and most sandals, which are less stable than other foot gear, are a poor choice for those trying to avoid ankle injury.
- A healthy diet helps keep muscles strong.

SKIN

The skin is the largest organ of the body, both in surface area and weight. It has a surface area of 1.8 m² and makes up approximately 16% of body weight i.e. 4.5 – 5 kg. Its thickness ranges from 0.5 mm on eye lids to 4 mm on heels. However over most of the body, it is 0.7– 3 mm thick.⁸⁹

More important, is that **the skin is a window through which the physician can "see" the entire body.**

The skin is often referred to as the "**Integumentary system**" is composed of epithelial, mesenchymal, glandular and neurovascular components. Specifically, the Integumentary system consists of the skin and its derivatives such as: sweat glands, sebaceous glands, nails, hair and erector pili muscles. The system also includes mammary glands and the teeth. ***The skin is divided into three main functional areas:***

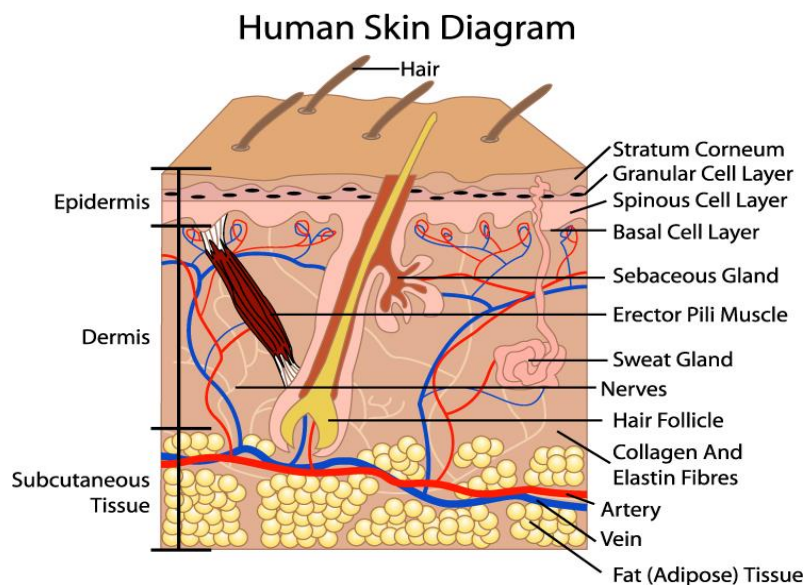
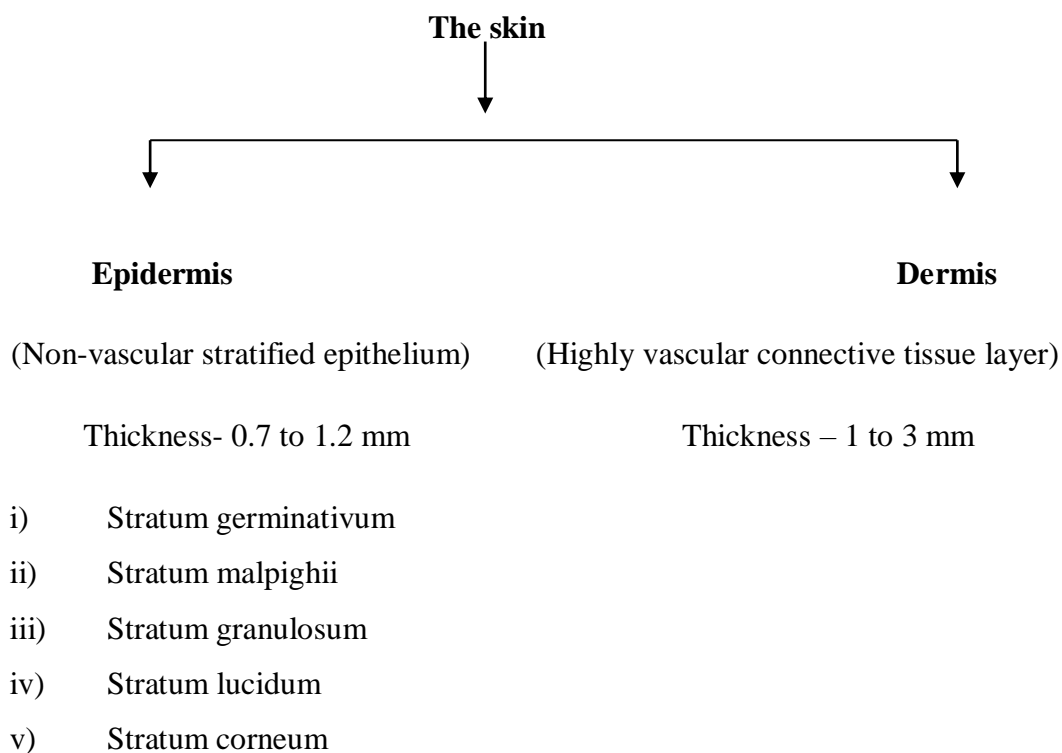


FIG - 32

1. **Epidermis:** the major protective layer derived from **ectoderm**.
2. **Dermis:** the major supportive layer derived from **mesoderm**.
3. **Skin Appendages:** cells derived from both **ectoderm** and **mesoderm**:
 - Eccrine Sweat Gland
 - Apocrine Sweat Gland
 - Sebaceous Gland
 - Hair Follicles
 - Nails

The skin is composed of 2 layers of distinctive structures, the epidermis and dermis. The epidermis and epithelial layer is derived from the ectoderm, underneath the dermis, a connective tissue layer of mesodermal origin. Deep to the dermis lies a layer of loose connective tissue forming the subcutaneous layer. It is in turn bond to the underlying tissue by a dense fibrous deep fascia.

The epidermis is highly impermeable to water and rather inert to chemicals. It has got high capacity for regeneration after damage and continuously replaces the entire dead cells as they are abraded from the surface. The epidermis also generates the appendages of the skin through hairs, nails, sebaceous glands, while the dermis gives the mechanical strength to the skin by the presence of higher proportion of collagen fibers. It provides a reservoir of defensive and degenerative elements capable of facing infection and repairing deep wounds. The interference between the dermis and epidermis shows a complex topology being marked by socket or ridge/groove in each digit between the lines. Such 2 layers confer special properties on the skin as a whole.



Physiology: ⁷⁸ Skin serves several functions, which are as follows:

- (1) **Thermoregulation:-** The haemostatic regulation of the body temperature is in two ways response to high environmental temperature or physical exercise is by the evaporation of sweat from skin and response to low environmental temperature is by production of sweat, this helps to conserve the heat loss during the flow of blood to skin in turn helping in regulation of body temperature.
- (2) **Protection:-** The skin, covers the body, provides physical barrier that protects the underlying tissues from physical abrasions, various infections, dehydration and ultraviolet radiation. Hairs and nails also have protective function.

- (3) **Cutaneous sensation:-** The skin contains abundant nerve ending and receptors that detect and get stimulated by temperature, touch and pain.
- (4) **Excretion and absorption:-** Besides removing heat and some water from body, sweat is also a vehicle for loss of small quantity of ions and several organic compounds. The absorption of fat soluble vitamins (ADEK) and certain drugs occur through skin.
- (5) **Immunity:** - Certain cells of epidermis are important components of the immune system that destroys the foreign invaders.
- (6) **Blood reservoir:** - The dermis is a house to extensive network of blood vessels that carry 8-10% of total blood flow in a resting adult. During moderate exercise, blood flow to the skin increases and helps to dissipate heat from the body. During strenuous exercise, however blood vessels of skin constrict so as to allow more blood supply for contracting muscles.
- (7) **Vitamin D synthesis:** - Vitamin D is a group of closely related compounds. Synthesis of Vitamin D begins with activation of the precursors (molecules) in the skin by UV rays present in sunlight. Enzymes in liver and kidney then modify the molecule, finally producing Calcitriol the most active form of vitamin D. Calcitriol contributes to the homeostasis of body fluids by aiding absorption of calcium from food and from digestive tract into blood. Thus, Vitamin D is a hormone, since it is produced in one location in the body, transported by blood and then exerts its effect in another location. For this reason, the skin can be considered as an endocrine organ.
- (8) **Has a cosmetic association:-** Due to its colour, complexion, luster etc skin is having a unique cosmetic effect than any other organ in the body.

TOPICAL APPLICATION

Definition: ⁹⁰ Topical drug administration's refer to external application of the drug to the surface for localized action. The choice of appropriate route in a given situation depends both on the drug as well as patient related factors.

Routes of Drug Administration: ⁹¹

1. Enteral route – oral administration
2. Parenteral route – other than oral
3. Topical route – local application

The permeability of the skin to drugs depends on the drug itself in particular to its liposolubility and on the vehicle in which the drug is introduced.

Parameters for resorption:

1. Localization: It is low at the level of sole and palm, while high at armpits, angle of jaw and scrotum.

2. Temperature and Cutaneous circulation: If the temperature is high there is vasodilatation which facilitates absorption.

3. State of skin: Extensive lesions such as burns, eczema etc increases the absorption.

4. Age: It decreases with age.

Topical application is often more convenient as well as encouraging to the patients. It is presumed that the drug would penetrate to the subjacent tissues attaining high concentrations in the affected muscles, joints while maintaining low blood levels. Consequently the gastro-intestinal and other systemic adverse effects would be minimized and first pass hepatic metabolism would also be avoided. Drugs can be efficiently delivered to the localized lesions on skin, oropharangeal, nasal mucosa, eye, ear canal etc in form of lotion, ointment, drops cream, spray etc. Measurement of drug concentration attained in tissues underlying the site of application as well as concurrent blood levels has shown that systemic absorption from topical NSAID preparations is slow taking ten times longer time to attain peak concentration compared to oral dosing. Higher blood levels remain below 15% of the same dose given orally. This is consistent with their lack of systemic toxicity. Local concentration up to a depth of 4-6mm i.e in the dermis, but at 25mm depth in muscles. The concentration is low or nearly the same as in blood. Marked variation has been noted in the concentration attained in muscles and in joints depending on the type of formulation, depth and distance from site of application as well as among different individuals. Better responses have generally been obtained in short lasting musculoskeletal pain.^{90a}

Choice of Non Steroidal Anti Inflammatory Drug

No single drug is superior to all others for every patient. Choice of drug is inescapably empirical. Many NASIDs have been marketed in topical formulations for application over painful muscles or joints. These preparations are being used for osteoarthritis, sprain, sports injuries, tenosinovitis, backache, spondylitis and other

forms of soft tissue rheumatism. Selection of NSAID depends on the cause and nature of pain (mild, moderate or severe; acute or chronic; ratio of pain; inflammation) along with consideration of risk factors in the given patient (age, concurrent disease, drug history, history of allergy) govern selection of analgesic. Also to be considered are the past experience of the patient, acceptability and individual preference. If one NSAID is unsatisfactory does not mean that other NSAID will also be unsatisfactory.^{90a}

DRUG REVIEW

There are large numbers of medicinal preparations mentioned by Sushruta for the management of bone injuries. In the present study the medicaments mentioned in Sushruta Samhita Chikitsa Sthana 3rd chapter is selected, where in the Parisheka and Lepa has been mentioned for external use over site of swelling. For Parisheka Nyagrodadhi Gana or Panchamoolaksheerapaka is advised while for Lepa, Manjisthadi is explained.^{52c,d} As per allied science PRICE (pain killer, rest, ice pack, compression and elevation) is the principle of management.

- Yogaratnakara has also mentioned Nyagrodadhi Gana and Manjisthadi Lepa in Sandhi–Bhagna Vrana Nidana and Chikitsa Prakarana.^{55b,c}
- Bhavaprakash has also mentioned Nyagrodadhi Gana and Manjisthadi Lepa in Bhagnadhikara same as that of Sushruta.^{56a,b}
- Acharya Cakradatta has described about Manjisthadi Lepa and Nyagrodadhi Gana for Parisheka in Bhagna Chikitsa.⁹²
- Acharya Vagbhata in Astanga Sangraha in Bhanga Pratisheda Prakaran explained about Nyagrodadhi Gana Parisheka.^{54b}
- Acharya Vagbhata in Astanga Hrdayam in Bhanga Pratisheda Prakaran explained about Nyagrodadhi Gana Parisheka.^{53b}

The drug used for Parisheka is Udumbara (*Ficus racemosa* Linn)

The ingredients of Manjisthadi Lepa are as follows.⁹³

- Manjistha (*Rubia cordifolia* Linn)
- Yashtimadhu (*Glycyrrhiza glabra* Linn)
- Rakta-Chandana (*Pterocarpus santalinus* Linn)
- Shali-Pishti (*Oryza sativa*)
- Shatadhauta Ghrita (hundred times processed Ghee).

Each of these drugs is being described here in brief.

UDUMBARA^{93a}

Latin name: – Ficus racemosa Linn

Family: – Moraceae

Synonyms:

Sanskrit: – Sweta valkala, Hemadugdha,
Sadaphala, Jantuphala, Apushpa

Hindi: – Umbar, gular

Kannada: – Atti

English: – Cluster fig

Classical Categorization:

- **Sushruta** – Nyagrodhadi gana
- **Charaka** – Mutrasangrahaniya, Kashaya Skanda
- **Vagbhata** – Nyagrodhadi

Habitat: – throughout India along hill streams

Morphology: – moderate to large deciduous tree of 10 – 20 meter in height

- **Bark** - smooth & reddish grey
- **Fruit** – 3.5 to 5cm long, red when ripe
- **Leaves**– simple alternate petiolate
- **Part used** - Bark, Fruit Latex, (Milk)

Chemical Constituents: – **Fruit & leaves** – gluacol

Fruits-Beta-sitosterol, lupeol acetate, friedelin, phytosterol

Bark - Beta-sitosterol, lupeol, friedelin, ceryl, behenate

Guna-Karma:

- **Rasa:** – Madhura, Kashaya
- **Guna:** – Guru, Ruksha
- **Veerya:** – Sheeta
- **Vipaka:** – Katu
- **Dosha Karma:** – Pitta-Kapha Shamaka
- **Karma:** – Vrana Ropana- Shodhana, Varnya
- **Dosage:** – Churna: 3-6gms, Kwatha:- 50-100ml



FIG 33

Uses:

- bark boiled in human milk relieves Atyagni.
- Udumbara Ksheera is used externally in Prameha Pidika.
- Udumbara Twaka Bhasma mixed with Madhu & Ghruta is used in Hikka.
- Juice of Udumbara Phala with Madhu is used in Rakta Pradara.

Research showed: - aqueous extract of bark reduces blood sugar (Shrotri & Aiman,1960). Alcoholic extract of stem bark possessed anti protozoal activity against E-hystolytica(Dhar et. al 1968).

MANJISTHA^{93b}

Latin name: - Rubia cordifolia Linn,
R. manjistha, R. secunda.

Family: - Rubiaceae

Synonyms: -

Sanskrit: - Yojanavalli, Samanga, Vastraranjini,
Raktanga, Kalameshika, Rasayani and
Madhukaparni



FIG 34

Marathi:- Manjista

Kannada:- Chitravalli.

English: Indian Madder, Dyer's Madder.

Classical Categorization:

- **Caraka** – Jwarahara, Varnya, Visaghna
- **Sushruta** – Priyangvadi, Pittasamsamana
- **Vagbhata** – Priyangvadi

Morphology: –This is a climbing plant growing in the north- Himalayas

- **Stem** – Long, rough, grooved
- **Leaves** – In whorls of 4, ovate lower leaves are larger than upper
- **Flowers** – Glabrous, tubular and 5 lobed
- **Fruit** – 4-6mm in diameter, purplish black when ripen
- **Pushpakala** – Sharat Rutu

- **Phala kala** – Shishira Rutu
- **Useful part** – Root, stem

Guna & Karma:

- **Rasa** – Madhura, Tikata, Kashaya
- **Guna** – Guru, Ruksha
- **Veerya** – Ushna
- **Vipaka** – Katu
- **Doshagnata** – Kapha-Pitta Shamaka
- **Karmas** – Varnya, Swarya, Vishghna, Raktashodaka, Mootra Visarjaniya.

Bahya Karma: – Shotahara, Vrana Ropana, & Kushtagna.

Chemical Constituents:

Roots contain resinous matter, gum, sugar, coloring matter and salts of lime. Coloring matter consists of a red crystalline principle - purpurin a yellow principle glucoside - Manjistin, garancin, alizarin (orange - red) and xanthine (yellow).

Action: Plant roots have anti-inflammatory, antiseptic, antihelminthic, emmenagogue, anodyne and diuretic property. It inhibits the lipoxygenase enzyme pathway and production of cumene hydro-peroxides. The lipoxygenase pathway catalyses the production of various inflammatory mediators. Studies have shown anti-bacterial activity.

Uses: Dried root was much used in dropsy, paralysis, jaundice, amenorrhea and visceral obstructions. The decoction tinges the blood, urine and even the bones red. A paste made by rubbing up the roots with honey is a valuable application for freckles and other discoloration of the skin, also in external inflammations, ulcers, skin diseases, pruritis, burns and slow healing of broken bones.

YASHTIMADHU^{93c}**Latin name:** – Glycyrrhiza glabra Linn**Family:** – Fabaceae**Sanskrit:** – Klitaka, Madhuka, Madhuyasti**Hindi:** – Mulethi**Kannada:** - Jethamaddu**English:** – Sweetwood, liquorice**FIG 35****Classical Categorization:**

➤ **Caraka** – Jivaniya, Sandhaniya, Sonitasthapana, Kandughna Snehopaga, Vamanopaga, Asthapanopaga, Purishavirajaneeya, Dahaprashamana, Varnya, Kanthya.

➤ **Sushruta** – Kakolyadi, Sarivadi, Vachadi, Anjanadi, Utpaladi, Nyagrodhadi.

➤ **Vagbhata** – Sarivadi, Anjanadi,

Habitate: – Arabia, Persia, Asia- minor and in Punjab, Sub - Himalayan tracts.

Morphology: – It's an herb of 2- 4 feet height.

➤ **Leaves** – Leaflets small in 4-7 pairs, ovate-lanceolate and smooth

➤ **Flowers** – Axillary spikes, lavender–violet in colour (seen in March)

➤ **Fruits** – Pods, compressed (seen in August)

➤ **Useful Part** – Root

➤ **Dosage** – Moola Churna = 1- 4 Masha

Chemical constituents: –It is having whitish, sweet factor – Glycyrrhizin 5-10% present. In this Glycyrrhizic acid, potassium and salts are present. Sugar 5-10%, Starch- 30% Fats, Gum, Asparagin- 1%.

Researches showed: Glycyrrhizin showed anti-arthritic and anti-inflammatory effect on formaldehyde – induced rat paw edema. (Gujral et al, 1961a)

1. The anti-inflammatory activity of Glycyrrhetic acid and its diacetate were similar to that of hydrocortisone. (Tangri et al, 1964)

2. The anti-inflammatory response of Glycyrrhiza glabra was found to be equivalent to that of oxyphenbutazone. It appeared to possess a more potent anti-pyretic and anti-exudative activity in comparison to oxyphenbutazone. (Saxema et al, 1970)

Guna-Karma:

- **Rasa** – Madhura
- **Guna** – Guru, Snigdha
- **Veerya** – Sheeta
- **Vipaka** – Madhura
- **Dosha-karma** – Tridosha Shamaka
- **Karma** – Snehana, Balya, Vrishya, Rasayana, Shothahara, Vranaropaka, Keshya, Dahashamaka.

In Sushruta Samhita in '*Sarvopaghata Shamaniya*' yoga this drug is included. So in all types of Abhigata this can be given. Along with the Ghrita, Yashtimadhu Kalka Prayoga is done over Abhigataja Vrana. It is also used in cleaning the wound as paste of Madhuka with Nimba to be applied. While paste of Madhuka and Tila mixed with Ghrita is helping for wound healing. By applying paste of Yashtimadhu with Ksheera and Navaneeta helps in the reduction of Shotha. Yashtimadhu Kalka with Ghrita is used in Burns.

SHALI^{93d}

Latin name: – Oryza sativa

Family: – Gramineae

Synonyms: Sanskrit – Shali

Hindi – Chaval

Kannada – Akki

English – Rice

Habit: – It's an aquatic, annual herb.

Stem is cylindrical and yellowish.



FIG 36

Shali types:

Bhavaprakash has classified Shali as of 4 types.

- | | |
|--|--|
| 1) Shali (Hemant rutu- Phala pakwa) | 2) Rakta - Shali |
| 3) Vrihi (One year crop) | 4) Shashtika - Shali (60 days crop) |

Part used: – Grain, spirit and vinegar.

Chemical constituents:

Rice contains more starch, small amount of fat, proteins and a trace of mineral matter. Of the total protein 5 p.c present in rice, globulin is 0.14, Albumin 0.04 and the remainder is just like a protein Glutenin.

Guna-Karma:

- **Rasa** – Madhura, Kasha
- **Guna** – Laghu, Snigdha
- **Veerya** – Sheeta
- **Vipaka** – Madhura
- **Dosha karma** – Vata - Pitta Prashamana. Alpa kaphakara
- **Karma** – Balya, Ruchya, Swarya, Vrishya, Brimhana, Mootrala

Uses: –Poultice of the rice with curd from which excess of water is removed applied comfortably hot, four times a day gives ample relief in abscesses, by diminishing its pain and burning sensation, by diminishing the thickness of the base. The rice poultice requires changing twice or even thrice daily. It is an excellent application to abscesses, boils, ulcers and other local inflammatory affections.

RAKTACHANDANA^{93e}

Latin name: – Pterocarpus santalinus Linn

Family: – Fabaceae

Synonyms:

Sanskrit: – Raktanga, Lohita, Raktasara, Ranjana,
Raktavrksa, Tilaparna, Asukla Candana.

Hindi: – Lal candana

Kannada: – Honne

English: – Red sandal wood

Classical Categorization:

- **Sushruta** – Patoladi, Sarivadi, Priyangvadadi

Habitat: – Its natural habitat of dry hills of southern India



FIG37

Morphology: – It's a tree of 15-30 feet height

- **Stem:** - Bark-blackish gray colored, on deep cut reddish colored liquid oozes out.
- **Leaves:** - pinnately compound with 3-5 leaflets
- **Heartwood** – greyish outside, blackish red inside
- **Fruits** – 6-9cms long
- **Flowers** – Yellow in colour
- **Part used** – Heart wood - Santalum rubrum (Kashta), Oil(Taila)

Chemical Constituents: –Santalin or Santalic acid, a crystalline red principle, Santal pterocarpin, a white crystalline insoluble substance, homoterocarpin with the same general properties, but more soluble in carbon bisulphide, glucoside and coloring matter. Alcohol extract showed protection against electric shock (ED₅₀ 1.0g/kg)

Guna-Karma:

- **Rasa** – Tikta, Madhura
- **Guna** – Guru, Ruksha
- **Veerya** – Sheeta
- **Vipaka** – Katu
- **Dosha karma** – Pittahara, Pitta-Kapha Shamaka
- **Karma** – Dahaprashamaka, Jwaraghna, Rakta-Pitta Shamaka, and Shothahara, Varnya, Bhrama, Visha

- **Dosage** – Kashata Churna: 1-2gms, Kandasara Churna: 2-5 gms.

Uses: - Paste of Raktachandana along with Manjistha is used as Lepa in Bhagna. Raktachandana, Manjistha, Lodhra, Vata paste is used in Youvanapidika.

SHATADHAUTA-GHRITA⁹⁴

Ingredients: Goghrita.

Method of preparation: Pure cow's ghee taken in big bronze plate and cold water should be poured above the level of ghee. It should be rubbed vigorously for a few minutes. When the water becomes slightly warm, it is replaced by fresh cold water. This method is repeated for 100 times. Such a processed ghee is called "**Shatadhauta Ghrita**".

However Ghrita is Laghu, but in a short amount of time, it is disintegrated & assimilated by virtue of 100 times washing, at certain height 3 feet sterile cool water poured over ghee. Because of this Ghrita attains readily the absorbability, either by internal or by external application. Both these agreeability presumed both at the mucosa of G.I.T. & at the cellular level. So this preparation is introduced into the text mostly for acute conditions where a tissue repair is needed. So it can be indicated in Bhagna, Urahakshata, Dagdha Vrana, Netrabhishyanda, Arbuda etc.

Guna-Karma:

- **Rasa** – Shadrasa
- **Guna** – Laghu
- **Veerya** – Sheeta
- **Vipaka** – Madhura
- **Doshakarma** – Pitta-Vata hara
- **Karma** – Deepana, Rasayana, Deerghamayusyakaram



FIG 38

Table No. 13:-⁹³ Properties of ingredients of Trail group (Udumbara & Manjisthadi Lepa)

Drugs	Rasa	Guna	Veerya	Vipaka	Doshagnata
Udumbara	Madhura, kashaya	Guru, Ruksha	Sheeta	Katu	Pitta-Kapha Shamaka
Manjistha	Madhura, Kashaya, Tikta	Guru, Ruksha	Ushna	Katu	Kapha-Pitta Shamaka
Yasthimadhu	Madhura	Guru	Sheeta	Madhura	Tridosha Shamaka
Raktachandana	Madhura	Guru	Sheeta	Katu	Pitta-Kapha Shamaka
Shalipishti	Madhura, Kashaya	Snigdha	Sheeta	Madhura	Vata - Pitta Prashamana
Shatadhauta Ghrita	Shadrasa	Laghu, Snigdha	Sheeta	Madhura	Pitta-Vata hara

To summarize according to **Rasa** all the ingredients are Madhurarasatmaka, with three drugs having Kashaya Rasa and one having Tikta Rasa, while Ghrita being Shadrasatmaka. This shows that the drugs are mainly helping to conciliate Pitta, Rakta and Vata, thus is acting as Shotahara and Vedanashamaka.

According to **Veerya** almost all i.e four drugs are Sheetata Veeryatmaka which acts as Pitta and Rakta Shamaka. Manjistha being Ushna Veerya help to subside Vata and Kapha indirectly acts as Vedanashamaka.

According to **Vipaka** three drugs are having Madhura Vipaka and three are Katu. This shows their Pitta and Raktha Shamaka action.

Based on the **Guna** they are Guru, Snigdha Guna Pradhana which pacifies Vata, while Ruksha and Laghu pacifies Kapha. Thus in total the *Manjisthadi Lepa* is *Tridosha Shamaka*.



FIG 39

Udumbara Kwatha Churna



FIG 40

Jala with Udumbara Kwatha Churna



FIG 41

Boiling Udumbara Kwatha



FIG 42

Filtering of Udumbara Kwatha



FIG- 43

Prepared Udumbara Kwatha



MANJISTHA



YASTHIMADHU



RAKTACHADANA



SHATADHOUTA GHRITA



SHALI PISHTI



PREPARED MANJISTHADI LEPA

FIG 44

JALA - WATER

Without water there would have been no life. For this reason, in early times habitation used to be near rivers, lakes and springs. Water constitutes nearly two third of the total weight of the body, 79% of blood, 80% of brain and muscles and 10% even of bones.⁹⁵

It is one among the panchamahabhuta. Adi Sankaracharya said, the water comes from the heavens and gets collected in the form of sea on the earth. Acharya Caraka considered Jala as the base for taste.⁹⁶

Definition:⁹⁷

Rain water is fit for drinking, which is having no taste, having qualities of nector, gives life, satisfaction, quenches the thirst, pacifies the tiredness, exhaustion, intoxication, unconsciousness, drowsiness, sleep and burning sensation.

Synonyms: - Amruta, Peya, Jala.

Sources of water:^{96a} Water is primarily derived from ocean. In tropical regions, evaporation of water into air is about 700 gollons (3182.20 lts) per minute per square mile of ocean surface. Water reaches earth again in the form of rain, hail, snow dew or moist, from water vapours in the atmosphere, derived mainly from evaporation of the sea, from lakes, rivers and other waters of the land.

Chief source of water supply:

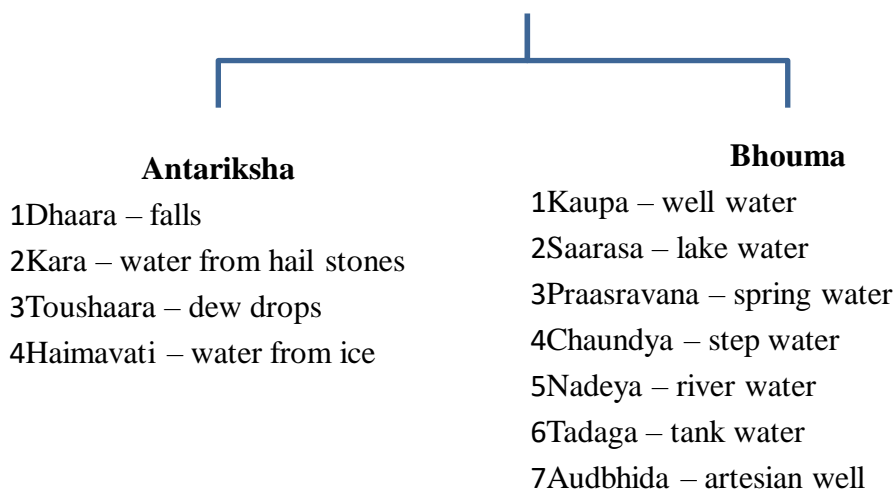
1. Rain water or snow water and artificial lakes.
2. Surface water i.e. streams, canals, rivers, tanks and ponds
3. Upland surface water and lakes
4. Ground water i.e. wells and springs
5. Sea water

Classification:^{97a} According to Acharya Sushruta- mainly two types

According to Acharya Charaka^{97b}

The entire water is only of one type, that which falls from the sky in the form of rain as directed by Indra, that is Antariksha or Aindra Jala.

Jala



Qualities of Antariksha Jala/ Divya Jala/ Aindra Jala: ^{97c}

Rain water is purest form of water which is cold, pure, beneficial, tasty, clear and light by nature.

Qualities of potable water: ^{97d}

Water which is devoid of smell, taste, pacifies thirst, unsoiled, cold, light and good for heart is known as wholesome water.

Criteria for water quality: ^{97e}

I. Physical qualities of water:

1. **Turbidity** - Free from turbidity. Jacksons candle turbidimeter is used to measure. Permissible limit – less than 5 units NTU (Nephelometric Turbidity Units).
2. **Colour** - Free from colour. Colorimeter is used to measure. Permissible limit is less than 5 units TUC (True colour units).
3. **Odour** - No disagreeable odour.
4. **Taste** - Palatable and free from disagreeable odour.

II. Chemical qualities:

1. **Chlorides** - Standard chloride level is 200mg/lit and maximum permissible level is 6000mg/lit.
2. **Hardness** - Should not exceed 300mg/lit.
3. **Free and saline ammonia** - Excellent indicator of sewage contamination

of recent origin, should not exceed 0.02mg/lt.

4. **Albuminoid ammonia** - Measure of decomposable organic matter, should not exceed 0.1mg/lt.
5. **Nitrites** - Pollution of recent origin except in case of deep wells, zero level in potable water.
6. **Nitrates** - Indicates old contamination, it should not exceed 1mg/lt.
7. **Oxygen absorbed** - Approximate test for amount of organic matter present. Oxygen absorbed at 37⁰ C in 3 hours should not be more than 1mg/lt.
8. **Microbiological quality** - E.coli, faecal streptococci, Clostridium perfringens, Entamoeba histolytica and helminths should not be present in drinking water.
9. **Dissolved oxygen** - Not less than 5mg/lt.
10. **Toxic substances** - Arsenic, cadmium, cyanide, lead, mercury, selenium should be within permissible limits.

III. Microbiological standards:

1. Coliform organisms and E. Coli
2. Faecal streptococci
3. Clostridium perfringens presence indicate faecal contamination.
International standards for drinking water relate five quality variables.
 - a) Microbiological pollutants.
 - b) Toxic substances.
 - c) Specific substances that may effect health.
 - d) Characteristics affecting acceptabilityof water.
 - e) Radioactive substances.

Microbiological

1. Through any year 95% of samples should not contain any Coliform organisms in 100 ml.
2. No sample should contain E coli in 100 ml.
3. No sample should contain more than 3 coliform organisms per 100 ml.
4. Coliform organisms should not be detectable in 100 ml of any two consecutive sample.

Water is an essential ingredient in our life. We can live on water alone for days , weeks and even months. The properties of water are extensive and that it is very

important to life, which is obvious from the fact that more than 3/4th is covered by water alone. The fresh morning air and bath in refreshing cool waters of the river invigorated the bodies and minds of people. Bathing in rivers served the purpose of having hip bath, sitz bath and all other benefits of hydrotherapy put in one. The soles, feet, palms and hands contain the maximum nerve endings of the body which when stimulated bring healing effect. When we walk fast the blood circulation becomes brisk and the body's heat increases. After a sudden halt due to heat produced in that process, the legs become tired and when cold water is poured over them, sudden coolness relaxes the blood vessels and the circulation gets back to normal. The stimulation effect of cold water also relieves the congestion of the blood vessels.

The effect and reaction of water is quicker than that of the drugs in acute diseases and in symptoms of majority of other disorders. Water action on body is to mitigate internal congestion, reduce inflammation and relieve pain, stimulate circulation, encourage elimination of toxins present in the system and lower or raise the temperature of the body.

Water is used for treating disorders in the form of solid, liquid and vapour, either hot or cold. It consists of baths, fomentations, sponges, compresses and sprays. Hot applications are useful in relieving internal and deep congestions, while cold applications are useful in reducing swelling and superficial congestions.⁹⁸



FIG 45
Dhara patra



FIG 46
Dhara patra jala

Table No - 14: Chemical constituents of water

Sl.No	Chemical	Upper limit of concentration
1.	Fluorides	0.5 – 0.8 mg/lt
2.	Arsenic	0.05 mg/lt
3.	Cadmium	0.005 mg/lt
4.	Cyanide	0.05 mg/lt
5.	Lead	0.05 mg/lt
6.	Mercury	0.001 mg/lt
7.	Selenium	0.01 mg/lt
8.	pH range	7 – 8.5
9.	Total solids	500 mg/lt
10.	Total hardness	2 m Eq/lt
11.	Iron	0.1 mg/lt
12.	Manganese	0.05 mg/lt
13.	Copper	0.05 mg/lt
14.	Zinc	5 mg/lt
15.	Calcium	75 mg/lt
16.	Magnesium	30 mg/lt
17.	Sulphate	200 mg/lt
18.	Chloride	200 mg/lt
19.	Phenolic substances	0.001 mg/lt
20.	Gross α activity	3 pCi/l
21.	Gross β activity	30 pCi/l

DICLOFENAC GEL

Diclofenac sodium is a white to slightly yellow crystalline powder. Diclofenac sodium is a benzene–acetic acid derivative. The chemical name is 2-[(2, 6-dichlorophenyl) –amino] benzeneacetic acid, monosodium salt. The molecular weight is 318.14. Its molecular formula is $C_{14}H_{10}Cl_2NNaO_2$. It has the following structural formula:⁹⁹

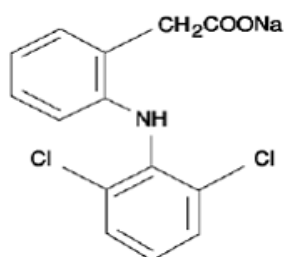


FIG 47

Diclofenac is a medicine called as non-steroidal anti-inflammatory drug. It is often referred to simply as 'an anti-inflammatory', or as an 'NSAID'. It works by preventing the production of some chemicals in your body which cause pain and inflammation.

Mode of action:^{90a}

Diclofenac is rapidly absorbed from the gastro intestinal tract and accumulates in the synovial fluid. Diclofenac is a potent inhibitor of COX-2 (cyclooxygenase) and prostaglandin synthesis, hence is an analgesic, anti-inflammatory and antipyretic agent. It has got good tissue penetration and concentration in synovial fluid is maintained for three times longer period than in plasma. It is used in the management of chronic inflammatory conditions such as rheumatoid arthritis, osteoarthritis and musculoskeletal pain.

Topical application is presumed to penetrate the subjacent tissues attaining high concentration in the affected muscles/joints, while maintaining low blood levels. The gastro-intestinal and other adverse effects with first pass metabolism would also be avoided.

Measurement of drug concentration attained in tissues underlying the site of application, as well as concurrent blood levels, shown that systemic absorption from

topical NSAID preparation is slow taking, 10 times longer time to attain peak concentration compared to oral dosing. Highest blood levels remain below 15% with their lack of systemic toxicity. Local concentrations are high up to a depth of 4-6mm in dermis but at 25mm depth in muscles. Marked variation has been noted in the concentration attained in muscles, joints depending on the type of formulation, depth and distance from the site of application as well as among different individuals. Better responses have been obtained in short lasting musculoskeletal pain.

Indications: ⁹⁹

Diclofenac sodium gel is indicated for the relief of injury associated acute short lasting pain, musculoskeletal pain of osteoarthritis of joints, such as the knees and those of the hands.

Contraindication:

Diclofenac sodium gel should not be administered in patients who have experienced asthma, urticaria, or other allergic-type reactions after taking aspirin or other NSAIDs.

Severe, rarely fatal, anaphylactic-like reactions to NSAIDs have been reported in such patients. People who use nonsteroidal anti-inflammatory drugs other than aspirin such as topical diclofenac may have a higher risk of having a heart attack or a stroke than people who do not use these medications.

While the risk of absorbing diclofenac topical into our bloodstream is low, an NSAID may cause life-threatening heart or circulation problems such as heart attack or stroke, especially if used for long term.

Precautions:

Do not use diclofenac topical on an open skin wound, or on areas of eczema, infection, skin rash, or burn injury. Do not cover the treated skin with a bandage or expose it to heat from a hot tub, heating pad, sauna, or heated water bed. Heat or bandaging can increase the amount of drug absorption through the skin and may cause harmful effects.

Dose of Diclofenac gel: ¹⁰⁰

1. Apply diclofenac sodium gel 4 times a day (a total of 8 grams each day i.e 2gms each time).

2. Do not apply more than 8 grams each day to any one of your affected hands, wrists or elbows.
3. The dose for your knees, ankles or feet is 4 grams of diclofenac sodium gel each time you apply it.
4. Do not apply more than 16 grams each day to any one of your affected knees, ankles or feet.

Table No 15:- Presentation and Price of Volini gel

Sl.No	Packing	Cost in Rs
1	10gms	31
2	15gms	55
3	30gms	105
4	50gms	148
5	75gms	185
	100gms	215

Table No 16:- Composition of Volini Gel

Chemical content	Percentage
Diclofenac diethylamine	1.16% w/w
Menthol	5% w/w
Methly salicylate	10% w/w
Linseed oil	3% w/w

How to use topical diclofenac gel:

1. Using the lines on the dosing card as a guide, squeeze the correct amount of gel onto the dosing card evenly. Make sure the gel covers the entire area marked for your correct dose. Put the cap back on the tube.
2. Clean and dry the skin area where you will apply the medication.
3. Apply the gel to the directed skin areas using the dosing card. Use your hands to gently rub the gel into the skin. Make sure to cover the entire affected area with the gel.

4. Hold the end of the dosing card with your fingertips, and rinse and dry the card. Store the dosing card until next use, out of reach of children. Do not share the dosing card with another person.
5. Wash your hands well after you apply the gel, unless you are treating your hands. If you are treating your hands, do not wash them for at least one hour after you apply the gel.
6. For strains and sprains this is usually three or four times a day for up to 14 days.
7. Keep all medicines out of the reach and sight of children. Store in a cool, dry place, away from direct heat and light.

Benefits of Topical application: ¹⁰¹

When diclofenac is applied to the skin as a gel instead of it having an effect all over body, it only works on the area where it is applied. It is absorbed into the skin and then moves deeper into areas of the body where there is inflammation (for example, muscle). Using a topical product means that the total amount of diclofenac in body remains low. This in turn means that side-effect of the medicine is lessened. It is suitable for use by adults and children over 14 years of age.

Adverse reaction:

- Any application site reaction
- Application site dermatitis
- Application site pruritus
- Application site erythema
- Application site paresthesia
- Application site dryness
- Application site vesicles
- Application site irritation Application site papules



FIG 48



FIG49
Diclofenac gel

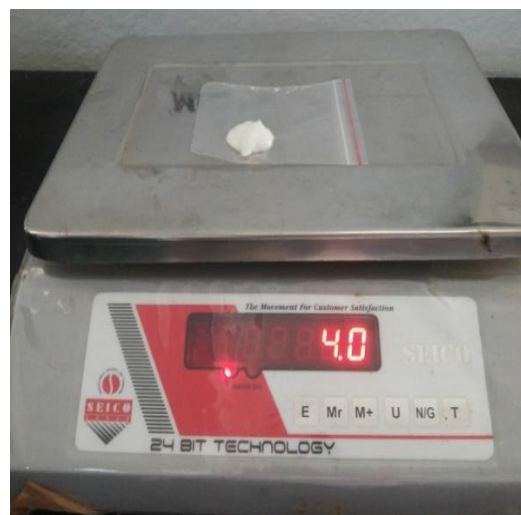


FIG 50
Quantity per application

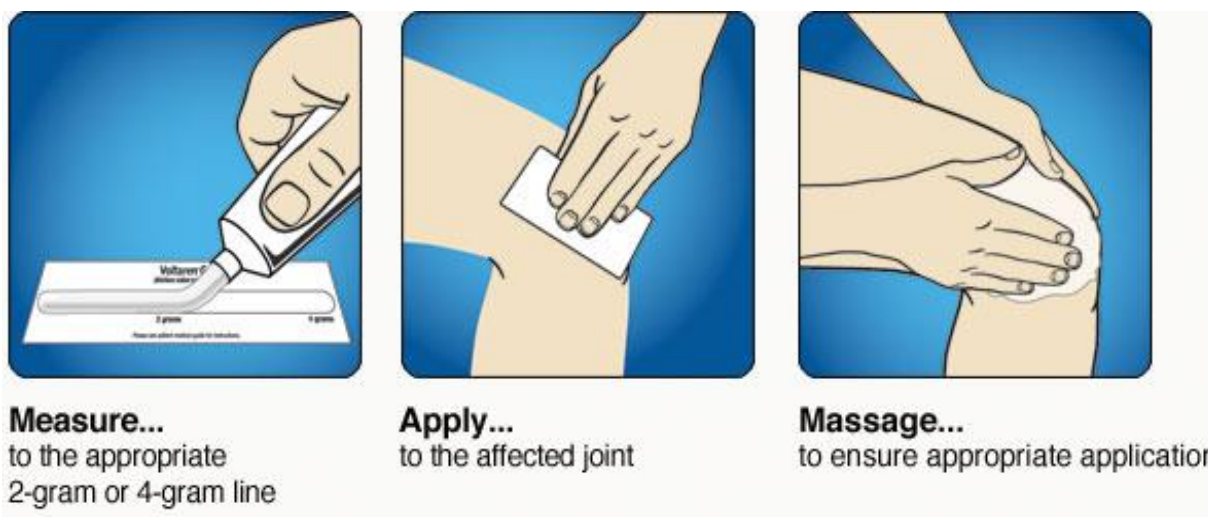


FIG 51 Diclofenac measuring card

MATERIALS AND METHODS

Research aims to venture to new facts from old facts in scientific manner in the form of critical investigation. It is an analysis in a systemic method to gain acquaintance, which helps to solve problems. Ultimate aim of research in medical science is to find appropriate answer for particular sickness and promote wellbeing.

On the scientific parameters available Ayurveda is formulated to re-establish old facts through modern methodology. Methodology means gathering the work carried is a systemic approach.

To assess the efficacy of Acharya Sushruta's principles in the management of acute injury - Ankle sprain is the aim of present clinical study.

Acharya Sushruta in the context of Asthi Bhagna mentioned, states if there is swelling without external wound in a part of the body, resulted from fall or hit then adopt Sheeta Parisheka or Sheeta Pradeha for betterment of the condition.⁹ Nyagrodhadi Kashaya for Parisheka is advised for reducing the Vedana. Udumbara is one of the drug among the Nyagrodhadi Gana having Sheeta Veerya.^{9a} Hence Udumbara Twak Parisheka is chosen for the study.

न्यग्रोधादि कषायं तु सुशितं परिषेचने।
पन्चमूलीविपक्वं तु क्षीरं कुर्यात् सवेदने॥ सु चि ३/११

Acharya Sushruta explains in Pradeha Sadhya Vyadhi one prefer Alepa during day time in the context of Vranalepanabandhana Vidhi Adhyaya.¹⁰ In the context of Vrana, Acharya Sushruta has recommend to go for Sheeta Upachara, as the normal flow of Vata is hampered due to vitiation of Rakta first immediately aafter injury or trauma.^{11b}

In acute traumatic conditions as the principle line of management Sheeta Lepa effectiveness is emphasized by different Acharyas like Vrdha Vagbhata, Vagbhata, Cakradatta, Bhavamishra and Yogaratnakara. In Bhagna Rogadhikara every Acharya has the same opinion. Acharya Indukanta in Indumatitika has commented on Sheeta, Sheeta means the drugs should be cold to touch and in potency. Acharya Sushruta in Bhagna Rogadhikara explains about Manjisthadi Lepa which possess Sheeta Guna.

आलेपनार्थं मन्जिष्ठा मधुकं रक्तचन्दनम्।
शतधौतघृतोन्मिश्रं शालिपिष्टं च संहरेत्॥ सु चि ३/७

In the context of Vranalepana-bandhana Adhyaya while explaining the benefits of Pradeha, In Marama Sthitha Dosha Acharya Sushruta emphasizes to use Pradeha at the site of marma. ⁴⁴

In the context of Jwara Nidana while explaining the Agantuja Jwara Bheda in Asthanga Hridaya, Acharya Vagbhata says how Doshas get aggravated resulting in Jwara. Here he narrates when one undergoes Shrama, Abhigata, Kshata etc Vata Dosha gets aggravated, which does the vitiation of Rakta. This vitiated Rakta further blocks the flow of Vata producing the symptoms as Vyatha, Shopha and Vaivarnya. To this Acharya Hemadri comments, by Kshata-Vyatha (uneasiness), Shopha (edema) and Vaivarnya (discoloration) are produced, while Ruja (pain) is result of Shrama. ³²

Considering the classical description of the different Ayurvedic and modern literature, a research study was carried to evaluate the efficacy of Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa over cold water irrigation followed by Diclofenac gel application in the form of clinical study. The study was carried on 200 patients of Ankle sprain and divided into two groups having 100 patients in each group.

Literary source:

- Library
- Relevant research articles
- e – library
- Internet

Drug Source: The drugs required for the research was procured form the pharmacy of K.L.E.University’s Ayurveda Pharmacy, Khasbag, Belgaum.

Sample size: Epi method (Analysed on 19/6/16 at 19:19 pm)

Expected propotion exposed in controls = 0.05

(1-confidence; 1- 0.95 = 0.05)

Confidence level =0.95 (95%)

Assumed odds ratio (margin error) =04

Power = 0.8

Sample size = 98

Sample Size for Quantitative data: (www.ness.com)

$$n = Z^2SD^2 / L^2$$

$$Z = 1.96$$

SD = Standard Deviation

L = Allowable error

n = Sample size or number

Total sample: 228 patients of Ankle sprain were screened of which 28 patients were dropouts. Of them 09 patients did not come for follow up, while 15 got relief by third day of treatment and discontinued the treatment. After diclofenac gel application 04 patients developed rashes, so discontinued the treatment.

Definite sample of study: 200

Source of data: 200 Patients of Ankle Sprain were selected by computerized random method from department of Shalyatantra, K.L.E.U's Shri B.M.K. Ayurved Mahavidyala, Shahapur, Belgaum and B.V.V.'s Ayurved Medical College and Hospital, Bagalkot. Karnataka. The patients visiting to outpatient and inpatient department were selected based on the diagnostic criteria.

Study design– Randomized, Open, Comparative, Clinical Study.

Sampling technique: www.randomnumbers.com

Ethical consideration: Taken from the Institutional Ethical committee.

METHODS OF COLLECTION OF DATA

- **Scope of the study** - To find an topical analgesic in acute ligament injuries.
- **Limitations**- Getting the procedure done daily is inconvenient for some individuals.
- **Consent** - Informed written consent was taken from every patient in the study in English or vernacular language.

- **Clinical Study:** Patients between the age group of 20-60 years, irrespective of sex, religion, occupation, fulfilling the clinical criteria for diagnosis of Ankle sprain. Patients were randomly selected from the OPD and IPD section of Shalyatantra department of K.L.E.U's Shri B.M.Kankanawadi Ayurved Mahavidyalaya, Post Graduate Studies and Research Center, Hospital, Shahapur – Belgaum, Karnataka and B.V.V.'s Ayurved Medical College and Hospital, Bagalkot. Karnataka.

Group A (Trail group) – Patients of Ankle sprain in this group received Udumbara Twak Kwatha Parisheka followed by application of Manjisthadi Lepa twice daily.

Group B (Control group) - Patients of Ankle sprain in this group received cold water irrigation followed by application of Diclofenac gel (Volini gel) twice daily.

Diagnostic criteria^{68b}

1. Diagnosis was done based on the history of inversion or eversion of Ankle & physical examination.

Symptoms

- Pain
- Swelling
- Redness

Signs

- Local temperature
- Tenderness
- Loss of function

Radiography

- X-ray of Ankle to rule out fracture and dislocation.

Inclusion criteria–

1. Patients with clinical features of Ankle sprain as pain, swelling, joint stiffness, loss of function.
2. Patients between age group 20 to 60 years
3. Patients of first and second grade Ankle sprain

Grade I – Mild pain

Mild swelling

Mild joint stiffness

Little or no loss of function

Grade II – Moderate to severe pain

Moderate swelling

Moderate joint stiffness

Moderate loss of function

Exclusion criteria –

1. Patients with fracture and dislocation of Ankle joint
2. Patients with third grade Ankle sprain

Grade III – Severe pain

Profuse swelling

Complete joint stiffness & Complete loss of function

Previous research works:¹³

1. S.R. Jayaprasad (1983); “A study on Gulpha Marma & management of its Abhighata.” Government Ayurvedic College, Trivandrum, Kerala.
2. Nagwade H.M. (1987); “Management of Marma-Ahighata w.s.r.to Soft tissue injury.” Dr B.R.K.R. Government Ayurvedic Medical College, Hyderabad, Vijayawada.
3. Joshi. Vaishali (1998); “To Study Shoolaghna and Shothaghna Effect of Dashangalepa in Amavastha of Vranshotha.” SDM college of Ayurveda, Udupi, Karnataka.
4. Chandramohan (2000); “Effect of Manjisthadi Lepa in the management of Bhagna & its complications”.
5. Hemant T (2000); “Susruta’s Technique of Management of Avrana Kanda Bhagna.” SDM college of Ayurveda, Hassan, Karnataka.
6. SiddangoudaPatil (2002); “Management of Kanda Bhagna with special reference to Radius Fracture”. SDM college of Ayurveda, Hassan, Karnataka.
7. Pallavi Hegde (2005); “Effect of Manjisthadi Lepa in the management of Ankle Sprain.” SDM college of Ayurveda, Hassan, Karnataka.

8. Ramya (2008); “Effect of Nyagrodhadigana Dravya in the management of Ankle sprain.” SDM college of Ayurveda, Hassan, Karnataka.

Required instruments and equipment’s:

1. Gas stove
2. Steel bowl
3. Filter
4. Tub
5. Dharapatra
6. Cotton cloth
7. Rubber sheath

Method of irrigation & application of Diclofenac Gel - Cold water (Tap water temperature – $7-13^{\circ}\text{C}$)¹⁰² is poured on the affected site from a height of 9 inches for 15 minutes. The site is dried with cotton cloth and later Volini gel is applied about 4gm each time in the form of thin layer. This procedure is carried twice daily.

Method of Preparation Udumbara Twak Kwatha and Parisheka^{52e}

Kwatha is prepared from Udumbara Twak Kwatha Churna according to standard Kwatha preparation method. Water 16 parts is mixed with 1part of Udumbara Twak and boiled till the water is reduced to 1/8part. Filter the prepared Kwatha and cool. Sheeta Kwatha is poured over the affected part in the form of Dhara from a height of 9 inches (12 Angula) for 15 minutes twice daily.

Drugs required for Manjisthadi lepa:

- i) **Manjistha**
- ii) **Yashtimadhu**
- iii) **Raktachandana**
- iv) **Shali Pishti**
- v) **Shatadhauta Ghrita.**

Method of preparation of lepa and application technique:

Sukshma Churna of Manjistha, Yastimadhu, Rakthachandana and Shali each in equal quantity is mixed with Shatadhouta Ghrita. To this mixture hot water is added till paste consistency. When cooled the prepared Lepa is applied in Pratilomagati with a thickness of Ardra Maheesha Charma(0.25cm) twice daily. Applied Lepa is removed before it dried completely.

Intervention:

Group A – Trail Group (Manjisthadi Group)

Selected patients were examined as per the clinical proforma prepared for the study and subjected to radiographic examination. The patients of this group underwent following procedure.

The patients of this group were subjected to following procedure.

- Patient in comfortable position either sitting or lying.
- Udumbara Twak Kwatha Parisheka is done from height of 9 inches for fifteen minutes.
- The part is dried by cotton cloth.
- Freshly prepared Sheeta Manjisthadi Lepa is applied over the affected Ankle in the Pratiloma Gati with a thickness of Ardra Maheesha Charma (0.25 cm).
- The Lepa is kept in situ till cracks were noted or till the patient complained of stretching sensation, i.e. before it dried completely.
- In all the patients the procedure is carried twice daily for one week.
- Foot elevation above heart level is recommended.

Group B –Control Group (Diclofenac Group)

- Patient in comfortable position either sitting or lying.
- Cold water irrigation done to the affected Ankle from a height of 9 inches for fifteen minutes duration.
- The part is dried by cotton cloth.
- Diclofenac Gel of 4gm after measuring from a measuring strip is applied over affected Ankle.
- This procedure is followed twice daily for one week period.

- Gradually rehabilitation is advised.
- Foot elevation above heart level is recommended.

Follow up study:

Patients were examined on initial day zero and further followed daily for one week. Then second week (15thday) and fourth week (30thday) to note the changes in signs and symptoms of the patients based on the research proforma and also to note whether the relief provided by the therapy is sustained or not or whether there is any relapse.

Assessment Criteria:

Daily assessment of the patient is carried out based on the gradings given to

a) Subjective parameters

- Pain
- Swelling
- Discoloration
- Tenderness

b) Objective parameters

Degree of movement of the joint by goniometry

a) Subjective parameters: To assess the efficacy of the trial preparation or improvement in the clinical symptoms of the condition, different signs and symptoms were arbitrarily graded on the basis of severity.

The clinical gradations of symptoms are as follows:

1) Pain⁷⁸

- No pain ----- 00
- Localized feeling of pain only during movement--- 01
- Localized feeling of pain during movement and
at rest but not disturbing the sleep----- 02
- Localized feeling of pain during movement and
at rest but disturbing the sleep -----03

2) Swelling

Ankle swelling was measured with tape in centimeters grade and the readings were recorded in case proforma. The measurement was taken at three levels that are above the Ankle (one inch above ankle joint), mid of the Ankle (at ankle joint) and below the Ankle joint (one inch below ankle joint) and at same levels compared with the measurements of normal limb.

- No Swelling ----- 00
- Swelling between 0-1cm-----01 Mild
- Swelling between 1.1-2cm-----02 Moderate
- Swelling between 2.1-3cm----- 03 Severe

3) Tenderness¹⁰³

- No tenderness----- 00
- Patient winces on deep palpation----- 01
- Patient winces on superficial palpation----- 02
- Patient does not allow to touch the part ----- 03

4) Loss of function

- Normal function/ Normal gait ----- 00
- Can walk with effort ----- 01
- Can walk with help of support-----02
- Cannot walk -----03

5) Discoloration

- No ecchymosis/discoloration ----- 00
- Ecchymosis / discoloration present ----- 01

6) Dorsiflexion⁶⁹

- Angle of 25⁰ -----00
- Angle above 15⁰----- 01
- Angle above 5⁰ ----- 02

7) Plantarflexion

- Angle of 35⁰ ----- 00
- Angle above 25⁰----- 01
- Angle above 15⁰----- 02
- Angle above 5⁰ ----- 03

- 8) Adduction–
 - Normal movement ----- 00
 - Mild pain (movement with pain)----- 01
 - Moderate pain (movement with difficulty)---- 02
 - Severe pain (movement not possible)----- 03
- 9) Abduction–
 - Normal movement ----- 00
 - Mild pain (movement with pain)-----01
 - Moderate pain (movement with difficulty)--- 02
 - Severe pain (movement not possible)----- 03
- 10) Inversion–
 - Normal movement ----- 00
 - Mild pain (movement with pain)-----01
 - Moderate pain (movement with difficulty)-- 02
 - Severe pain (movement not possible)----- 03
- 11) Eversion–
 - Normal movement ----- 00
 - Mild pain (movement with pain)-----01
 - Moderate pain (movement with difficulty)-- 02
 - Severe pain (movement not possible)----- 03

Total Effect of the Therapy

The overall effect of the results in both groups was assed at the end of 7th day treatment, in following:

Complete Remission: Improvement in all the signs and symptoms was considered as complete remission that is 100%.

Marked Improvement: Marked improvement was changes between 50% and 99%.

Moderate Improvement: Below 49 % improvement was considered as Moderate improvement.

Unchanged: If there was no improvement in signs and symptoms then Unchanged.

Format of Patient consent form

Name of the Patient: _____

Name of the Physician: _____

Name of the Institution: _____

The Informed Consent

I,.....,have read the information in this form (or it has been read to me). I was free to ask any questions and they have been answered. I am over 18 years of age and, exercising my free power of choice, here by give my consent to be included as a patient for” **“A Randomised Comparative Clinical Trial of Udumbara Twak Kwath Parisheka followed by Manjithadi Lepa with Diclofenac Gel application for Shothahara role in the Management of Ankle Sprain.”**

1. I have read and understood this consent form and the information provided to me.
2. I have had the consent document explained to me.
3. I have been explained about the nature of the treatment.
4. My responsibilities have been explained to me by the investigator.
5. I have been advised about the risks associated with the treatments.
6. I have informed the physician of all the treatments I am taking or have taken in the past..... months including Allopathic, Ayurvedic, Homeopathic or any household treatments.
7. I agree to cooperate with the physician and I will inform him/her immediately if I suffer unusual symptoms.
8. My identity will be kept confidential if my data are publicly presented.
9. I have had my questions answered to my satisfaction regarding expected results as well as unwanted effects of the procedures/medications.

I am signing this consent from with my knowledge and own interest, I confirm that the information given in this document has been clearly explained to me and apparently understood by me. I will be given a copy of this consent document.

Patient’s sign: _____

Name: _____

Place: _____ Date: _____ Time: _____

OBSERVATIONS

The clinical trial was conducted on 200 patients of Ankle Sprain. The patients were divided randomly in two groups each comprising of 100 patients. The patients of first group pursued, Trial drug i.e. Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa, while the patients of second group pursued Control treatment i.e. underwent cold water irrigation followed by Diclofenac gel application. At the outset Nidanatmaka aspects of all 200 patients are being presented here. Thereafter the effects of medicament in both groups are being illustrated.

Table No -17: Age wise distribution of 200 patients of Ankle Sprain

Age in years	Patients in number and Percentage				Total	%
	Trial Group		Control Group			
20 – 30	61	61%	64	64%	125	62.5%
31 – 40	18	18%	22	22%	40	20%
41 – 50	16	16%	10	10%	26	13%
51 – 60	05	05%	04	04%	09	4.5%

In this series of 200 patients of ankle sprain, the youngest age limit of patient was 20 years and eldest age limit patient was 54 years. 62.5% of the patients belonged to 20 -30 years age group, while 20% were between 31-40 years, 13% between 41-50 years and 4.5% belonged to 51-60 years age group (Table-17).

Graph-1: Age wise distribution of 200 patients of Ankle Sprain

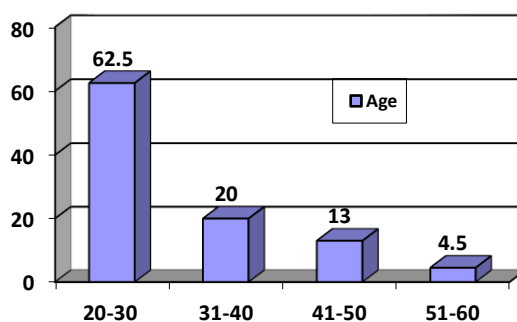


Table No -18: Gender distribution of 200 patients of Ankle Sprain

Gender	Patients in number and Percentage				Total	%
	Trial Group		Control Group			
Male	37	37%	39	39%	76	38%
Female	63	63%	61	61%	124	62%

Gender wise analyzing of data showed that 62% of patients were female and 38% of patients were male (Table-18).

Graph-2: Gender wise distribution of 200 patients

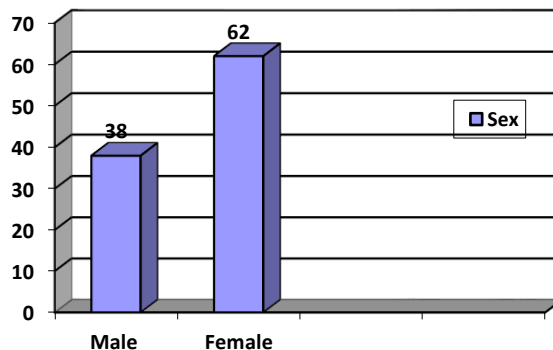


Table No -19: Religion of the 200 patients of Ankle Sprain

Religion	Patients in number and Percentage				Total	%
	Trial Group		Control Group			
Hindu	88	88%	96	96%	184	92%
Muslim	09	09%	02	02%	11	5.5%
Christian	03	03%	02	02%	5	2.5%

Analysis of data based on religion showed that 92% of patients belonged to caste Hindu, 5.5% were Muslim and 2.5% were Christian (Table-19).

Graph-3: Religion wise distribution of 200 patients

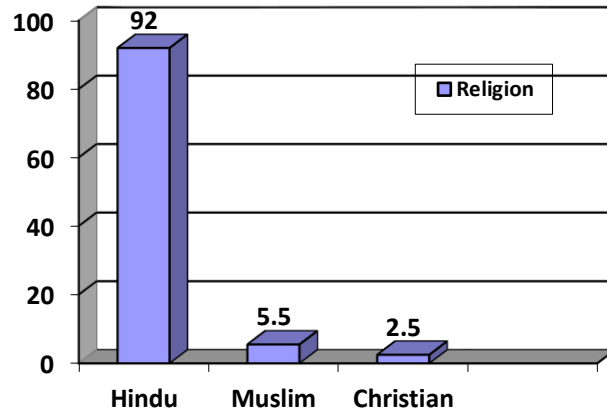


Table No -20: Distribution of 200 patients on the basis of Economical Status

Economic Status	Patients in number and Percentage				Total	%
	Trial Group		Control Group			
Lower income group	16	16%	14	14%	30	15%
Lower middle income group	45	45%	45	45%	90	45%
Higher middle income group	31	31%	29	29%	60	30%
Higher income group	08	08%	12	12%	20	10%

In the present study of 200 patients of Ankle sprain, 45% were of lower middle income group and 30% of the patients from higher middle income group, while 15% from lower income group and 10% from higher income group (Table-20).

Graph-4: Economic Status wise distribution of 200 patients

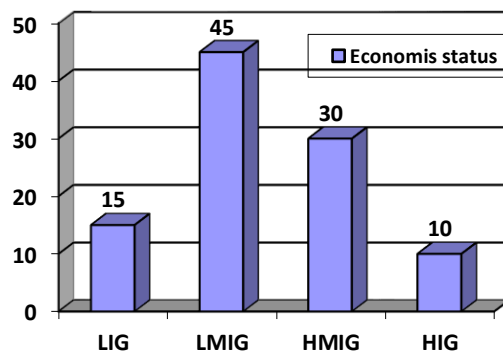


Table No -21: Occupation wise distribution of 200 patients of Ankle Sprain

Occupation	Patients in number and Percentage				Total	%
	Trial Group		Control Group			
Students	39	39%	35	35%	74	37%
Home maker	25	25%	25	25%	50	25%
Job holder	18	18%	23	23%	41	20.5%
Laborer	18	18%	17	17%	35	13.5%

Occupation wise distribution of 200 patients of this series showed 37% patients were students, 25% were home maker, 20.5% were job holders and 13.5% were doing labours work (Table-21).

Graph-5: Occupation wise distribution of 200 patients

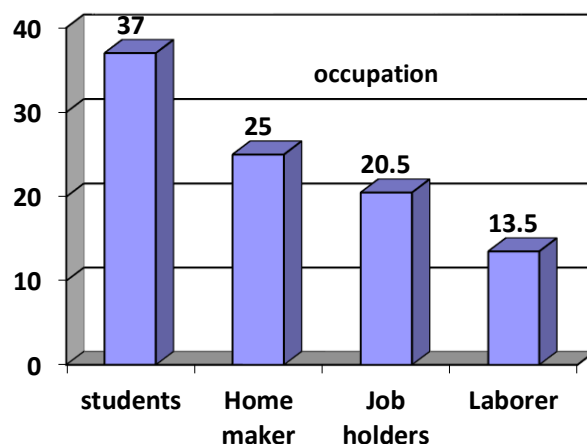


Table No -22: Distribution of 200 patients on the basis of their Habitat.

Habitat	Patients in number and Percentage				Total	%
	Trial Group		Control Group			
Rural	18	18%	12	12%	30	15%
Urban	82	82%	88	88%	170	85%

Analysis of 200 patients from their habitat point of view showed, 15% were reported from rural area and 85% patients belonged to urban area (Table-22).

Graph-6: Habitat wise distribution of 200 patients

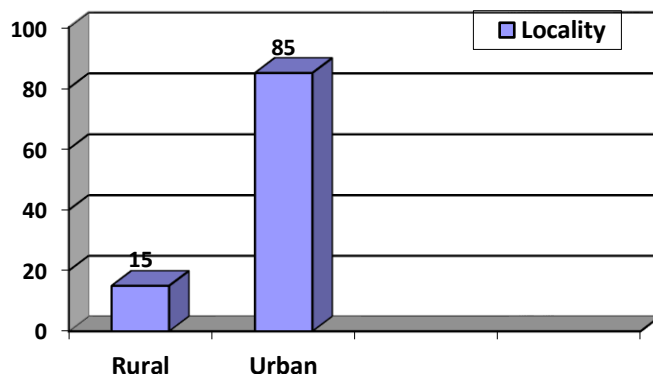


Table No -23: Diet pattern of 200 patients of Ankle Sprain

Diet	Patients in number and Percentage				Total	%
	Trial Group		Control Group			
Vegetarian	46	46%	54	54%	100	50%
Mixed	54	54%	46	46%	100	50%

Analysis of diet pattern showed that 50% of the patient’s belonged to vegetarian system while remaining 50% followed mixed pattern (Table-23).

Graph-7: Diet wise distribution of 200 patients

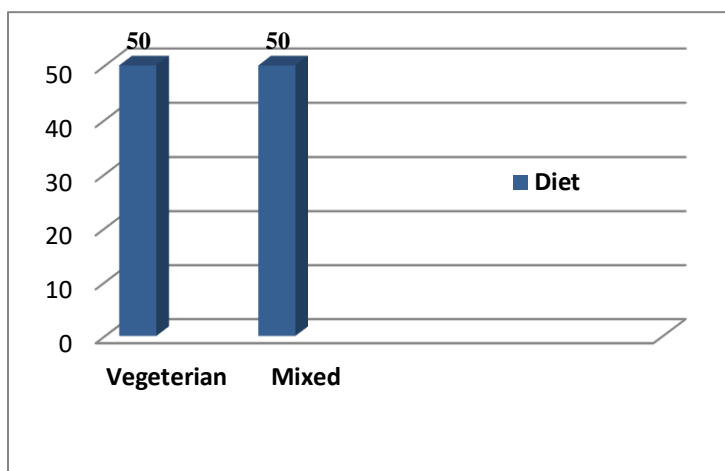


Table No -24: Prakruti wise distribution of 200 patients of Ankle Sprain

Prakruti	Patients in number and Percentage				Total	%
	Trial Group		Control Group			
Vata Pitta	46	46%	61	61%	107	53.5%
Vata Kapha	3	2	30	30%	62	15.5%
Pitta Kapha	22	22%	09	09%	31	31%

On analyzing the data related to Prakruti, it was found that 53.5% patients were of Vata-Pitta Prakruti, 15.5% were of Vata-Kapha Prakruti and 31% were of Pitta-Kapha Prakruti (Table-24).

Graph-8: Prakruti wise distribution of 200 patients

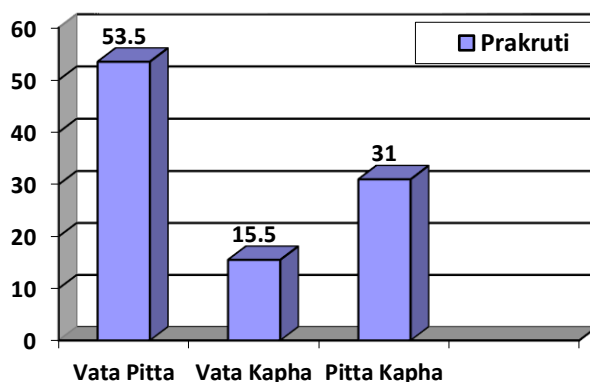


Table No -25: Nidra/Sleep pattern in 200 patients of Ankle Sprain

Nidra	Patients in number and Percentage				Total	%
	Trial Group		Control Group			
Sound	80	80%	88	88%	168	84%
Disturbed	20	20%	12	12%	32	16%

Analysis of Nidra in 200 patients of Ankle sprain showed that 84% of patients in this series had sound sleep while remaining 16% of patients had disturbed sleep (Table-25).

Graph-9: Nidra wise distribution of 200 patients

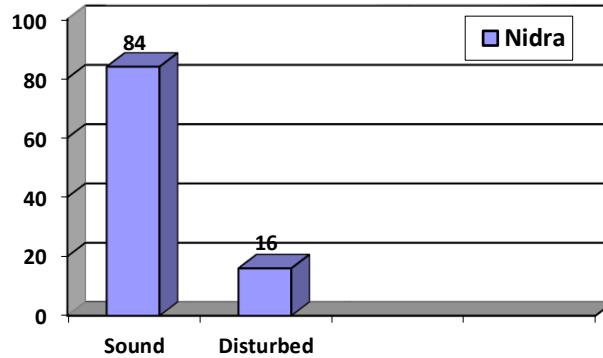


Table No -26: Vyayamashakthi of 200 patients of Ankle Sprain

Vyayamashakthi	Patients in number and Percentage				Total	%
	Trial Group		Control Group			
Pravara	17	17%	13	13%	30	15%
Madhyama	75	75%	80	80%	155	71.5%
Avara	08	08%	07	07%	15	16%

Analysis of Vyayamashakthi showed that 71.5% of the patients in this series had Madhyama Vyayamashakthi while remaining 16% patients had Avara Vyayamashakthi and 15% of patients had Pravara Vyayamashakti (Table-26).

Graph-10: Distribution of 200 patients of Ankle sprain according to Vyayamashakthi

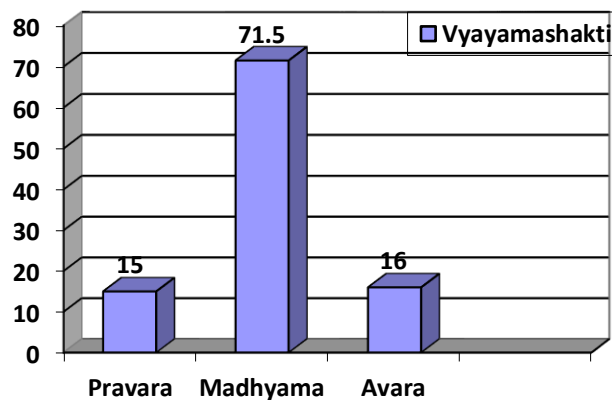


Table No -27: Distribution of 200 patients based on Satva

Satva	Patients in number and Percentage				Total	%
	Trial Group		Control Group			
Pravara	14	14%	11	11%	25	12.5%
Madhyama	70	70%	73	73%	143	71.5%
Avara	16	16%	16	16%	32	16%

Analysis of Satva of 200 patients showed 12.5% of them had Pravara Satva, 71.5% had Madhyama Satva and 16% patients had Avara Satva (Table-27).

Graph-11: Satva wise distribution of 200 patients

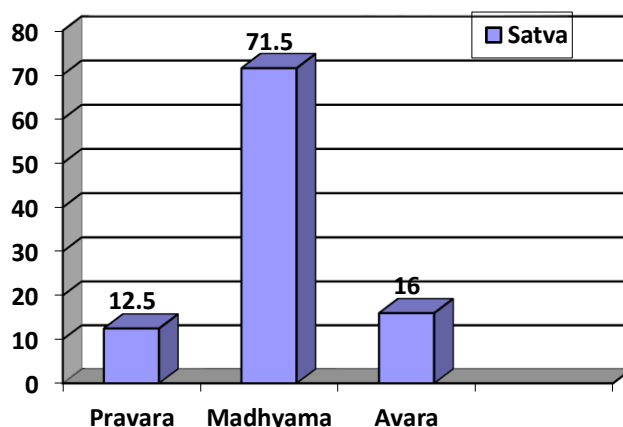


Table No - 28: Mode of Injury Recorded in 200 patients of Ankle Sprain

Mode of injury	Patients in number and Percentage				Total	%
	Trial Group		Control Group			
Getting down/stepping down	34	34%	32	32%	66	33%
Sports injury	17	17%	20	20%	37	18.5%
Fast walking	18	18%	15	15%	33	16.5%
Slip of Leg	13	13%	09	09%	22	11%
High heeled walk	06	06%	07	07%	13	6.5%
Jumping	04	04%	07	07%	11	5.5%
Direct trauma	05	05%	05	05%	10	05%
Fall	03	03%	05	05%	08	04%

In the study of 200 patients on mode of injury which resulted in Ankle sprain are as follows- 33% got injured while getting down the steps or stepping down, 18.5% as a result of sports injury, 16.5% during fast walk, 11% due to slip of leg, 04% by falling down, 05% had direct trauma at ankle and 6.5% had ankle sprain by walking with high heeled foot wear (Table-28).

Graph-12: Distribution of 200 patients of Ankle sprain as per Mode of injury

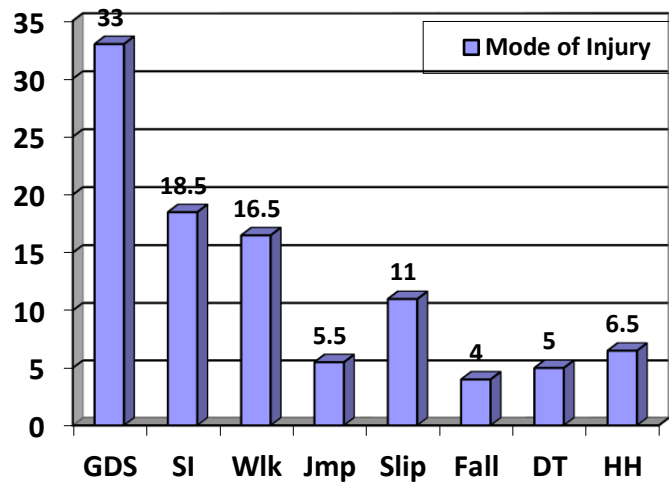


Table No -29: Mechanism of Injury Recorded in 200 patients of Ankle Sprain

Mechanism of injury	Patients in number and Percentage				Total	%
	Trial Group		Control Group			
Inversion	84	84%	83	83%	167	83.5%
Eversion	16	16%	17	17%	33	16.5%

Analysis of the mechanism of injury reported by the 200 patients of this series showed that in 83.5% the injury was due to inward twist of the foot i.e. inversion, while remaining 16.5% had the injury by out ward twist of the foot i.e. eversion (Table-29).

Graph-13: Distribution of 200 patients according to Mechanism of injury

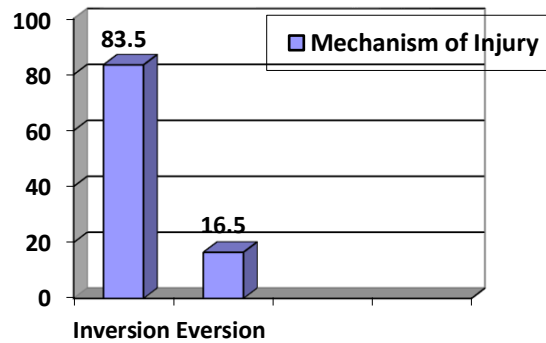


Table No -30: Side Involved Recorded in 200 patients of Ankle Sprain

Dominant side	Patients in number and Percentage				Total	%
	Trial Group		Control Group			
Right	30	30%	23	23%	53	26.5%
Left	70	70%	77	77%	147	73.5%

In this series 73.5% patients sustained sprain of the left foot while remaining 26.5% patients had sprain of the right foot (Table-30).

Graph-14: Dominant side involved in 200 patients of Ankle sprain

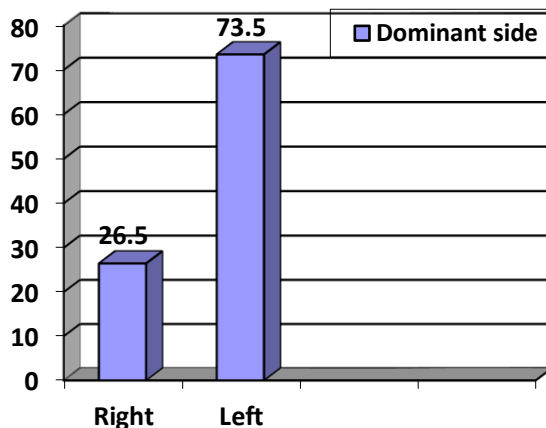


Table No -31: Distribution of Ankle Sprain patients according to Grades

Grades	Patients in number and Percentage				Total	%
	Trial Group		Control Group			
Grade I	56	56%	65	65%	121	60.5%
Grade II	44	44%	35	35%	79	39.5%

In the series of 200 patients 60.5% of them sustained Grade I and 39.5% of them had Grade II Ankle Sprain (Table -31).

Graph-15: Grade of Ankle Sprain of 200 Patients

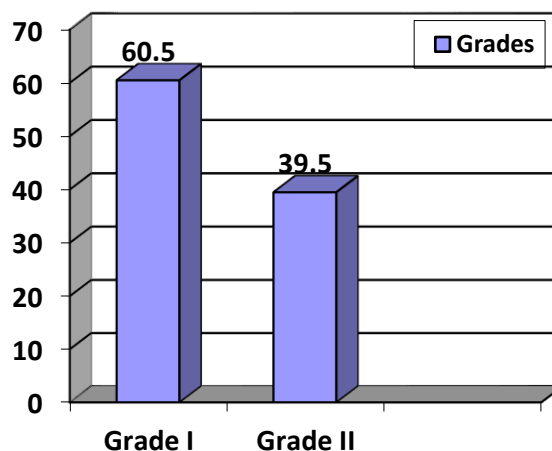


Table No -32: Discoloration in foot of 200 patients of Ankle Sprain

Discoloration	Patients in number and Percentage				Total	%
	Trial Group		Control Group			
Present	25	25%	16	16%	41	20.5%
Absent	75	75%	84	84%	159	79.5%

Analysis of discoloration in foot followed by Ankle sprain, showed 79.5% of the patients had no discoloration while 20.5% had discoloration or ecchymosis at the site of sprain (Table-32).

Graph-16: Discoloration wise distribution of 200 patients

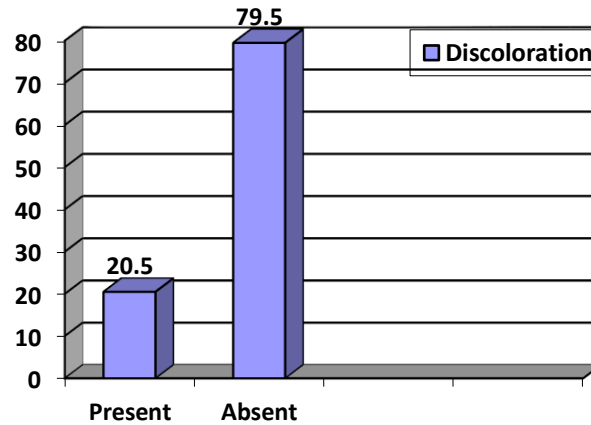


Table No -33: Distribution of patients based on Severity of Ankle Swelling

Severity	Patients in number and Percentage				Total	%
	Trial Group		Control Group			
Mild	42	42%	48	48%	90	45%
Moderate	39	39%	44	44%	83	41.5%
Severe	19	19%	08	08%	27	13.5%

Out of 200 patients 45% suffered from mild swelling, while 41.5% had moderate and 13.5% had severe swelling (Table-33).

Graph-17: Severity of Swelling in 200 patients

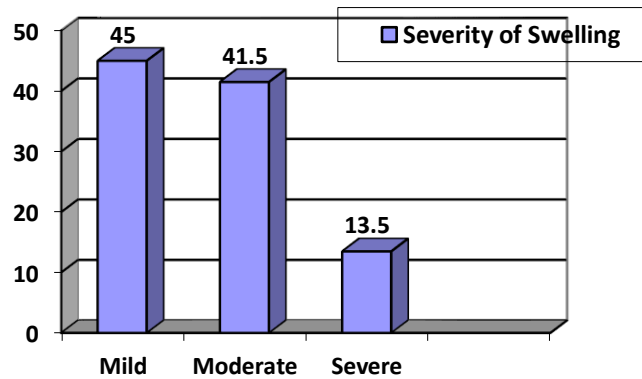
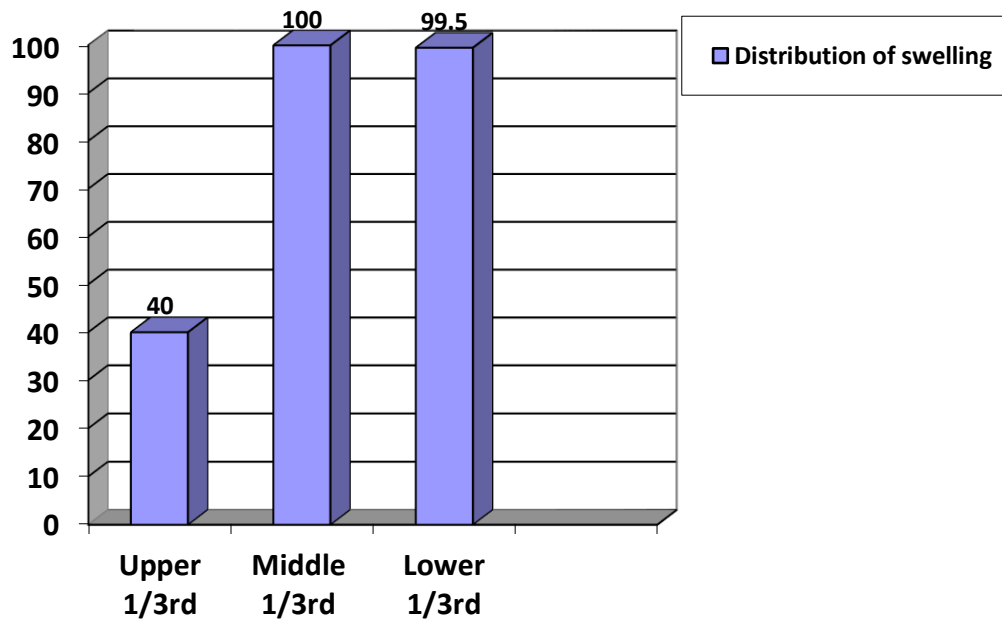


Table No -34: Distribution of Swelling near Ankle in patients of Ankle Sprain

Part of Ankle joint	Patients in number and Percentage				Total	%
	Trial Group		Control Group			
Upper 1/3 rd	44	44%	36	36%	80	40%
Middle	100	100%	100	100%	200	100%
Lower 1/3 rd	99	99%	110	100%	199	99.5%

Among the three sites of recording of swelling in 200 patients of Ankle sprain, more swelling was noted in the middle(100%) and lower 1/3rd (99.5%) as compared to upper 1/3rd (40%) (Table-34).

Graph-18: Part of ankle joint affected by swelling in 200 patients of Ankle sprain.



RESULTS

Patients of Ankle sprain were treated with modern and Ayurvedic remedy according to the grouping. These 200 patients were divided randomly in two groups, each comprising of 100 patients. In Trial group 100 patients underwent Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa while in the Control group 100 patients underwent cold water irrigation followed by Diclofenac gel application. Effects of the therapy in each patient are being recorded according to the case proforma as before, during and after treatment under the respective heading and analyzed.

Statistical test applied: One way ANOVA test with sub test i.e. Tukey's Multiple Comparison test.

Effects of Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa application on the Patients of Ankle Sprain:

In the Trial group 100 patients of Ankle sprain were treated with Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa application. The effects of this Lepa on the various parameters adopted for this Trial are as follows:

Table No -35: Effect of Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa application on Pain in Ankle sprain

Pain	Treatment days	Mean score		% of relief	SE(±)	P<0.05	95% CI
		BT	AT				
During Treatment	I day	1.66	1.65	0.60	0.065	No	-0.170 to 0.190
	III day		1.05	36.74	0.045	Yes	0.430 to 0.790
	VII day		0.08	95.18	0.027	Yes	1.400 to 1.760
Follow-up	II Week		0.0	100	0.0	Yes	1.480 to 1.840
	IV Week		0.0	100	0.0	Yes	1.480 to 1.840

One week of procedure of Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa application in patients of Ankle sprain reduced the pain by 0.60% on first day, 36.74% on third day and significant 95.18% by end of one week. Pain completely reduced on the first follow up of one week i.e. 100% with statistical significance of P value <0.05 (Table-35).

Table No -36: Effect of Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa application on Tenderness of Ankle sprain

Tenderness	Treatment days	Mean score		% of relief	SE (±)	P<0.05	95% CI
		BT	AT				
During Treatment	I day	1.53	1.53	0.0	0.059	No	-0.162 to 0.162
	III day		1.03	33.33	0.041	Yes	0.337 to 0.662
	VII day		0.08	95.42	0.027	Yes	1.287 to 1.613
Follow-up	II Week		0.0	100	0.0	Yes	1.367 to 1.693
	IV Week		0.0	100	0.0	Yes	1.367 to 1.693

There was no outcome on tenderness on 1st day, 33.33% reduction on 3rd day and 95.42% of reduction in tenderness on 7th day and after one week of follow up 100% result was noted. Thus Parisheka and Lepa have statistically highly significant result with P-value < 0.05 (Table-36).

Table No -37: Effect of Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa application on Swelling of Upper 1/3rd of Ankle Joint

Swelling	Treatment Days	Mean	score	% of relief	SE (±)	P<0.05	95% CI
		BT	AT				
During Treatment	I day	0.58	0.58	00	0.080	No	-0.211 to 0.211
	III day		0.23	60.34	0.054	Yes	0.139 to 0.561
	VII day		0.0	100	0.0	Yes	0.369 to 0.791
Follow-up	II Week		0.0	100	0.0	Yes	0.369 to 0.791
	IV Week		0.0	100	0.0	Yes	0.369 to 0.791

Table No -38: Effect of Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa application on Swelling of Middle 1/3rd of Ankle Joint

Swelling	Treatment Days	Mean	score	% of relief	SE(±)	P <0.05	95% CI
		BT	AT				
During Treatment	I day	2.05	2.05	00	0.082	No	-0.232to0.232
	III day		1.02	50.24	0.073	Yes	0.797 to 1.262
	VII day		0.05	97.56	0.021	Yes	1.768 to 2.232
Follow-up	II Week		0.0	100	0.0	Yes	1.818to 2.282
	IV Week		0.0	100	0.0	Yes	1.818to 2.282

Table No -39: Effect of Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa application on Swelling of Lower 1/3rd of Ankle Joint

Swelling	Treatment days	Mean	score	% of relief	SE (±)	P <0.05	95% CI
		BT	AT				
During Treatment	I day	1.72	1.72	00	0.086	No	-0.241 to 0.241
	III day		0.72	58.13	0.753	Yes	0.758 to 1.242
	VII day		0.04	97.67	0.196	Yes	1.438 to 1.922
Follow-up	II Week		0.0	100	0.0	Yes	1.478 to 1.962
	IV Week		0.0	100	0.0	Yes	1.478 to 1.962

Lepa provided highly significant (P<0.05) relief in swelling in all parts of the ankle joint after application for one week. On 3rd day decrease in size of swelling by 60.34%, 50.24% and 58.13% in upper, middle and lower part respectively and on 7th day swelling came down 100% in upper 1/3rd, 97.56% in middle and 97.76% in lower part of ankle joint (Table-37, 38 and 39).

Table No -40: Effect of Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa application on Loss of function of Ankle Joint

Loss of Function	Treatment days	Mean score		% of relief	SE (±)	P<0.05	95% CI
		BT	AT				
During Treatment	I day	1.25	1.24	0.8	0.045	No	-0.112 to 0.132
	III day		0.91	27.2	0.045	Yes	0.217 to 0.462
	VII day		0.0	100	0.035	Yes	1.128 to 1.372
Follow-up	II Week		0.0	100	0.0	Yes	1.128 to 1.372
	IV Week		0.0	100	0.0	Yes	1.128 to 1.372

One week Trial drug application 0.8% improvement on 1st day, 27.2% improvement on 3rd day and 100% improvement at the end of one week in loss of function of ankle joint was observed. This improvement was statistically highly significant (P<0.05) and normal functioning of ankle joint continued during follow up weeks (Table-40).

Table No -41: Effect of Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa application on Discoloration of Ankle sprain

Discoloration	Treatment days	Mean score		% of relief	SE (±)	P<0.05	95% CI
		BT	AT				
During Treatment	I day	0.17	0.17	00	0.037	No	-0.104 to 0.104
	III day		0.12	29.41	0.032	Yes	-0.054 to 0.154
	VII day		0.0	100	0.0	Yes	0.065 to 0.274
Follow-up	II Week		0.0	100	0.0	Yes	0.065 to 0.274
	IV Week		0.0	100	0.0	Yes	0.065 to 0.274

The discoloration of the affected joint site gradually faded away by 29.41% on 3rd day and completely vanished by one week of Trial Parisheka and Lepa application. This effect of the therapy was statistically highly significant (P<0.05) and persisted in follow up studies (Table-41).

Table No -42: Effect of Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa application on Dorsiflexion of Ankle Joint

Dorsiflexion	Treatment days	Mean score		% of relief	SE (±)	P <0.05	95% CI
		BT	AT				
During Treatment	I day	1.33	1.33	0	0.0472	No	-0.132 to 0.132
	III day		0.90	32.33	0.0414	Yes	0.297 to 0.562
	VII day		0.01	99.24	0.0100	Yes	1.188 to 1.452
Follow-up	II Week		0.0	100	0.0	Yes	1.198 to 1.462
	IV Week		0.0	100	0.0	Yes	1.198 to 1.462

In consideration with range of movement, no change on 1st day, 32.33% improvement on 3rd day and significant improvement of 99.24% on 7th day and normal dorsiflexion was observed by 15th day of the study with statistically highly significant P value <0.05 (Table 42).

Table No -43: Effect of Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa application on Plantarflexion of Ankle Joint

Plantar flexion	Treatment days	Mean score		% of relief	SE (±)	P <0.05	95% CI
		BT	AT				
During Treatment	I day	1.46	1.45	0.68	0.055	No	-0.139 to 0.159
	III day		0.90	29.45	0.041	Yes	0.410 to 0.709
	VII day		0.01	99.31	0.010	Yes	1.300 to 1.600
Follow-up	II Week		0.0	100	0.0	Yes	1.310 to 1.610
	IV Week		0.0	100	0.0	Yes	1.310 to 1.610

In consideration with range of movement, 0.68% improvement on 1st day, 29.45% improvement on 3rd day and significant improvement of 99.31% on 7th day and normal plantarflexion was observed by 15th day of the Trial with statistically highly significant P value <0.05 (Table 43).

Table No -44: Effect of Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa application on Inversion of Ankle Joint

Inversion	Treatment days	Mean score		% of relief	SE (±)	P <0.05	95% CI
		BT	AT				
During Treatment	I day	1.01	1.01	00	0.038	No	-0.118 to 0.118
	III day		0.24	76.23	0.045	Yes	0.651 to 0.888
	VII day		0.0	100	0.0	Yes	0.891 to 1.129
Follow-up	II Week		0.0	100	0.0	Yes	0.891 to 1.129
	IV Week		0.0	100	0.0	Yes	0.891 to 1.129

Range of movement of Inversion had no change on 1st day, 76.23% improvement on 3rd day and 100% on 7th day which continued during the follow up period also. Thus inversion movement showed statistically highly significant result with P value <0.05 (Table 44).

Table No -45: Effect of Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa application on Eversion of Ankle Joint

Eversion	Treatment days	Mean score		% of relief	SE (±)	P <0.05	95% CI
		BT	AT				
During Treatment	I day	0.50	0.43	14	0.055	No	-0.068 to 0.020
	III day		0.07	86	0.025	Yes	0.291 to 0.568
	VII day		0.0	100	0.0	Yes	0.361 to 0.638
Follow-up	II Week		0.0	100	0.0	Yes	0.361 to 0.638
	IV Week		0.0	100	0.0	Yes	0.361 to 0.638

Eversion movement improved by 14% on day 1, while 86% improvement on 3rd day and normal range on 7th day. This 100% result continued for further follow up days with statistically highly significant P value <0.05 (Table 45).

Table No -46: Effect of Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa application on Abduction of Ankle Joint

Abduction	Treatment days	Mean score		% of relief	SE (±)	P <0.05	95% CI
		BT	AT				
During Treatment	I day	0.480	0.390	18.75	0.052	No	-0.040 to 0.220
	III day		0.040	91.66	0.019	Yes	0.309 to 0.570
	VII day		0.0	100	0.0	Yes	0.349 to 0.610
Follow-up	II Week		0.0	100	0.0	Yes	0.349 to 0.610
	IV Week		0.0	100	0.0	Yes	0.349 to 0.610

Abduction movement improved by 18.75% on 1st day, 91.66% improvement was noted on 3rd day only and 100% continued to 7th day and further follow up days. Statistically P value is <0.05 which is highly significant (Table 46).

Table No -47: Effect of Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa application on Adduction Ankle Joint

Adduction	Treatment days	Mean score		% of relief	SE (±)	P <0.05	95% CI
		BT	AT				
During Treatment	I day	0.90	0.83	7.77	0.0513	No	-0.046 to 0.205
	III day		0.11	87.77	0.0314	Yes	0.673 to 0.925
	VII day		0.0	100	0.0	Yes	0.783 to 1.035
Follow-up	II Week		0.0	100	0.0	Yes	0.783 to 1.035
	IV Week		0.0	100	0.0	Yes	0.783 to 1.035

Adduction movement improved by 2.56% on 1st day, 88.46% improvement was noted on 3rd day and normal range of movement on 7th day, this continued in further follow up. Statistically the P value <0.05, is highly significant (Table 47).

Effect of Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa application on Deranged movements of Ankle Joint:

Therapy result was assessed on various movements of the involved ankle joint. Initially dysfunctions in dorsi-flexion, plantar-flexion, inversion, eversion, abduction and adduction were recorded by goniometry and also comparing with the normal limb movements. One week Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa application corrected all these functions to 100%, which were statistically highly significant (P<0.05). On the follow up study also these effects were found constant (Table-42, 43, 44, 45, 46 and 47).

Effects of Control cold water irrigation followed by Diclofenac gel application on the patients of Ankle Sprain:

100 patients of Ankle Sprain were treated with cold water irrigation followed by diclofenac gel application. The effects of procedure on various parameters adopted for this study are as follows:

Table No -48: Effect of cold water irrigation followed by Diclofenac gel application on Pain of Ankle sprain

Pain	Treatment days	Mean score		% of relief	SE (±)	P <0.05	95% CI
		BT	AT				
During Treatment	I day	1.560	1.56	0.0	0.064	No	0.176 to 0.176
	III day		1.27	18	0.044	Yes	0.113 to 0.466
	VII day		0.11	92.94	0.031	Yes	1.274 to 1.626
Follow-up	II Week		0.0	100	0.0	Yes	1.384 to 1.736
	IV Week		0.0	100	0.0	Yes	1.384 to 1.736

Cold water irrigation followed by diclofenac gel application was done for one week, no change was observed on day 1 while, 18% pain reduction was noted on day 3, pain significantly reduced up to 92.94% on day 7 and which was completely cut down by first week of follow up i.e day 15 (Table-48).

Table No -49: Effect of cold water irrigation followed by Diclofenac gel application on Tenderness of Ankle sprain

Tenderness	Treatment days	Mean	score	% of relief	SE (±)	P <0.05	95%CI
		BT	AT				
During Treatment	I day	1.440	1.44	0	0.060	No	-0.169 to 0.169
	III day		1.25	13.19	0.043	Yes	0.020 to 0.359
	VII day		0.11	92.36	0.031	Yes	1.161 to 1.499
Follow-up	II Week		0.0	100	0.0	Yes	1.271 to 1.609
	IV Week		0.0	100	0.0	Yes	1.271 to 1.609

The Control group contributed 0, 13.19 % and 92.36% relief in tenderness after application on day 1st, 3rd and 7th respectively, which was statistically highly significant with P value <0.05. Tenderness was found completely relieved on first follow up of one week (Table-49).

Table No -50: Effect of cold water irrigation followed by Diclofenac gel application on Swelling of Upper1/3rd of Ankle Joint

Swelling	Treatment days	Mean	score	% of relief	SE (±)	P <0.05	95%CI
		BT	AT				
During Treatment	I day	0.42	0.42	00	0.051	No	-0.138 to 0.138
	III day		0.20	52.38	0.402	Yes	0.081 to 0.358
	VII day		0.0	100	0.0	Yes	0.281 to 0.558
Follow-up	II Week		0.0	100	0.0	Yes	0.281 to 0.558
	IV Week		0.0	100	0.0	Yes	0.281 to 0.558

Table No -51: Effect of cold water irrigation followed by Diclofenac gel application on Swelling of Middle 1/3rd of Ankle Joint

Swelling	Treatment days	Mean	Score	% of relief	SE (±)	P <0.05	95%CI
		BT	AT				
During Treatment	I day	2.15	2.15	00	0.070	No	-0.206 to 0.206
	III day		1.51	29.76	0.627	Yes	0.433 to 0.846
	VII day		0.16	92.55	0.401	Yes	1.775 to 2.188
Follow-up	II Week		0.0	100	0.0	Yes	1.943 to 2.357
	IV Week		0.0	100	0.0	Yes	1.943 to 2.357

Table No -52: Effect of cold water irrigation followed by Diclofenac gel application on Swelling of Lower 1/3rd of Ankle Joint

Swelling	Treatment days	Mean	score	% of relief	SE (±)	P <0.05	95%CI
		BT	AT				
During Treatment	I day	2.00	2.00	00	0.073	No	-0.212 to 0.212
	III day		1.40	30	0.635	Yes	0.387 to 0.812
	VII day		0.12	94	0.356	Yes	1.668 to 2.092
Follow-up	II Week		0.0	100	0.0	Yes	1.788 to 2.212
	IV Week		0.0	100	0.0	Yes	1.788 to 2.212

One week application of gel did not show any result on 1st day after treatment. Swelling reduced by 52.38%, 29.78% and 30% in upper, middle and lower part of ankle joint respectively on 3rd day. Later on 7th day highly significant (P<0.05) relief in swelling as complete relief of 100% in upper 1/3rd, middle 92.55% and lower 1/3rd 94%. On the follow up study also it remained almost sustained in all the three parts (Table-50, 51 and 52).

**Table No -53: Effect of cold water irrigation followed by Diclofenac gel application
Loss of function of Ankle Joint**

Loss of function	Treatment days	Mean Score		% of relief	SE (±)	P <0.05	95% CI
		BT	AT				
During Treatment	I day	1.14	1.14	0	0.034	No	-0.093 to 0.093
	III day		1.03	9.6	0.017	Yes	0.016 to 0.203
	VII day		0.04	96.49	0.019	Yes	1.007 to 1.193
Follow-up	II Week		0.0	100	0.0	Yes	1.047 to 1.233
	IV Week		0.0	100	0.0	Yes	1.047 to 1.233

One week Control gel application provided no change on 1st day, 9.6% improvement on 3rd day and 96.49% improvement at the end of one week in loss of function of ankle joint. This improvement was statistically highly significant (P<0.05) and 100% normal functioning of Ankle joint by first follow up and continued as same in further follow up study (Table-53).

Table No -54: Effect of cold water irrigation followed by Diclofenac gel application on Discoloration of Ankle sprain

Discoloration	Treatment days	Mean	score	% of relief	SE (±)	P <0.05	95% CI
		BT	AT				
During Treatment	I day	0.1600	0.16	00	0.036	No	-0.106 to 0.106
	III day		0.16	00	0.036	No	-0.106 to 0.106
	VII day		0.0	100	0.036	Yes	0.053 to 0.264
Follow-up	II Week		0.0	100	0.0	Yes	0.053 to 0.266
	IV Week		0.0	100	0.0	Yes	0.053 to 0.266

The discoloration over the affected site fades by the end of one week of gel application. This effect of the therapy was statistically highly significant (P<0.05) and sustained as it is in the follow up studies also (Table-54).

Table No -55: Effect of cold water irrigation followed by Diclofenac gel application on Dorsiflexion of Ankle Joint

Dorsiflexion	Treatment days	Mean		% of relief	SE (±)	P <0.05	95% CI
		BT	AT				
During Treatment	I day	1.25	1.25	00	0.043	No	-0.118 to 0.118
	III day		1.10	12	0.030	Yes	0.031 to 0.268
	VII day		0.04	96.8	0.019	Yes	1.091 to 1.329
Follow-up	II Week		0.0	100	0.0	Yes	1.131 to 1.369
	IV Week		0.0	100	0.0	Yes	1.131 to 1.369

In consideration with range of movement, no change on 1st day, 12% improvement on 3rd day and 96.8% on 7th day and normal dorsiflexion was observed by 15th day of the study with statistically highly significant P value <0.05 (Table-55).

Table No -56: Effect of cold water irrigation followed by Diclofenac gel application on Plantar Flexion of Ankle Joint

Plantar flexion	Treatment days	Mean score		% of relief	SE (±)	P<0.05	95% CI
		BT	AT				
During Treatment	I day	1.25	1.25	0	0.043	No	-0.118 to 0.118
	III day		1.10	12	0.030	Yes	0.031 to 0.268
	VII day		0.04	96.8	0.019	Yes	1.091 to 1.329
Follow-up	II Week		0.0	100	0.0	Yes	1.131 to 1.369
	IV Week		0.0	100	0.0	Yes	1.131 to 1.369

In consideration with range of movement, no change on 1st day, 12% improvement on 3rd day and 96.8% on 7th day and normal plantar flexion was observed by 15th day of the study with statistically highly significant P value <0.05 (Table-56).

Table No -57: Effect of cold water irrigation followed by Diclofenac gel application on Inversion of Ankle Joint

Inversion	Treatment days	Mean Score		% of relief	SE (±)	P <0.05	95% CI
		BT	AT				
During Treatment	I day	0.940	0.94	00	0.046	No	-0.137 to 0.137
	III day		0.62	34.04	0.487	Yes	0.183 to 0.457
	VII day		0.0	100	0.0	Yes	0.803 to 1.077
Follow-up	II Week		0.0	100	0.0	Yes	0.803 to 1.077
	IV Week		0.0	100	0.0	Yes	0.803 to 1.077

Range of movement of Inversion had no change on 1st day, 34.04% improvement on 3rd day and 100% on 7th day which continued during the follow up period. Thus inversion movement showed statistically highly significant result with P value <0.05 (Table-57).

Table No -58: Effect of cold water irrigation followed by Diclofenac gel application Eversion of Ankle Joint

Eversion	Treatment days	Mean score		% of relief	SE (±)	P <0.05	95% CI
		BT	AT				
During Treatment	I day	0.52	0.51	1.92	0.050	No	-0.115 to 0.135
	III day		0.06	88.46	0.023	Yes	0.335 to 0.585
	VII day		0.0	100	0.0	Yes	0.395 to 0.645
Follow-up	II Week		0.0	100	0.0	Yes	0.395 to 0.645
	IV Week		0.0	100	0.0	Yes	0.395 to 0.645

Eversion movement was same as before treatment on day 1, while 88.46% improvement on 3rd day and normal range on 7th day. This 100% result continued for further follow up days with statistically highly significant P value <0.05 (Table 58).

Table No -59: Effect of cold water irrigation followed by Diclofenac gel application on Abduction of Ankle Joint

Abduction	Treatment days	Mean score		% of relief	SE (±)	P<0.05	95% CI
		BT	AT				
During Treatment	I day	0.520	0.51	1.92	0.050	No	-0.108to0.128
	III day		0.0	100	0.0	Yes	0.401 to 0.638
	VII day		0.0	100	0.0	Yes	0.401 to 0.638
Follow-up	II Week		0.0	100	0.0	Yes	0.401 to 0.638
	IV Week		0.0	100	0.0	Yes	0.4014to0.638

Abduction movement improved by 1.92% on 1st day, 100% improvement was noted on 3rd day only and continued to 7th day and further follow up. Statistically significance result of P value <0.05 was observed (Table 59).

Table No -60: Effect of cold water irrigation followed by Diclofenac gel application on of Adduction of Ankle Joint

Adduction	Treatment days	Mean score		% of relief	SE (±)	P<0.05	95% CI
		BT	AT				
During Treatment	I day	0.780	0.760	2.56	0.042	No	-0.090 to 0.130
	III day		0.090	88.46	0.028	Yes	0.579 to 0.800
	VII day		0.0	100	0.0	Yes	0.669 to 0.890
Follow-up	II Week		0.0	100	0.0	Yes	0.669 to 0.890
	IV Week		0.0	100	0.0	Yes	0.669 to 0.890

Adduction movement improved by 2.56% on 1st day, 88.46% improvement was noted on 3rd day and normal range of movement on 7th day, this continued in further follow up. Statistically the P value <0.05 is highly significant (Table-60).

Effect of cold water irrigation followed by Diclofenac gel on Deranged movements of Ankle Joint:

Effect of the therapy was assessed on various types of movements of ankle joint. Initially dysfunctions in dorsi-flexion, plantar-flexion, inversion, eversion, abduction and adduction, were recorded with goniometry and compared with the movements of normal limb. One week cold water irrigation followed by diclofenac gel application corrected all these functions to 100%, which were statistically highly significant ($P < 0.05$). On the follow up study also these effects were found insistent (Table- 55, 56, 57, 58, 59 and 60).

Table No -61: Statistical analysis showing the result on Clinical features after one week treatment with Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa for Ankle sprain

Symptoms	Mean score		% of relief	S.E (±)	‘P’
	BT	AT			
Pain	1.66	0.08	95.18	0.02	<0.05
Tenderness	1.53	0.08	95.42	0.02	<0.05
Swelling	1.45	0.03	98.41	0.07	<0.05
Loss of function	1.24	0.0	100	0.0	<0.05
Discoloration	0.17	0.0	100	0.0	<0.05

The Trial group showed 95.18% improvement in pain, 95.42% in tenderness, 98.41% in swelling and 100% in loss of function and discoloration respectively. There was marked improvement in all the parameters of Ankle sprain with $p < 0.05$ after one week treatment (Table-61).

Table No -62: Statistical analysis showing results of Degrees of foot movements *after one week* treatment with Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa

Foot Movements	Mean score		% of relief	S.E (±)	‘P’
	BT	AT			
Dorsiflexion	1.33	0.01	99.24	0.01	<0.05
Plantarflexion	1.45	0.01	99.31	0.01	<0.05
Inversion	1.01	0.0	100	0.0	<0.05
Eversion	0.5	0.0	100	0.0	<0.05
Abduction	0.48	0.0	100	0.0	<0.05
Adduction	0.90	0.0	100	0.0	<0.05

Significant improvement in the movements of joint with 99.24% in dorsiflexion, 99.31% in plantar-flexion and 100% result in inversion, eversion, abduction and adduction respectively after one week of management (Table-62).

Table No -63: Table showing result on Clinical features *after one week* treatment with cold water irrigation followed by Diclofenac gel application for Ankle Sprain

Symptoms	Mean score		% of relief	S.E (±)	‘P’
	BT	AT			
Pain	1.56	0.11	92.94	0.03	<0.05
Tenderness	1.44	0.11	92.36	0.03	<0.05
Swelling	1.52	0.09	95.51	0.51	<0.05
Loss of function	1.14	0.04	96.49	0.01	<0.05
Discoloration	0.16	0.0	100	0.0	<0.05

The control group showed 92.94% improvement in pain, 92.36% in tenderness, 95.51% in swelling and 96.49% in loss of function and 100% in discoloration. There was marked improvement in all the parameters of Ankle sprain with $p < 0.05$ after one week treatment (Table-63).

Table No -64: Table showing results of Degrees of foot movements *after one week* with cold water irrigation followed by diclofenac gel application

Foot Movements	Mean score		% of relief	S.E (±)	‘P’
	BT	AT			
Dorsiflexion	1.25	0.04	96.8	0.01	<0.05
Plantarflexion	1.25	0.04	96.8	0.01	<0.05
Inversion	0.94	0.0	100	0.0	<0.05
Eversion	0.52	0.0	100	0.0	<0.05
Abduction	0.52	0.0	100	0.0	<0.05
Adduction	0.78	0.0	100	0.0	<0.05

Significant improvement in the movement of ankle joint with 96.8% in dorsiflexion and plantar-flexion each and 100% result in inversion, eversion, abduction and adduction after one week (Table-64).

OVERALL RESULT**Table No -65: Comparative study of results of both the groups *after one week* treatment for Ankle sprain**

Characteristics	Trial Group			Control Group		
	Mean score		% of relief	Mean score		% of relief
	BT	AT		BT	AT	
Pain	1.66	0.08	95.18	1.56	0.11	92.94
Tenderness	1.53	0.08	95.42	1.44	0.11	92.36
Swelling	1.45	0.03	98.41	1.52	0.09	95.51
Loss of function	1.24	0.0	100	1.14	0.04	96.49
Discoloration	0.17	0.0	100	0.16	0.0	100
Dorsiflexion	1.33	0.01	99.24	1.25	0.04	96.8
Plantarflexion	1.45	0.01	99.31	1.25	0.04	96.8
Adduction	0.90	0.0	100	0.78	0.0	100
Abduction	0.48	0.0	100	0.52	0.0	100
Inversion	1.01	0.0	100	0.94	0.0	100
Eversion	0.5	0.0	100	0.52	0.0	100

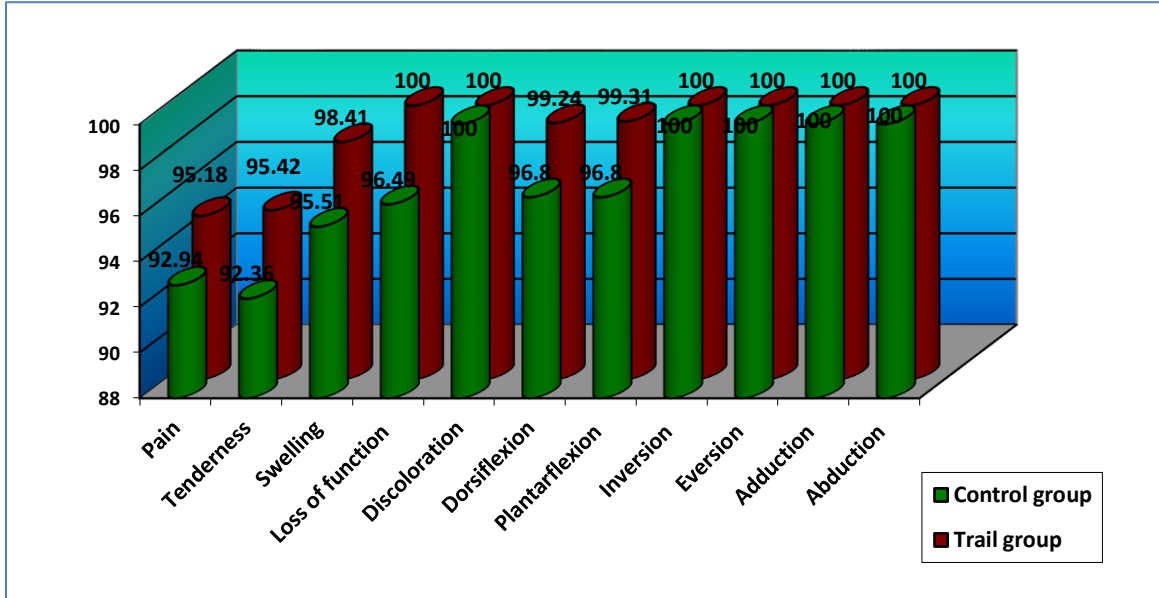
Comparison of results in both the groups showed 100% improvement in movements of joint and discoloration with marked improvement in other clinical features of Trial and Control group after one week treatment (Table- 65).

Table No -66: Comparative study of *follow up* results of both the groups in Ankle sprain

Characteristics	Trial Group			Control Group		
	Mean Score		% of relief	Mean Score		% of relief
	BT	AT		BT	AT	
Pain	1.66	0	100	1.56	0	100
Tenderness	1.53	0	100	1.44	0	100
Swelling	1.45	0	100	1.52	0	100
Loss of function	1.24	0	100	1.14	0	100
Discoloration	0.17	0	100	0.16	0	100
Dorsiflexion	1.33	0	100	1.25	0	100
Plantarflexion	1.45	0	100	1.25	0	100
Adduction	0.909	0	100	0.78	0	100
Abduction	0.48	0	100	0.52	0	100
Inversion	1.01	0	100	0.94	0	100
Eversion	0.5	0	100	0.52	0	100

Both the groups showed complete remission in all the parameters in the follow up period (Table- 66).

Graph-19 Graph showing the Comparative results of both groups after one week treatment for Ankle Sprain



Graph-20 Graph showing the Comparative results of follow up of the both groups of Ankle Sprain

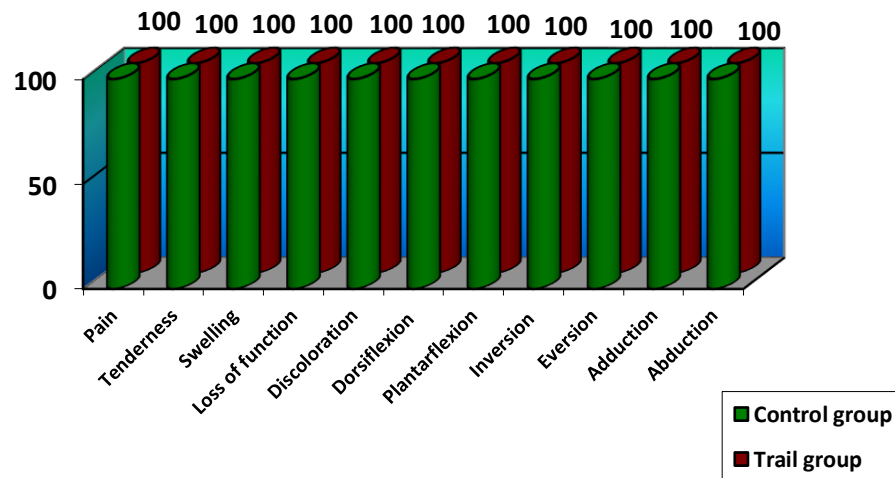


Table No –67: Number of patients improved by 100% in signs and symptoms day wise analysis in Trial group

Criteria	No of patients affected	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Total
Pain	100	00	00	07	39	21	17	08	92
Tenderness	100	00	00	07	32	27	15	11	92
Swelling	Above 44	01	10	14	10	01	01	06	43
	Middle 100	00	00	00	17	22	23	22	84
	Below 100	00	00	03	20	17	30	13	83
Loss of function	100	00	00	11	52	12	20	05	100
Ecchymosis	17	00	00	05	12	00	00	00	17
Dorsiflexion	100	00	00	13	37	22	19	08	99
Plantarflexion	100	00	00	13	30	25	19	12	99
Inversion	91	00	16	54	21	00	00	00	91
Eversion	46	06	22	11	04	03	00	00	46
Abduction	46	09	14	19	03	01	00	00	46
Adduction	85	34	39	12	00	00	00	00	85

Table No –68: Number of patients improved by 100% in signs and symptoms day wise analysis in Control group

Criteria	No of patients affected	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Total
Pain	100	00	00	00	13	32	21	23	89
Tenderness	100	00	00	00	11	32	22	24	89
Swelling	Above 41	00	09	11	06	04	11	09	41
	Middle 100	00	00	00	15	22	25	20	82
	Below 100	00	00	03	17	18	31	19	88
Loss of function	100	00	00	00	14	38	29	19	96
Ecchymosis	16	00	00	00	09	07	00	00	16
Dorsiflexion	100	00	00	00	16	38	22	20	96
Plantarflexion	100	00	00	00	14	39	23	20	96
Inversion	88	00	02	22	41	10	10	03	88
Eversion	52	01	29	16	06	00	00	00	52
Abduction	52	01	44	07	00	00	00	00	52
Adduction	78	02	31	36	09	00	00	00	78

OVERALL EFFECT

Table No -69: Total effect of Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa with cold water irrigation followed by Diclofenac gel application after one week treatment for Ankle sprain.

Total Effect	Patients in number and Percentage				Total	%
	Trial Group		Control Group			
Complete remission	92	92%	89	89%	181	90.5
Marked improvement	08	08%	11	11%	19	9.5
Moderate improvement	00	00%	00	00%	0	0
No improvement	00	00%	00	00%	0	0

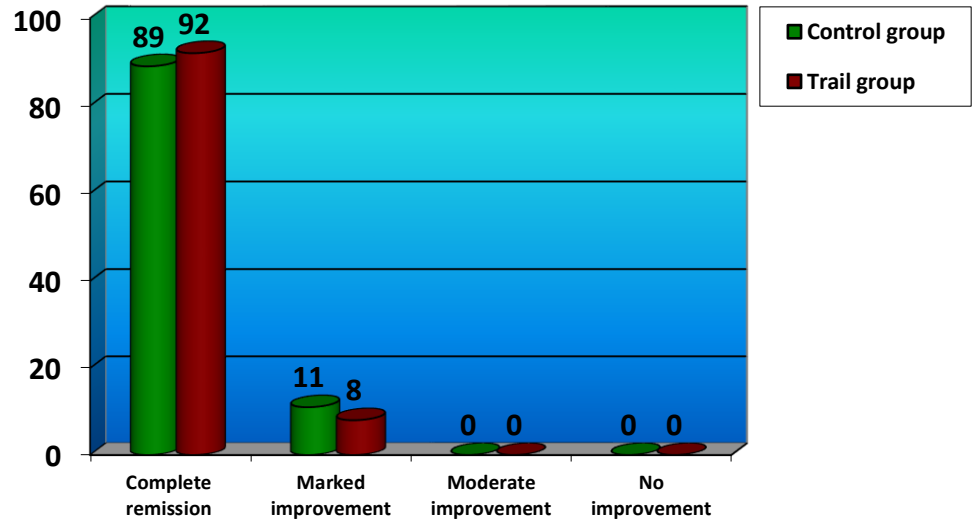
Overall result showed 92% complete remission, 08% moderate improvement in Trial group and 89% complete remission, 11% moderate improvement in Control group. No patient was there in both groups without any improvement after one week treatment (Table-69).

Table No -70: Total effect of Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa with cold water irrigation followed by diclofenac gel application treatment for Ankle Sprain during follow up week

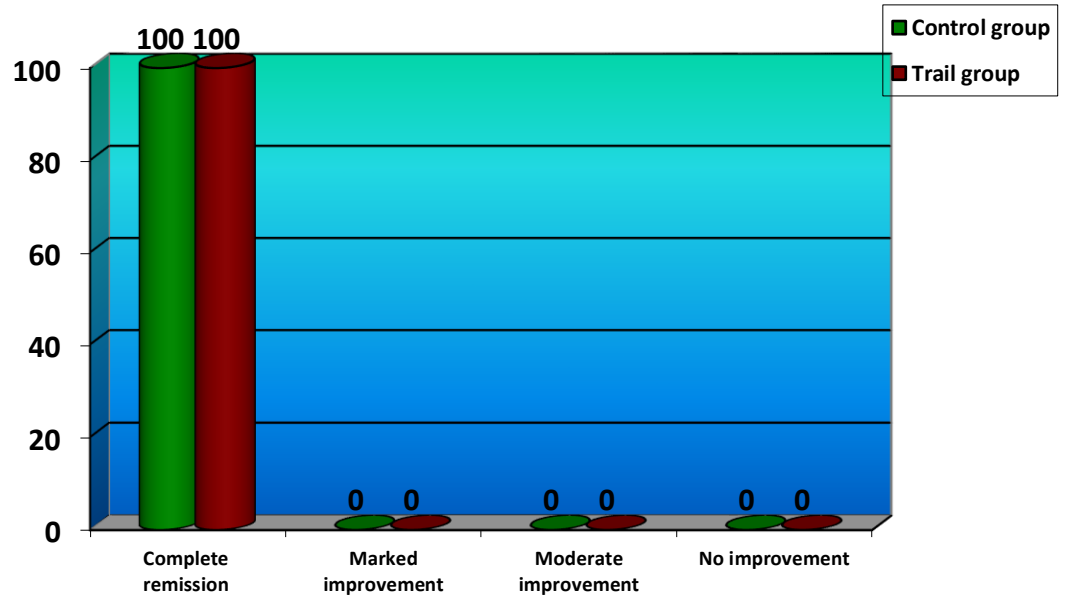
Total Effect	Patients in number and Percentage				Total	%
	Trial Group		Control Group			
Complete remission	100	100%	100	100%	200	100%
Marked improvement	00	0%	00	0%	0	0%
Moderate improvement	00	0%	00	0%	0	0%
No improvement	00	0%	00	0%	0	0%

The groups showed 100% complete remission in the follow up study (Table-70).

Graph-21 Overall results in the both groups after one week of treatment for Ankle Sprain



Graph- 22 Overall results in the both groups of follow up of treatment for Ankle Sprain



DISCUSSION

The competitive, frantic and busy lifestyle is increasing the incidence of trauma. Gulpha is the imperative joint in the leg present at the junction of leg and foot. Gulpha Marma is present at the intersection of Pada and Jangha. It is Rujakara Marma and produces the symptoms as Ruja (pain), Stabdha Padata (stiffness of joints) or Khanjata (limping) when injured. Generally Ruja Sthala is rich of nociceptive nerve endings, which are found abundantly in ligaments, tendons, periosteum and apophyseal joints. Kurchasira Marma is situated below the Gulpha Sandhi and is also Rujakara Marma, when injured produces the symptoms as Ruja (pain) and Shopha (swelling).

From the above explanation it is obvious that Kurchasira Marma can be correlated to retinaculum, which is present below the Gulpha Sandhi. Gulpha Marma can be compared to ligaments, as these ligaments are attached to the malleoli of tibia and fibula running obliquely downwards to insert into the talus. Further injury to Gulpha Marma produces symptoms as Ruja (pain), Stabdha Padata (stiffness of joints) or Khanjata (limping), which are similar to the features of Ankle Sprain as pain (Ruja), stiffness of joint (Stabdha Padata), loss of function (Khanjata) and swelling.

Ankle pain is most often due to an ankle sprain, which is an injury that causes a stretch or tear of one or more ligaments in the ankle joint. Ankle sprain is mainly caused by inversion (85%). Most commonly anterior talo-fibular ligament followed by calcaneo-fibular ligament and rarely posterior talo-fibular ligament or eversion of foot where deltoid ligament is involved.

From the above description similarity between the clinical features of Gulpha Marma Viddha Lakshana and Ankle sprain is noted. Hence Ankle sprain can be correlated with Gulpha Marmabhighata.

The Nidana for Agantuja Vrana is Patana, Abhighata etc. Acharya Sushruta in the context of Asthi Bhagna mentioned, if fall or trauma has resulted in swelling without any external wound, then one should adopt Sheeta Parisheka, Sheeta Pradeha for the recovery of ailment. Other Acharyas like Vrdha Vagbhata, Vagbhata, Cakradatta, Bhavamishra and Yogaratnakara opine the same.

In Bhagna Rogadhikara every Acharya has emphasized the use of Sheeta Lepa in acute traumatic conditions as the principle line of management.

Considering the Samprapti, after Abhighata Rakta is vitiated which do Margavarodha to Vata, producing the Lakshanas of Vataavarodha. Hence *Vyadhi Viparita Chikitsa* is followed i.e Sheeta Parisheka and Pradeha.

The specific nature of reducing the Dosha or Vyadhi can be brought about by altering the formulation. Thus Seka provide extensive utility for various conditions, hence it is of great importance in this perspective. In Bhagna, Secana should be done with Nyagrodhadi Kashaya and in painful state with Panchamooli Kashaya or Secana with Tilataila is advocated. Seka relieves fatigue, conciliates Vata, promotes rejoining of fractured bones and pacifies the pain caused due to injury, burns, hit or abrasions.

In Pittajashopa, Raktaja, Abhighataja and Visaja conditions Seka can be adopted using Ksheera (milk), Ghrita, Madhu (honey), Sarkarodaka (sugar juice), Ikshurasa (sugarcane juice) or decoctions prepared out of Madhura drugs or Ksheerivriksha and the state of liquid used should not be hot. Hence Udumbara which is Madhura Rasatmaka and one among Ksheerivriksha is chosen for the study.

In the context of benefits of Pradeha, Acharya Sushruta emphasizes to use *Pradeha* at the site of *Marama Stitha Dosha*. So the present study is carried based on the same principle.

The soles and palms contain the maximum nerve endings of the body which when stimulated bring healing effect. The stimulation effect of cold water also relieves the congestion of the blood vessels. The effect and reaction of water is quicker than that of the drugs in acute diseases and in symptoms of majority of other disorders.

Water action on body is to mitigate internal congestion, reduce inflammation and relieve pain, stimulate circulation, encourage elimination of toxins present in the system and lower or raise the temperature of the body. Hot applications are useful in relieving internal and deep congestions, while cold applications are useful in reducing swelling and superficial congestions.

Diclofenac is a potent inhibitor of COX-2 (cyclooxygenase), hence is an analgesic, antiinflammatory and antipyretic agent.

The goal of all therapeutic approaches is to regain Ankle stability and healing time of the ligament must be ascertained.

In this study 228 patients of Ankle Sprain were screened, among them only 200 patients were selected and randomly divided into Trail and Control group consisting of 100 patients in each group. Significance of the observations pertaining to various aspects made in the study are as follows:

Limitations: Among 200 patients only 23 cases in trail group and 22 cases in control group got admitted. The condition is not seriously taken by many individuals and is probably neglected. The procedure can be undertaken on OPD bases. Hence admission rate has fallen.

Analgesics used: Number of patients who used analgesics before consulting.

	Ointment	Tablet	Injection
Trail group	11	12	01
Control group	15	11	01

Place of work: K.L.E.U's Shri B.M.K. Ayurved Mahavidyala, Shahapur, Belgaum and B.V.V.'s Ayurved Medical College and Hospital, Bagalkot. Karnataka.

Duration of work: 4 years and 8 months.

DISCUSSION ON OBSERVATIONS:

1. Age – In the series of 200 patients of ankle sprain, maximum 62.5% (125) of the patients belonged to 20-30 years age group, 20% between 31-40 years, while 13% to 41-50 years and 4.5% to 51-60 years (Table-17). Maximum percent are young individuals, the reason may be young adults speedily indulge in an assortment of activities such as fast walk, fast drive, playing on uneven surfaces, jumping etc. This may be the reason to endure injuries.

2. Gender – In this study 62% (124) of patients were female and 38% (76) of patients were male (Table-18). Rationality behind this is females are less cautious of themselves when they are indulged in the work or are more puzzled during work, stressed and wearing of high heeled footwear are some of attributers. Nearly 2:1 ratio for F: M is observed in the study.

3. Religion – As per the caste category, Hindu were 92%(184), Muslim 5.5%(11) and Christian 2.5%(5) (Table 19). The reason may be that the number of patients visiting to K.L.E. and B.V.V.S. Ayurved Hospital are more of Hindus, hence their percentage is more.

4. Socio-Economic Status – Patients belonging to lower income group 15%(30), lower middle class were 45%(90), the high incidence is probably due to their laborious work, maintenance of poor health status and 30%(60) patients were from the higher middle income group class (Table-20), may be due to busy schedule, excessive walking, using of high heel footwear are the attributes to the cause and higher income group 10%(20) people walking without attention towards stepping.

5. Occupation – Occupation wise distribution of the patients showed that 37% (74) of the patients were students, 25% (50) were home maker, 20.5%(41) were doing service and labourers 13.5%(35) (Table-21). Various degree colleges, boys and girls hostel are in the campus near the hospital so the students number is more, most of them were boarder, who indulged in playing, quickly getting down the steps; in case of homemakers due to their indulgence in busy schedule, not cautious of the gait while walking resulted in slip or fall with inversion of the foot. Job holders in stress of reaching the work place on time ran to catch bus or twist while giving kick to start the bike. Labourer un-noticing the pits while walking in field sustained ankle injury.

6. Habitat – Further analysis showed that 15%(30) patients were from rural area and 85%(170) patients belonged to urban area (Table-22). Arduous life styles, walking on uneven surface (roads), unaware of next step are the reasons behind this. Rural people visit the doctor only when symptoms are severe; this may be one of the rationales why the incidence was found more in urban area.

7. Diet -Concerned with diet pattern 50%(100) were vegetarian and remaining 50%(100) used mixed diet. Diet play role to maintain strength and stability of bones and ligaments. Hence healthy diet is must which can be supplemented by either vegetables or non vegetarian diet. Along with diet other factors also add on(Table 23).

8. Prakruti – In this series of 200 patients of ankle sprain 53.5% patients were of Vata-Pitta Prakruti, 15.5% were of Vata-Kapha Prakruti and 31% were of Pitta-Kapha

Prakruti (Table-24). Vata-Pitta Prakruti people are Chala Guna Pradhana and have instable walk, resulting in either inversion or eversion of foot, while Vata-Kapha people have stable joints because of the Sthira Guna of Sleshaka Khapa and Pitta-Kapha Prakruti are annoyed in nature by Visra guna of Pitta, hence more incidence is found in Vata-Pitta and Pitta-Kapha Prakruti people.

9. Nidra - The patients who suffered from Ankle sprain, among them 84%(168) had sound sleep while 16%(32) had disturbed (Table-25). Disturbance was mainly owing to pain during change in position and worry of unable to attend work place.

10. Vyayamashakthi and Satva – Analysis of Vyayamashakthi showed that 15% had Pravara Vyayamashakthi, 71.5% of the patients in this series had Madhyama Vyayamashakthi while remaining 16% patients had Avara Vyayamashakthi (Table - 26). Vyayamashakthi was assessed based on the movements of the joints and ability to perform their routine activities. As most of the patients sustained Grade I injury and were more concerned with daily activities either related to business, household work or academic activity were able perform their routine activities without any difficulty and had capacity to bear the hurt. Vyayamashakthi is interlinked with Satva of the patient. Among 200 patients of Ankle Sprain 12.5% had Pravara Satva, 71.5% had Madhyama Satva and 16% patients had Avara Satva (Table-27). Pain threshold differs in all individuals. Thus patients with Madhyama Vyayamashakthi were found to have Madhyama Satva and tolerated the pathology to their capacity.

11. Mode and Mechanism of Injury – The analysis on mode of injury showed that 33% (66) patients got injured while getting down or stepping down the stairs. The rationality behind this is, getting down the stairs in hurry, fast stepping down or getting down the steps with talking to others lead to improper proprioception of the ankle joint during the movement, leading to instability and resulting in twist of the foot and then sprain; 18.5%(37) got injured while playing on uneven surface, sports related like foot ball, volley ball, tenniquit, running etc, 16.5%(33) during morning fast walk or walk on uneven surface; 11%(22) due to slip of leg in bathroom or stepping on water lay floor; 6.5%(13) experienced ankle sprain due to walking with high heeled footwear or loosely fitted footwear which lessen the grip on ground;

5.5%(11) during jumping down from compound, chair etc; 05%(10) had direct trauma by hard object and 04%(08) fall from bike, while running (Table-28).

Further analysis showed in 83.5%(167) patients the injury was due to inward twist of the foot i.e. inversion, while remaining 16.5%(33) had the injury due to the out ward twist of the foot (eversion) (Table-29).

The movement of inversion and eversion take place at subtalar and talo-calcaneo-navicular joints and partly at transverse lateral joint. The eversion injuries are less common than the inversion injuries because the deltoid ligament, which attaches the medial malleolus to the talus is very strong. Consequently it is not prone to rupture as the lateral ligaments. Among the three lateral ligaments anterior talo-fibular is weakest, so more subjected to injury.

12. Dominant side involved – Maximum patients i.e. 73.5%(147) got sprain of left foot while remaining 26.5%(53) patients had sprain of right foot (Table-30). The probability may be, after stepping of right foot firmly less caution is taken for the next stepping that may be reason for left side dominance.

13. Types of Ankle sprain according to Grades – In the series of 200 patients 60.5% (121) endured from Grade I and 39.5% (79) from Grade II Ankle sprain. It is noted that obese people suffered more from Grade II Ankle sprain due to overweight and more stress on the ligaments.

Excessive stress prevents early healing. In lean individuals ankle sprain is due to their fast unstable walk. Patients of Grade I were moderately built and sustained injury of less force. Thus, force of twist signifies the severity and stability in walk (Table-31).

14. Discoloration/Ecchymosis - Following Ankle sprain 20.5%(41) patients developed bluish discoloration below lateral malleolus. This is mainly due to localized collection of superficial, internal capillary bleed which tells the severity of sprain. 79.5%(159) did not present with any discoloration as maximum had Grade I sprain (Table-32).

15. Swelling of the affected limb – Out of 200 patients in the series 45%(90) suffered from mild swelling while 41.5%(83) and 13.5%(27) each had moderate and severe

swelling respectively (Table-33). Grade of sprain and presentation decides the type of swelling.

Among the three sites of recording at ankle, more swelling was noted in the middle(100%) of ankle joint and one inch below ankle joint i.e lower 1/3rd (99.5%) as compared to upper 1/3rd (40%) 1 inch above ankle joint (Table-34). As the ligaments are present along the lateral and medial malleoli, sprain results in collection of tissue exudates in the middle and lower 1/3rd of the Ankle leading to edema. Severity depends on the force of injury.

DISCUSSION ON RESULTS

Effect of Manjisthadi lepa and Diclofenac gel

Patients of Ankle sprain were randomly divided into two groups by computerized random number technique each group comprising of 100 patients. Patients of Trail group underwent Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa application and those of Control group were treated with cold water irrigation followed by Diclofenac gel application. The study was carried to see the combined effect of Udumbara Twak Kawtha Parisheka and Manjisthadi Lepa in combating Ankle sprain especially to reduce the swelling (Shothahara) and to compare with modern line of management.

The procedure is carried for one week in both the groups. The effects of medicine are being discussed here under the heading of each parameter adopted for this study.

Statistical test applied: One way ANOVA test with sub test i.e. Tukey's Multiple Comparison test.

Effects of cold water irrigation followed by Diclofenac gel application and Udumbara Twak Kawtha Parisheka followed by Manjisthadi Lepa on Pain

On day one of procedure showed minimal relief of 0.60%, on third day 36.74% and on seventh day 95.18% relief in pain was observed by Udumbara Twak Kawtha Parisheka followed by Manjisthadi Lepa application. The pain was found completely relieved on the first follow up of one week (Table-35).

On the other hand no change in pain was observed on first day. On third day of procedure 18% relief was noted and by the end of one week 92.94% relief by cold water irrigation followed by diclofenac gel application. Pain was completely relieved on the first follow up (15th day) of one week (Table-48).

When viewed through the intensity of pain the mean was more in trail group i.e. mean score of 1.66 as compared to control group, which was 1.56.

The compared effects of both the groups showed pain intensity has diminish more in trail group when compared to control and was equally sustained in both the groups for further follow up period.

The probable reason may be, in the acute condition of injury there is peripheral capillary bleed which gets localized resulting in edema, in turn puts pressure on nerve endings leading to pain. This has been intellectually explained as, after Abhigata there is vitiation of Rakta that does the Avarana to the flow of Vata, resulting in Ruja. As a result during the initial stage i.e. immediately after trauma Sheeta Upachara is advised, it aids to pacify Rakta. Thus the obstruction is cleared and pain relief is observed and also the nerve conduction capacity is reduced by cold measures.

Hence Acharya Sushruta's principle holds good even today, because in all acute traumatic conditions he has advised to adopt Sheeta Upachara, which is similar to ice packs according to allied science.

Cold water irrigation brings vasoconstriction and minimize bleed. In initial response to injury prostaglandins, bradykinins are released which initiate inflammatory process. Diclofenac mainly acts on COX 2 and inhibits prostaglandins synthesis. Thus helps to effect on pain.

Effects of cold water irrigation followed by Diclofenac gel application and Udumbara Twak Kawtha Parisheka followed by Manjisthadi Lepa on Tenderness

As such application of gel or Lepa did not produce any benefit on first day but Manjisthadi Lepa provided significant relief of 33.33% in tenderness on the third day and increased to 95.42% by one week of Lepa application. Tenderness was found completely relieved on first follow up of one week and onwards (Table-36).

On the other hand improvement of 13.19% was observed on the third day and it became 92.36% after one week of the application of Diclofenac gel. Tenderness was found completely relieved on first follow up of one week and then onward (Table-49).

Comparison of effects in both the groups on tenderness showed, though initially no improvement was appreciated, however third day onwards changes began having significant relief by one week.

On the basis of above results it may be concluded that, Manjisthadi Lepa provided better initial relief in comparison to Diclofenac gel. Tenderness is because of pressure effect on tissue exudates. This is reduced by initial vasoconstriction and later vasodilatation effect of cold, which absorbs the exudates into circulation.

Udumbara Twak Kwatha Parisheka helps to ease Vedana by its Vrana Shodana and Ropana property and by its Sheeta potency acts as vasoconstrictor. Manjistha being Raktashodhaka in action and Ushna in potency aids in vasodilatation, thus the tissue exudates are absorbed to relieve the pressure and tenderness in return.

Cold water irrigation aid in vasoconstriction followed by vasodilatation. Diclofenac gel application acts as anti-inflammatory and reduces the tissue exudates, thus helps to relieve tenderness.

Effects of cold water irrigation followed by Diclofenac gel application and Udumbara Twak Kawtha Parisheka followed by Manjisthadi Lepa on Swelling of Upper 1/3rd, Middle and Lower 1/3rd of Ankle joint

Manjisthadi Lepa provided highly significant ($P < 0.05$) relief in swelling in all parts of the ankle joint after application for one week. On 3rd day 60.34%, 50.24% and 58.13% result in upper, middle and lower part respectively and on 7th day 100% in upper 1/3rd, 97.56% in middle and 97.76% in lower part of ankle joint (Table-37, 38 and 39).

One week application of gel did not show any result on 1st day after treatment. Swelling reduced by 52.38%, 29.78% and 30% in upper, middle and lower part of ankle joint respectively. Later on 7th day highly significant ($P < 0.05$) relief in swelling as complete relief of 100% in upper 1/3rd, middle 92.55% and lower 1/3rd 94% (Table-50, 51 and 52). On the follow up study also it remained almost sustained in all the three parts. Further consideration showed that the swelling was more noted in the mid and lower part of the ankle. Hence both the therapies reduced the swelling more in

middle and lower 1/3rd of ankle and swelling in upper 1/3rd was less hence reduced faster.

Manjisthadi Lepa is the combination of five ingredients, in which Shali Pishti is one. This ingredient is not only acting as binding agent but also putting pressure effect. Thus indirectly it is giving effect of crepe bandage to reduce the swelling. The drugs as Manjistha, Yastimadhu and Raktachanda have Shothahara property. Irrigation of cold water prevents further bleed and localized blood collection. Cold water aid in absorption of tissue exudates by latent vasodilatation effect. Diclofenac acts as anti-inflammatory, thus helps to relieve swelling.

Effects of cold water irrigation followed by Diclofenac gel application and Udumbara Twak Kawtha Parisheka followed by Manjisthadi Lepa on Loss of function of Ankle Joint

On the other side first day procedure of Udumbara Twak Kawtha Parisheka followed by Manjisthadi Lepa provided improvement of 0.8% in loss of function of Ankle Joint, which became 27.2% after three days of Lepa and increased to 100% after one week of Lepa application. This relief continued on the follow up study also (Table-40).

One day procedure of cold water irrigation followed by Diclofenac gel application did change the gait, improvement of 9.6% was noted on third day and significant improvement of 96.49% on seventh day in loss of function of ankle joint. On first follow up it was 100% and sustained in all the weeks of follow up (Table-53).

On the basis of the above effects it was noted that Parisheka and Lepa provided better pick up in loss of function of ankle joint in comparison to the irrigation and gel application.

Once the pain and swelling gradually reduced, restricted movement at ankle joint became free with normal functioning of joint.

Effects of cold water irrigation followed by Diclofenac gel application and Udumbara Twak Kawtha Parisheka followed by Manjisthadi Lepa on Discoloration at site of Ankle sprain

Ecchymosis at the site of Ankle sprain remained the same on first day of Manjisthadi Lepa application. On third day 29.41% improvement and 100% after one week which was sustained up to the last follow up of the study (Table-41).

Similarly one day and third day treatment did not have change on discoloration at affected site of ankle and later on gradual change began which completely vanished by seventh day of diclofenac gel application. This 100% effect of the therapy remained sustained on all the follow up study weeks also (Table-54).

It is obvious from the foregoing study that the overall effect of trail group was better in improving the discoloration in comparison to control group.

Discoloration or Ecchymosis is mainly due to subcutaneous collection of bleed following sprain. Cold water irrigation does vasoconstriction which prevents further bleed. But diclofenac gel does not act directly to reduce ecchymosis. Hence this procedure took long time to show the effect.

The body is made up of Panchamahabhuta and skin is not devoid of them. Due to predominance of Vayu Mahabhuta, it possesses the property of tactile sensation. Moreover with the help of Bhrajaka Pitta it absorbs, metabolizes the oils and other topical medicaments, in addition to gives lusture and complexion to the body. The local Bhrajaka Pitta is vitiated in initial stage of injury leading to discoloration. By Udumbara Twak Kawtha Parisheka followed by Manjisthadi Lepa, the vitiated Pitta is mitigated and skin colour is brought back to normalcy. This action is by Sheeta Veerya Pradhana ingredients in Parisheka and Lepa that is Udumbara, Yastimadhu, Raktachandana, Shali and also by Rakta Shodhaka property of Manjistha.

Effects of cold water irrigation followed by Diclofenac gel application and Udumbara Twak Kawtha Parisheka followed by Manjisthadi Lepa on Dorsiflexion of Ankle Joint

One day application of Manjisthadi Lepa provided no relief in the dorsiflexion. But it provided significant relief of 32.33% and 99.24% on the third and seventh day of Lepa application respectively and on the follow up weeks it maintained as 100% (Table-42).

On the other hand Gel application provided no relief in dorsi-flexion after one day of treatment, relief of 12% on third day and 96.8% on seventh day of gel application and resulted in 100% in the follow up weeks (Table-55).

On the basis of the above results it can be concluded that both types of procedure started providing progress in dorsi-flexion only after third day, but overall

effect in relieving the movement of dorsiflexion was better in Trail group than Control group.

Effects of cold water irrigation followed by Diclofenac gel application and Udumbara Twak Kawtha Parisheka followed by Manjisthadi Lepa on Plantar-flexion of Ankle Joint

One day application of Lepa provided relief of 0.68% in the plantar-flexion, which increased to 29.45% and 99.31% on the third day and seventh day of the procedure respectively and in the follow up weeks it sustained as 100% (Table-43). Following cold water irrigation and application of diclofenac gel as such on first day no improvement was noted in plantar-flexion but progressively change of 12% on third day followed by 96.8% noteworthy improvement was observed on seventh day which became 100% in follow up days (Table-56).

On the basis of the above results it may be said that initially the effect was minimal, which become better on the third day and best on seventh day in study group. Therefore the effect of treatment in both the group for providing relief in the movement of plantar flexion may be taken as near to equal.

Effects of cold water irrigation followed by Diclofenac gel application and Udumbara Twak Kawtha Parisheka followed by Manjisthadi Lepa on Inversion of Ankle Joint

Inversion movement before and after first day treatment remained the same, with significant aid of 76.23% and 100% in the inversion, on third and seventh day respectively in trail group (Table-44).

On the other hand one day formula in both groups had no effect, later three days procedure provided relief of 34.04%, which become 100% on the seventh day in control group (Table-57).

In this way the effect of Trail group in improving the inversion movement was significant.

Effects of cold water irrigation followed by Diclofenac gel application and Udumbara Twak Kawtha Parisheka followed by Manjisthadi Lepa on Eversion of Ankle Joint

One day Lepa application provided relief of 14% in eversion. But three days application of Lepa provided the significant relief of 86% which become 100% on the seventh day (Table-45).

On the other hand one day application of gel provided relief of 1.92% in eversion, which increased to 88.46% and 100% on the third and seventh day respectively (Table-58).

In this way the overall effect in improving the eversion movement was better in control group.

Effects of cold water irrigation followed by Diclofenac gel application and Udumbara Twak Kawtha Parisheka followed by Manjisthadi Lepa on Abduction of Ankle Joint

One day application provided relief of 18.75% in the abduction. But three days application of Lepa provided significant relief of 91.66%, which become 100% on seventh day of application (Table-46).

On the other hand Abduction function though not hampered in many beneficiaries, first day procedure provided relief of 1.92% in the abduction, which increased significantly to 100% on the third day and continued further to seventh day and in follow up days respectively (Table-59).

In this way overall effect in improving the abduction movement was better in control group.

Effects of cold water irrigation followed by Diclofenac gel application and Udumbara Twak Kawtha Parisheka followed by Manjisthadi Lepa on Adduction of Ankle Joint

On the other side one day application of the Manjisthadi Lepa provided relief of 7.77% in adduction, which increased to 87.77% and 100% on third and seventh day of application respectively (Table-47).

Application of Diclofenac gel provided relief of 2.56% in adduction on first day, which increased significantly to 88.46% on third day and 100% on seventh day of application (Table-60).

It is clear from the above results that initially the effect of Lepa was slightly better which become much better on the third day in Gel group. Therefore the effect of both the group in providing relief in the movement of adduction may be taken equal at the end of first week.

Effects of cold water irrigation followed by Diclofenac gel application and Udumbara Twak Kawtha Parisheka followed by Manjisthadi Lepa on Range of Movement of Ankle Joint:

The outcome of the remedy was assessed on several movements of ankle joint. Initially range of movement in dorsi-flexion, plantar-flexion, inversion and eversion, abduction and adduction, were recorded. One week of treatment corrected all these functions near to 100%, which were statistically highly significant ($P < 0.05$). On follow up study also these effects were found sustained in both the groups (Table –42, 43, 44, 45, 46, 47, 55, 56, 57, 58, 59 and 60).

Comparison of the Effects of cold water irrigation followed by Diclofenac gel application and Udumbara Twak Kawtha Parisheka followed by Manjisthadi Lepa in relief of symptoms in days on patients of Ankle Sprain

In control group reduction in pain was noted from 4th on wards in 13 patients while in trail group on 3rd day itself 07 patients and on 4th day 39 patients showed improvement, by the end of 7th day it was 89 patients and 92 patients in control and trail group respectively.

Change in the size of swelling was noted in 11 patients in control and 14 in trail group by 3rd day and by end of treatment (7th day) 82 in control and 84 in trail group.

In concerned with range of movement 16 patients in control and 37 in trail group by 4th day and by end of treatment (7th day) 96 in control and 99 in trail group was noted.

From the above findings it can be stated that Parisheka with Lepa started action earlier in several patients compared to water irrigation and diclofenac gel application (Table-67 and 68).

Comparison on overall effect of cold water irrigation followed by Diclofenac gel application and Udumbara Twak Kawtha Parisheka followed by Manjisthadi Lepa on the Patients of Ankle Sprain

On the basis of foregoing discussions it may be concluded that Udumbara Twak Kawtha Parisheka followed by Manjisthadi Lepa provided comparatively better relief in pain, tenderness, ankle swelling, loss of function, ecchymosis, dorsi-flexion, plantar-flexion and inversion as compared to cold water irrigation followed by Diclofenac gel application.

On the other hand cold water irrigation followed by Diclofenac gel application bestowed better results in adduction, abduction and eversion.

On the basis of the above mentioned comparison of the effects of both trail and control groups, it may be concluded that both types of treatment methods imparted significant relief to the patients of Ankle Sprain but the effects of Udumbara Twak Kawtha Parisheka followed by Manjisthadi Lepa were better in comparison to cold water irrigation followed by Diclofenac gel application.

Therefore it can be concluded that Udumbara Twak Kawtha Parisheka followed by Manjisthadi Lepa were better in comparison to cold water irrigation followed by Diclofenac gel application over signs and symptoms and on range of movement.

OVERALL RESULT

Overall result showed in trail group 92% complete remission and 08% marked improvement was noted in patients who underwent Udumbara Twak Kawtha Parisheka followed by Manjisthadi Lepa and 89% complete remission and 11% marked improvement in control group who underwent cold water irrigation followed by Diclofenac gel application, with no patients in No improvement category in both the groups after one week treatment (Table-69). Both the groups showed 100% complete remission in the follow up study on second and fourth week (Table-70), with no incidence of relapse of any parameters.

DISCUSSION ON UDUMBARA TWAK KWATHA PARISHEKA
FOLLOWED BY MANJISTHADI LEPA

Discussion on Udumbara Twak Kwatha Preparation: The type of Kwatha prepared is Samana Kwatha, where 1part Udumbara Twak Kwatha Churna is mixed with 16 parts of water and reduced to 1/8th. After filtering, Kwatha is cooled and then used for Parisheka.

Discussion on Udumbara Twak Kwatha Parisheka: Udumbara by its Kashaya Guna has Vrana Ropana property. Madhura Rasa and Sheeta Veerya act as vasoconstriction to prevent further bleed. It is also Varnya hence facilitate to reduce ecchymosis. Parisheka is mainly advocated in painful condition. As Ankle sprain is also a painful condition of Ankle, which hampers its locomotor function. Therefore in such situation Nyagrodadhi Gana Kashaya is advised. One of effective drug in the Nyagrodadhi Gana is Udumbara which is preferred in this study. Seka relieves fatigue, conciliates Vata, promotes rejoining of fractured bones and pacifies the pain caused due to injury. The therapy facilitates the dissemination of drug potency.

Discussion on Manjisthadi Lepa: The results of the Lepa on pain, tenderness, swelling was remarkable within 36-48 hours after application of Lepa. This may be because following drugs are present in the Lepa:

Manjistha: Manjistha by its action is Raktaprasadaka and is having Ushna Veerya due to which it will dilate the peripheral vessels, especially venous dilatation followed by peripheral arterial blood flow.

This may be the reason for reduction of swelling around the site of sprain. As it is Kapha-Pitta-Shamaka which will reduce the local edematous residue and its Ushna Veerya property helps to penetrate into the tissue. The chemical composition is calcium salts, gum, resinous matter, which may be absorbed and thus initiate for early healing.

Swelling is one of the reasons for pain at the site of Ankle sprain due to pressure on peripheral sensory nerves. Lepa is applied in cold state; this reduces the conduction capacity of the nerves resulting in pain relief. The reduction of swelling

and pain may be due to Ushna Veerya of Manjistha. Madhura Rasa acts as Vata Shamana, which in turn aids to reduce pain.

Yashtimadhu: This drug is mentioned in Sandhaneeya Gana by Caraka. Madhura and Kashaya Rasa definitely enhance the ligament healing. By Madhura and Snigdha properties it reduces the Pitta and acts as anti-inflammatory. Madhura Vipaka and Guru Guna does Vata Shamana i.e. responsible for Vedanahara. As it is having anti-microbial property by which it doesn't allow the growth of microbes in the Lepa. Its chemical composition includes salts and potassium, these may also help for healing process.

Raktachandana: Due to its Madhura Rasa and Sheeta Veerya reduces the vitiated Sthanika Rakta by which it helps to lessen pain. By Shotahara property it will take out the edematous fluid from the site of Ankle sprain. By the Varnya property helps to reduce ecchymosis.

Shalipishti: The Laghu Guna makes the drug penetrate through the skin very easily. The Pishti prepared out of it is having Picchila Guna and makes other drugs to mix compactly with it. Mean while Sheeta Veerya and Snigdha Guna of the drug create stickiness on the skin which gives local compression effect and facilitate tissue fluid to escape.

The starch content of the Shali gives strong support to the site of Ankle sprain. Hence this may be very important drug in reducing swelling, pain and does local immobilization.

Shatadhauta Ghrita: The Laghu Guna of Ghrita is enhanced after it has been washed hundred times. Means it attains much Laghutva by its Samskara and becomes readily permeable into the skin by body temperature. As the molecules of Ghrita are further reduced, this is now absorbed easily into the skin. The Snigdha and Madhura property of the same reduces swelling and pain. The fatty lobules of the Ghrita act as base for the Lepa and aid in easy penetration of the drug and help for tissue repair.

Method of preparation of Lepa:

Sukshma Churna of Manjistha, Yastimadhu, Raktachandana and Shalipasti are taken in equal quantity (one part) while Shatadoutaghrita is taken half part. The

quantity of Ghrita taken is half because, if taken in equal amount Lepa would become ointment consistency and would not dry. All the above ingredients are taken in a bowl and mixed uniformly by adding Ushna Jala since adherence to skin was better, when compared to the Lepa prepared by mixing in Sheeta Jala. This is because the Picchila property of Shali is enhanced by Ushna Jala and acts as good binding agent. Lepa prepared by this manner was applied at the affected site of sprain when it cooled.

Time duration for Lepa drying: In the study an attempt was made also to note the time taken by the Lepa to become dry. The time of drying is influenced by the season. In the hot season Lepa gets dried by 3 hours while in cold season nearly 3 1/2 to 4 hours was required to dry up. Here dry means development of cracks over the Lepa associated with stretching sensation or feeling of tightness.

Probable mode of action of Manjisthadi Lepa: It is termed as Nirvapana Karma when Parisheka and Lepa both are followed. The fundamental process of tissue healing is dependent on the cellular activity. A reduction in temperature can bring about changes that ultimately may be beneficial in the process. These include reduction in bleeding; reduce swelling at the site of acute trauma, pain relief and reduction in local muscle spasm.

The reduction in swelling that accompanies the application of cold therapy following acute injury can be attributed to immediate vasoconstriction of the arterioles and venules, which reduces the circulation to the area and therefore reduces the extravasations of fluid into the interstitium. This effect is enhanced by the reduction in both cell metabolism and vasoactive substances, such as histamine, which are also associated with cooling. It is important to note that the period of vasoconstriction lasts between 10-15 minutes and is then followed by the cycle of Cold Induced Vasodilatation followed by vasoconstriction known as the “Lewis Hunting reaction”. Thus the initial phase of vasoconstriction helps to reduce the flow of blood into tissue following recent injury. This helps to limit the swelling and the extent of tissue damage.

Application of cold produces vasoconstriction only for a limited period of time. But Sheeta Lepa is maintaining its cooling effect for a prolonged duration which also helps for the absorption of medicinal properties of the Lepa. As Ghrita is base of Lepa it acts as vehicle for the absorption of drugs through the skin. It is possible that

cooling may lead to reduction in bleeding by reducing the blood flow and is most likely to occur during the early phase of treatment.

The major effect of cold therapy is to relieve pain. The probable mechanism involved is the stimulation of cold receptors. These receptors are present in the epidermis and are attached to medium diameter myelinated A fibers, although few connect to small diameter unmyelinated C fibers. Temperature of 25⁰C activates cold receptors, which send impulses into spinal cord through posterior root and close the pain gate. Cold also stimulates the mid brain which may release Beta Endorphins or Enkephalins into posterior horn and indirectly reduce pain by stimulation of thalamus.

Comparison of PRICE with Manjisthadi Lepa

- ❖ **P : Pain killer** → Sheeta Veerya of Lepa pacifies Rakta removes Avarana thus Vata is freed and subsides pain
- ❖ **R : Rest** → Application of Lepa makes one to rest
- ❖ **I : Ice application** → Sheeta Guna and Veerya of Lepa has long lasting cold effect
- ❖ **C : Compression** → Shali Pisti gives compression effect for long duration
- ❖ **E : Elevation** → Prevents collection

DISCUSSION ON COLD WATER IRRIGATION FOLLOWED BY DICLOFENAC GEL APPLICATION

Cold water irrigation: Water is a natural healer and constitutes 75% of our body weight. Hydrotherapy has several benefits in treating diseases. The soles of feet and palms of hands contain the maximum nerve endings of the body which when stimulated bring healing effect. Following injury or trauma blood circulation becomes brisk and the body's heat increases. After a sudden halt due to heat produced in that process, the legs become tired and when cold water is poured over them, sudden coolness relaxes the blood vessels and the circulation gets back to normal. The stimulation effect of cold water also relieves the congestion of the blood vessels.

The effect and reaction of water is quicker than that of the drugs in acute diseases and in symptoms of majority of other disorders. Water action on body is to

mitigate internal congestion, reduce inflammation and relieve pain, stimulate circulation, encourage elimination of toxins present in the system and lower or raise the temperature of the body.

Water is used for treating disorders in the form of solid, liquid and vapour, either hot or cold. It consists of baths, fomentations, sponges, compresses and sprays. Hot applications are useful in relieving internal and deep congestions, while cold applications are useful in reducing swelling and superficial congestions.

Diclofenac: Diclofenac is rapidly absorbed from the gastro intestinal tract and accumulates in the synovial fluid. Diclofenac is a potent inhibitor of COX-2 (cyclooxygenase) and prostaglandin synthesis hence is an analgesic, anti-inflammatory and antipyretic agent. It is used in the management of chronic inflammatory conditions such as rheumatoid arthritis, osteoarthritis and musculoskeletal pain.

When diclofenac is applied to the skin as a gel instead of it having an effect all over body, it only works on the area where it is applied. It is absorbed into the skin and then moves deeper into areas of the body where there is inflammation (for example, muscle). Using a topical product means that the total amount of diclofenac in body remains low. This in turn means that side-effect of the medicine is lessened.

Dose and Method of application: Diclofenac gel i.e Volini gel was chosen, as this brand of Ranbaxy was available easily. It is available as 10gms, 15 gms, 30 gms, 50 gms, 75 gms and 100 gms. Each time application dose is maximum upto 4gms, but this specified quantity depends on the area affected. Hence in the present study 3gms was enough to produce the required result.

On application of 4gms of gel at the site of Ankle sprain twice daily it produced burning sensation with skin rashes in 04 patients, hence these patients were dropped from the study and their problem was managed by Ayurvedic line of management.

The gel was applied at the site of Ankle sprain as thin layer (Chandanavat) twice daily.

Discussion on procedure: The advantage of this procedure was easy availability of drugs, effortless procedure, can be carried on OPD (out patient department) basis,

patients them self can perform the procedure after training. The disadvantage was unwillingness to get admitted to hospital for the treatment.

Discussion on Action: There was relief in pain by 3-4 hours after application but again pain recurred. After 48 to 72 hours there was appreciable difference. After 72 hours only swelling gradually started to reduce. The gel applied dried within ½ an hour.

Probable mode of action of Diclofenac gel:

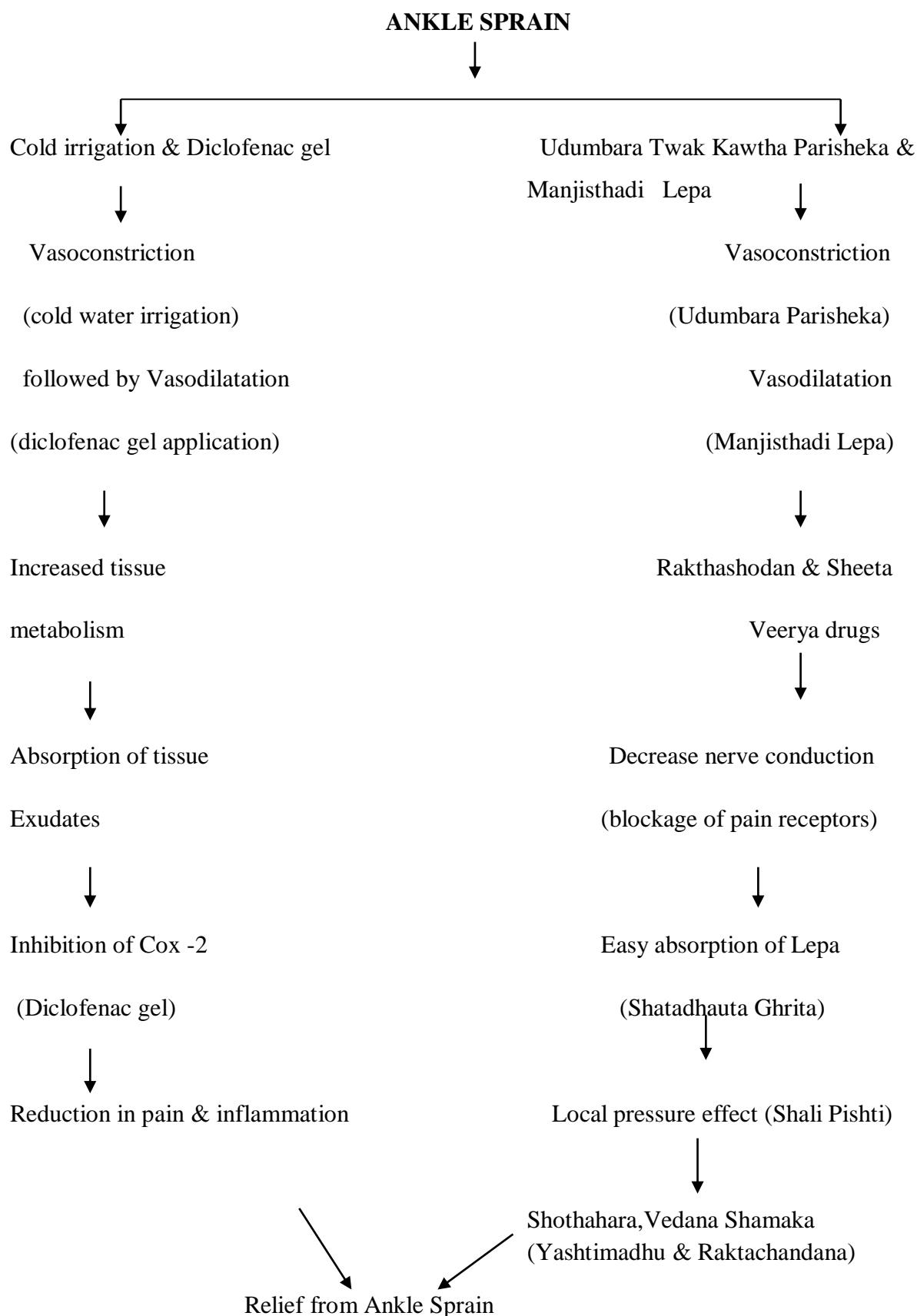
A good blood supply is essential for healing and if there is infection, the increased number of leucocytes and fluid exudates available assist in destroying bacteria. Increase in metabolism being greatest in the region where most heat is generated. Accelerated cellular metabolism can produce many beneficial therapeutic effects to treat injury or infection.

Heating may change the property of specific tissue. For example - the tendon extensibility can be increased by raising the temperature with the result that a stretch of a given intensity will produce greater elongation when heat is applied.

When diclofenac gel is applied local heating effect is produced. Heating results in the reduction of tension over the tissues resulting in reduction of pain. It also increases the tissue oxygen uptake by the muscles.

The increase in blood flow means there are great number of leucocytes and more nutrients available for healing. Warm receptors are located in the dermis and are attached to small diameter, unmyelinated C fibers. They are activated by temperature of 40°C.

They carry the impulses through C fibers to posterior horn and then to thalamus, from here to the pain center to pacify the pain. Thus heating is beneficial in the chronic conditions of injury.



CONCLUSIONS

“Weight of the body is on your feet take care as that of your face.”

- ❖ Analysing the external causes for Shotha as per the classics Patana and Abhighata, injuries or trauma by external measures. Ankle sprain is either results from inversion or eversion of foot during sports or other reasons.
- ❖ Going the through Lakshanas of Gulpha Marma Abhighata and Ankle sprain both share analogous character, hence can be co-related with each other, the features mainly are Ruja(pain), Stabdhapadata(stiffness of joint), Khanjata(loss of function/Limping).
- ❖ A clinical Trail was conducted on patients of Ankle sprain to evaluate the benefit of treatment modality. 200 patients were selected and randomly divided by computer method in two groups with 100 patients in each group. The method followed was computerized random number technique. Group A/Trail group patients (100) were externally treated by Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa while Group B/Control group patients (100) underwent cold water irrigation followed by diclofenac gel application twice daily for one week.
- ❖ Similarly in Trail group i.e Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa comparatively better relief was noted in symptoms like in pain 95.18%, tenderness by 95.42%, ankle swelling by 98.41%, loss of function improved by 100% and discoloration/ecchymosis reduced by 100%.
- ❖ Ankle range of movement's improved by 99.24% in dorsi-flexion, plantar-flexion by 99.31%, inversion 100%, eversion 100%, adduction 100% and abduction 100% in Trail group ankle sprain patients.
- ❖ On evaluating the results of Control group i.e cold water irrigation followed by Diclofenac gel application it was observed that a reduction of 92.94% in pain, tenderness 92.36%, ankle swelling by 95.51%, loss of function improved by 96.49% and discoloration cleared by 100%.
- ❖ Considering the ankle range of movement's dorsi-flexion improved by 96.8%, plantar-flexion 96.8%, inversion 100%, eversion 100%, adduction 100% and abduction 100% improvement was noted in the patients of Control group.

Thus Trail group showed early action in comparison with Control group.

- ❖ Evaluating the results in percentage form Trail group treatment showed better results compared to Control group in all the parameters.
- ❖ Both the treatment modalities has shown statistically highly significant result with $P < 0.05$ after one week treatment.
- ❖ Complete remission of clinical features in Trail group patients 92% and 08% marked improvement, while 89% of patients had complete remission and marked improvement in 11% patients who belonged to Control group after one week of treatment. During the follow up study 100% improvement in both the groups was observed.

It may be concluded from the above findings that both drugs provided significant relief to the patients of Ankle sprain, while comparing the results, Trail group showed better results and earlier with no adverse effects on patients of Ankle sprain.

SCOPE FOR FURTHER STUDY

- ❖ Ankle sprain management can be tried with various other drugs mentioned in the classics.
- ❖ Separate Trail to comparative the effect of Parisheka and Lepa can be undertaken.
- ❖ Various other traumatic conditions like contusions; traumatic cellulitis etc. should be studied using Manjisthadi Lepa.
- ❖ Ankle sprain especially caused due to sports related injury - A Survey study can be undertaken.
- ❖ Comparative between the Ayurvedic line of management and Allied science using Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa and PRICE (Pain killer, Rest, Ice, Compression and Elevation).
- ❖ For better understanding applicability, mode of action, analysis of the ingredients of Manjisthadi Lepa.

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**TILAK MAHARASHTRA VIDYAPEETH
DEPARTMENT OF PhD STUDIES
PUNE, MAHARASHTRA.**

**CASE PROFORMA OF
“A Randomised Comparative Clinical Trial of Udumbara Twak Kwatha
Parisheka followed by Manjisthadi Lepa with Diclofenac Gel application for
Shothahara role in the Management of Ankle Sprain”**

PhD Scholar: Dr Pallavi A.Hegde

Guide: Prof. P. Hemanth Kumar

Patient Details

Name : OPD/IPD No :
Age (in years) : DOA :
Sex : DOD :
Religion : Social status :
Occupation : Address :

Diagnosis :

• **PRADHANA VEDANA:**

Chief Complaints	Duration	Site of injury	Yes/No
Pain		Right Ankle Joint	
Swelling		Left Ankle Joint	
Discolouration			
Loss of function			

• **MECHANISM OF INJURY:**

Lateral (Inward) twist Medial (outward) twist

Others

• **PRADHANA VEDANA VRITTANTA:**

• **POORVA VYADHI VRITTANTA:**

Diabetes Mellitus

Ankle Sprain

Hypertensive

Fracture lower limb

• **CHIKITSA VRITTANTA:**

Allergic to NSAID

Allergic to other drugs

• **KAUTUMBIKA VRITTANTA:**

• **VAYAKTIKA VRITTANTA:**

- Ahara : shakhahari / ubhaya
- Mala : frequency /day
- Mutra : frequency /day
- Nidra : sound /disturbed
- Vyasana : none/ alcohol /tobacco / cigarette smoking / drugs/ others

• **SARVADEHIKA PAREEKSHA:**

- Weight - kgs
- Pulse - bts /min
- Blood Pressure - mm of Hg
- Temperature - ° F
- Prakruti : V/P/K/VP/VK/PK/S
- Satva : pravara /madhyama/avara
- Vyayamashakti : pravara /madhyama/avara
- Desha : rural /urban

• **SANSTHANIKA PAREEKSHA:**

C.V.S:

R.S:

P/A:

C.N.S.:

• **STHANIKA PAREEKSHA :**

A. DARSHANA PAREEKSHA:

1. Discoloration (Ecchymosis):

Present

Absent

2. Gait (Limping):

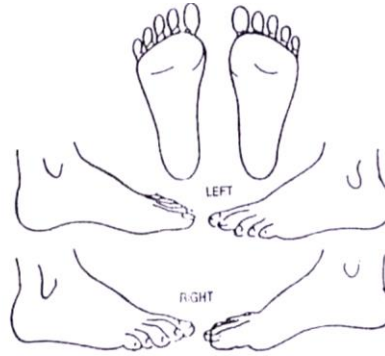
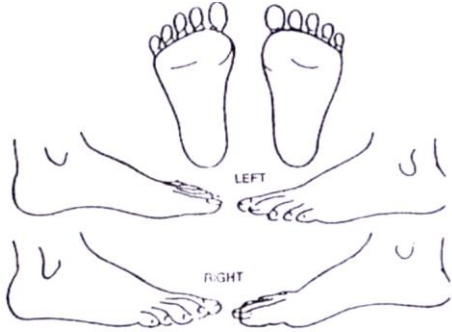
Present

Absent

3. Extension of swelling:

Localized swelling
 Involving entire foot

Pictorial presentation for swelling



Before treatment

After treatment

B. SPARSHANA PAREEKSHA:

1. Degree of movement:

Movement	BT	day 1	day2	day3	day4	day5	day6	day7
Dorsiflexion								
Plantarflexion								
Inversion								
Eversion								
Abduction								
Adduction								

2. Signs:

Signs	BT	day 1	day2	day3	day4	day5	day6	day7	
1. Pain									
2. Tenderness									
3. Swelling									Normal limb
Above Ankle joint									
Mid of Ankle joint									
Below Ankle joint									
4. Ecchymosis									
5. Loss of Function									

- **RADIOLOGICAL INVESTIGATION:**
Findings-

- **VYADHI VINISCHAYA:**

- **MANAGEMENT:**

Cold water irrigation followed by Diclofenac Gel application

TIME	day 1	day2	day3	day4	day5	day6	day7
Cold water irrigation morning							
Evening							
Time of application Morning							
Evening							

- **FOLLOW UP:**

Clinical Features	BT (Day-1)	AT 1st WK (Day- 7)	2nd WK (Day- 15th)	4th WK (Day – 30th)
Pain				
Tenderness				
Swelling				
Discoloration				
Loss of function				

Signature of Ph.D Scholar

(Dr. Pallavi A. Hegde)

Signature of Guide

(Dr. P. Hemanth Kumar)

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DEPARTMENT OF PhD STUDIES
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Occupation : Address :
Diagnosis :

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Chief Complaints	Duration	Site of injury	Yes/No
Pain		Right Ankle Joint	
Swelling		Left Ankle Joint	
Discolouration			
Loss of function			

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Lateral (Inward) twist Medial (outward) twist
Others

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• **POORVA VYADHI VRITTANTA:**

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Ankle Sprain

Hypertensive

Fracture lower limb

• **CHIKITSA VRITTANTA:**

Allergic to NSAID

Allergic to other drugs

• **KAUTUMBIKA VRITTANTA:**

• **VAYAKTIKA VRITTANTA:**

- Ahara : shakhahari / ubhaya
- Mala : frequency /day
- Mutra : frequency /day
- Nidra : sound /disturbed
- Vyasana : none/ alcohol /tobacco / cigarette smoking / drugs/ others

• **SARVADEHIKA PAREEKSHA:**

- Weight - kgs
- Pulse - bts /min
- Blood Pressure - mm of Hg
- Temperature - ° F
- Prakruti : V/P/K/VP/VK/PK/S
- Satva : pravara /madhyama/avara
- Vyayamashakti : pravara /madhyama/avara
- Desha : rural /urban

• **SANSTHANIKA PAREEKSHA:**

C.V.S:

R.S:

P/A:

C.N.S.

• **STHANIKA PAREEKSHA :**

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1. Discoloration (Ecchymosis):

Present

Absent

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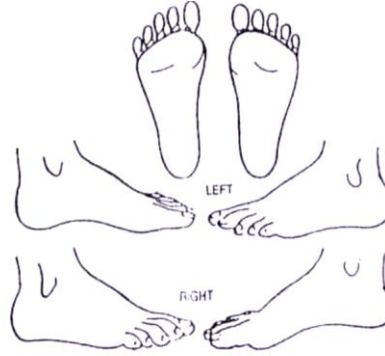
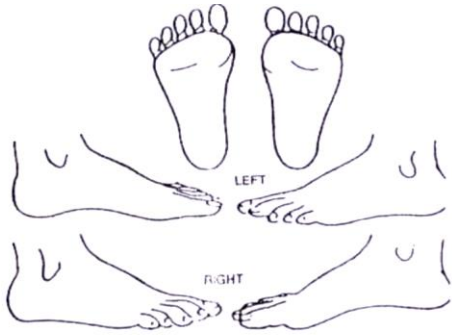
Present

Absent

3. Extension of swelling:

Localized swelling
 Involving entire foot

Pictorial presentation for swelling



Before treatment

After treatment

B. SPARSHANA PAREEKSHA :

1. Degree of movement:

Movement	BT	day 1	day2	day3	day4	day5	day6	day7
Dorsiflexion								
Plantarflexion								
Inversion								
Eversion								
Abduction								
Adduction								

2. Signs:

Signs	BT	day 1	day2	day3	day4	day5	day6	day7	
1. Pain									
2. Tenderness									
3. Swelling									Normal limb
Above Ankle joint									
Mid of Ankle joint									
Below Ankle joint									
4. Ecchymosis									
5. Loss of Function									

- **RADIOLOGICAL INVESTIGATION:**
Findings-

- **VYADHI VINISCHAYA:**

- **MANAGEMENT:**

Udumbaratwakkwatha Parisheka followed by Manjisthadi Lepa

TIME	day 1	day2	day3	day4	day5	day6	day7
Kwatha parisheka Morning							
Evening							
Time of Lepa application Morning							
Evening							
Time of Lepa removal Morning							
Evening							

- **FOLLOW UP:**

Clinical Features	BT (Day-1)	AT 1st WK (Day- 7)	2nd WK (Day- 15th)	4th WK (Day – 30th)
Pain				
Tenderness				
Swelling				
Discoloration				
Loss of function				

Signature of Ph.D Scholar

(Dr. Pallavi A. Hegde)

Signature of Guide

(Dr. P. Hemanth Kumar)

CASE - 1

Name : Mr Santosh Madar

Age : 30 years

Sex : Male

Occupation: Teacher

OPD : 45633

Date : 04/10/12

Address: Kakti, Belgaum

C/O - Pain, swelling and difficulty to walk since 2 days

H/O - outward twist of left foot walking on uneven road

O/E – Tenderness, swelling, diminished foot movements

Radiograph – L Ankle AP & lateral = No evidence of fracture

Diagnosis – L Ankle sprain – Grade II

Management – Cold water irrigation followed by Diclofenac gel application



Before treatment



Coldwater irrigation



Diclofenac gel application



After treatment (7th day)

CASE - 2

Name : Smt Shantala K. V.

Age : 50 years

Sex : Female

Occupation: House wife

OPD : 52303

Date : 28/11/12

Address: Tilakwadi, Belgaum

C/O - Pain, swelling and difficulty to walk since 1 day

H/O – inward twist of left foot while morning walk

O/E – Tenderness, swelling, diminished foot movements

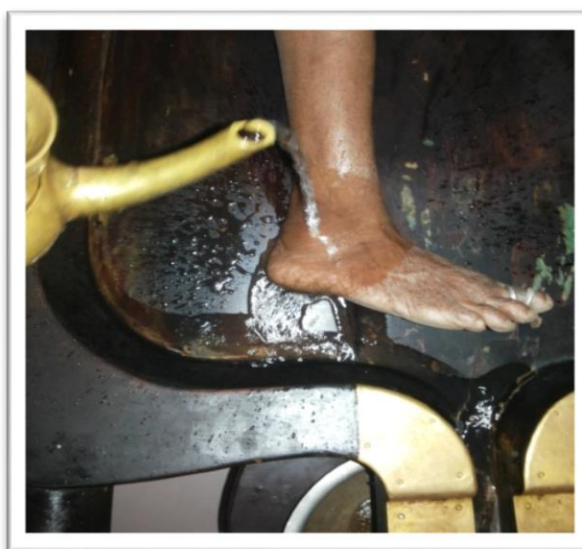
Radiograph – L Ankle AP & lateral = No evidence of fracture

Diagnosis - L Ankle sprain – Grade I

Management – Cold water irrigation followed by Diclofenac gel application



Before treatment



Coldwater irrigation



Diclofenac gel application



After treatment (7th day)

CASE - 3

Name : Mrs Maheswari Kamat

Age : 34 years

Sex : Female

Occupation: House wife

OPD : 185

Date : 02/01/13

Address: Pulbhagalli, Belgaum

C/O - Pain, swelling, difficulty to walk with wound since 1 day

H/O – Fall from bike with inward twist of left foot

O/E – Wound at anterior aspect of L malleolus, with swelling and tenderness

Radiograph – L Ankle AP & lateral = No evidence of fracture

Diagnosis - L Ankle sprain – Grade II

Management – Cold water irrigation followed by Diclofenac gel application



Before treatment



Coldwater irrigation



Diclofenac gel application



After treatment (7th day)

CASE - 4

Name : Rani Shastri
Age : 23 years
Sex : Female
Occupation: Student

OPD : 41471
Date : 04/09/14
Address: Vidyagiri, Bagalkot

C/O - Pain, swelling and painful walk since 2 days
H/O - Inward twist of right foot while getting down the steps
O/E – Tenderness, swelling, hampered foot movements
Radiograph – R Ankle AP & lateral = No evidence of fracture
Diagnosis - R Ankle sprain – Grade I
Management – Cold water irrigation followed by Diclofenac gel application



Before treatment



Coldwater irrigation



Diclofenac gel application



After treatment (7th day)

CASE - 5

Name : Mr Ravindrachar Joshi

Age : 42 years

Sex : Male

Occupation: Poojari

OPD : 31751

Date : 05/7/12

Address:Yellur, Belgaum

C/O –Pain, swelling and mild pain during walking since 1 day

H/O – Inward twist of right foot while walking

O/E – Swelling, tenderness and restricted foot movements

Radiograph – R Ankle AP & lateral = No evidence of fracture

Diagnosis - R Ankle sprain – Grade I

Management – Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa



Before treatment



Parisheka with Udumbara Kwatha



Manjisthadi Lepa application



After treatment (7th day)

CASE - 6

Name : Smt Gouramma Talikoti

Age : 40 years

Sex : Female

Occupation: House wife

OPD : 40124

Date : 29/08/12

Address: Yellur, Belgaum

C/O - Pain, swelling, difficulty in walking since 2 days

H/O – Inward twist of right foot in filed

O/E – gross swelling, tenderness and restricted R foot movements

Radiograph – R Ankle AP & lateral = No evidence of fracture

Diagnosis - R Ankle sprain – Grade II

Management — Udumbara Twak Kwatha Parisheka followed by Manjithadi Lepa



Before treatment



Parisheka with Udumbara Kwath



Manjithadi Lepa application



After treatment (7th day)

CASE - 7

Name : Smt Sangeeta Hiregoudar
Age : 48 years
Sex : Female
Occupation: House wife

OPD : 6148
Date : 03/03/15
Address: Kulgeri cross,
Bagalkot

C/O - Pain, swelling, difficulty in walking since 2 days

H/O – Outward twist of right foot

O/E – swelling, tenderness and painful R foot movements

Radiograph – R Ankle AP & lateral = No evidence of fracture

Diagnosis - R Ankle sprain – Grade I

Management – Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa



Before treatment



Parisheka of Udumbara Kwatha



Manjisthadi Lepa application



After treatment (7th day)

CASE - 8

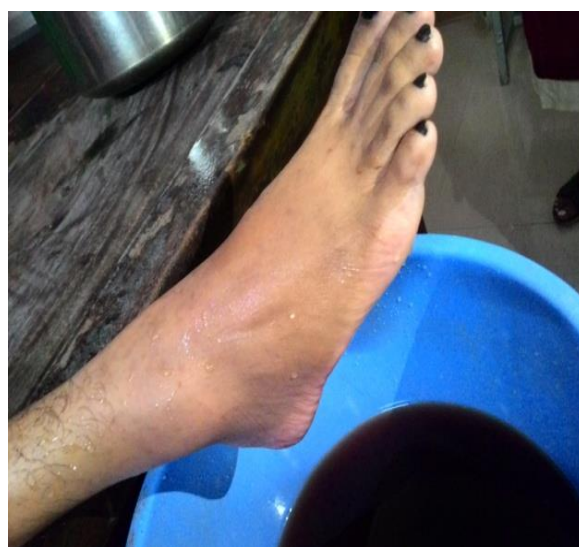
Name : Shilpa Rathi
Age : 21 years
Sex : Female
Occupation: Student

OPD : 8487
Date : 20/3/15
Address: Ladies hostel
Bagalkot

C/O - Pain, swelling and pain during walking since 2 days
H/O - Inward twist of right foot while walking with high heeled foot wear
O/E – swelling, tenderness and restricted R foot movements
Radiograph – R Ankle AP & lateral = No evidence of fracture
Diagnosis - R Ankle sprain – Grade I
Management – Udumbara Twak Kwatha Parisheka followed by Manjisthadi Lepa



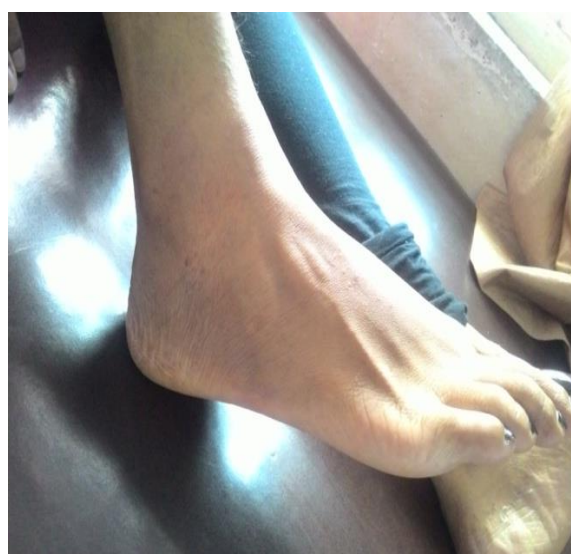
Before treatment



Parisheka with Udumbara Kwatha



Manjisthadi Lepa application



After treatment (7th day)

Master chart

Showing details of Incidence of clinical study

Trail group- Manjisthadi Group

Sl. No.	Date	OPD. No	Name	Age	Sex	Religion	Occupation	Desha	S E S	Diet	Prakruti	Vyayama shakthi	Satva	Nidra
2	29/6/12	30586	Vijaylaxmi	28	F	H	Student	Urban	HMIG	Mixed	PK	Madhyama	Madhyama	Sound
3	05/7/12	31751	Ravindrachar	42	M	H	Carpenter	Rural	LMIG	Veg	VP	Madhyama	Madhyama	Sound
8	02/8/12	36203	Nimitha	20	F	H	Student	Urban	HMIG	Mixed	VP	Madhyama	Avara	Sound
9	10/8/12	37319	M.Bhagya	36	F	H	Teacher	Rural	HMIG	Mixed	PK	Madhyama	Madhyama	Sound
12	23/8/12	39496	Fathima	20	F	M	House Wife	Urban	LMIG	Mixed	VP	Avara	Avara	Sound
13	29/8/12	40124	Gouramma	40	F	H	House Wife	Rural	LMIG	Mixed	VK	Madhyama	Madhyama	Disturbed
14	31/8/12	40418	Arthi	21	F	H	Student	Urban	HMIG	Mixed	PK	Madhyama	Avara	Disturbed
16	06/9/12	40982	Nivya Thomas	21	F	Ch	Student	Urban	HMIG	Mixed	VP	Avara	Madhyama	Sound
17	12/9/12	41237	Asha	23	M	H	Student	Urban	HMIG	Veg	PK	Madhyama	Madhyama	Disturbed
19	18/9/12	42366	Susheelamma	33	F	M	Aya	Urban	LIG	Mixed	PK	Madhyama	Avara	Disturbed
22	30/9/12	44974	Sanjeev	22	M	H	Student	Urban	HMIG	Mixed	VK	Madhyama	Madhyama	Sound
24	07/10/12	46215	Savithamma	45	F	H	Hostel Worker	Urban	LIG	Mixed	VP	Madhyama	Madhyama	Disturbed
25	11/10/12	47109	Krishnasimha	20	M	H	Student	Urban	LMIG	Veg	KP	Madhyama	Madhyama	Sound
27	16/10/12	48037	Suma Joshi	22	F	H	Student	Urban	LMIG	Veg	VP	Madhyama	Avara	Disturbed
28	21/10/12	49153	Jayanthi	25	F	H	House Wife	Urban	LMIG	Mixed	VK	Madhyama	Madhyama	Sound
29	25/10/12	49838	Prasad.K.T	30	M	H	Mechanic	Urban	LMIG	Mixed	VP	Madhyama	Pravara	Sound
30	31/10/12	50224	Rajashree	21	F	H	Student	Urban	LMIG	Mixed	VP	Avara	Avara	Sound
33	15/11/12	50852	Chaithanya	25	F	H	Student	Urban	HMIG	Veg	PK	Madhyama	Madhyama	Sound

Master chart

34	23/11/12	51571	Shakunthala	54	F	H	House wife	Urban	HMIG	Veg	VK	Madhyama	Avara	Sound
35	8/11/12	52303	Shanthala	50	F	H	House wife	Urban	HMIG	Veg	VK	Madhyama	Madhyama	Sound
36	03/12/12	53269	Lalitha	37	F	H	House wife	Urban	LMIG	Veg	VK	Madhyama	Madhyama	Sound
41	29/12/12	57017	Pragati	20	F	H	Student	Urban	LMIG	Mixed	VP	Pravara	Pravara	Sound
42	31/12/12	57328	Virupaksha	42	M	H	Farmer	Rural	LMIG	Mixed	VP	Madhyama	Madhyama	Sound
46	09/1/13	915	Jwalamma	46	F	H	House wife	Rural	LMIG	Mixed	PK	Madhyama	Madhyama	Disturbed
47	10/1/13	1007	Prasanna.N.Ra o	48	M	H	Principal	Urban	HIG	Veg	VP	Pravara	Pravara	Disturbed
48	14/1/13	1178	Simple Thomas	22	F	Ch	Student	Urban	HMIG	Mixed	VK	Madhyama	Madhyama	Sound
49	16/1/13	1735	Santosh	24	M	H	Mechanic	Urban	LIG	Mixed	VP	Madhyama	Madhyama	Sound
51	19/1/13	2571	Shivappachar	42	M	H	Rtd Inspector	Rural	LMIG	Veg	PK	Madhyama	Pravara	Sound
53	25/1/13	3015	Chetan	21	M	H	Student	Urban	HMIG	Mixed	VK	Madhyama	Madhyama	Sound
54	29/1/13	3821	Sumitha L	20	F	H	Student	Urban	LMIG	Mixed	PK	Madhyama	Avara	Sound
55	03/2/13	4356	Sudha M.P	52	F	H	House wife	Urban	LMIG	Veg	VK	Madhyama	Madhyama	Sound
57	06/2/13	4738	Pooja Singh	24	F	H	Student	Urban	HMIG	Mixed	VP	Madhyama	Madhyama	Sound
59	10/2/13	5637	Hariprasad K.	35	M	H	Businessman	Rural	LMIG	Mixed	VP	Madhyama	Madhyama	Sound
60	12/2/13	5824	Shilpa Karaddi	20	F	H	Student	Urban	LMIG	Veg	VP	Madhyama	Madhyama	Sound
62	18/2/13	6319	V.K.Rajan	48	M	H	Mechanic	Urban	LMIG	Mixed	PK	Madhyama	Madhyama	Sound
63	20/2/13	6495	Afsana	25	F	M	House wife	Urban	LMIG	Mixed	VK	Madhyama	Avara	Sound
64	25/2/13	6948	Leelashree	21	F	H	House wife	Urban	HMIG	Mixed	VP	Madhyama	Madhyama	Sound
65	28/2/13	7383	K.P.Devraju	43	M	H	X- Serviceman	Urban	LMIG	Mixed	VK	Pravara	Pravara	Sound
67	05/3/13	8367	Manjula	36	F	H	House wife	Urban	LMIG	Veg	PK	Pravara	Pravara	Sound

Master chart

68	10/3/13	9236	Abdul	32	M	M	Auto driver	Urban	LIG	Mixed	VK	Madhyama	Madhyama	Sound
69	15/3/13	10893	Prema	32	F	H	Aya	Urban	LIG	Veg	KV	Madhyama	Madhyama	Sound
72	27/3/13	13120	AthiraKrishna n	20	F	H	Student	Urban	HMIG	Mixed	VK	Madhyama	Madhyama	Sound
75	10/4/13	15142	Pavan Deshpande	28	M	H	Clerk	Rural	LMIG	Veg	KV	Avara	Madhyama	Sound
76	16/4/13	16218	Hemalata Patil	38	F	H	House wife	Urban	LMIG	Mixed	VP	Madhyama	Madhyama	Disturbed
77	20/4/13	16739	Ramaya Rathod	24	F	H	Student	Urban	HIG	Veg	PK	Madhyama	Madhyama	Sound
79	03/5/13	18350	Rakesh Kadam	34	M	H	Teacher	Rural	MIG	Veg	VK	Pravara	Pravara	Sound
81	06/5/13	21032	Navya Patel	22	F	H	Dental student	Urban	HIG	Veg	VP	Avara	Avara	Sound
82	08/5/13	21954	Shilpashri Kumbar	20	F	H	Student	Urban	LMIG	Mixed	VP	Madhyama	Madhyama	Sound
86	28/5/13	29341	Keshavmurthy K	46	M	H	Cnductor	Rural	LMIG	Veg	VK	Madhyama	Madhyama	Sound
88	02/6/13	30423	Bahuraj Athani	24	M	H	Student	Urban	LMIG	Mixed	VK	Pravara	Pravara	Sound
90	08/6/13	31276	Anil Katti	21	M	H	Student	Rural	HMIG	Mixed	PK	Pravara	Pravara	Sound
97	27/7/13	39709	Ramesh Hatti	38	M	H	M.R.	Rural	LMIG	Mixed	VP	Pravara	Pravara	Disturbed
99	29/7/13	40618	Anita Palled	28	F	H	House wife	Urban	HMIG	Veg	KP	Avara	Avara	Disturbed
100	04/8/13	41896	Sunil Hiremath	42	M	H	Business	Urban	LMIG	Veg	VP	Pravara	Pravara	Sound
104	15/9/13	50833	Kavya Dandin	20	F	H	Student	Urban	LMIG	Veg	VP	Madhyama	Madhyama	Sound
105	21/9/13	51422	Shweta Gundabatti	22	F	H	Student	Urban	LMIG	Veg	VP	Madhyama	Madhyama	Sound
106	30/9/13	53158	Vidya Salimath	23	F	H	Student	Urban	HMIG	Veg	VK	Madhyama	Madhyama	Sound
107	03/10/13	54241	Pavanaa Kulkarni	25	F	H	House wife	Rural	LMIG	Veg	PK	Madhyama	Madhyama	Sound
110	07/11/13	60243	Rajesh Hallar	29	M	H	Computer operator	Urban	HMIG	Mixed	VP	Pravara	Madhyama	Sound
114	19/12/13	69787	Babitha Mohan	22	F	H	Student	Urban	HMIG	Mixed	VK	Madhyama	Madhyama	Sound

Master chart

115	28/12/13	70855	Nandhita Raj	21	F	H	Student	Urban	HMIG	Mixed	VP	Madhyama	Madhyama	Sound
121	28/1/14	6192	Gangamma Madar	52	F	H	House wife	Rural	LIG	Mixed	VK	Madhyama	Madhyama	Sound
123	05/2/14	7816	Abdul Nadaf	33	M	M	Mechanic	Urban	LIG	Mixed	PK	Pravara	Madhyama	Sound
125	13/2/14	9483	Kavita Rathod	30	F	H	House wife	Rural	LMIG	Veg	PK	Madhyama	Madhyama	Sound
127	03/3/14	12531	Pankaj Pawar	25	M	H	Press reporter	Urban	LMIG	Veg	KV	Madhyama	Madhyama	Sound
129	25/3/14	18354	Kalappa Nidagundi	38	M	H	Building contractor	Urban	LMIG	Mixed	VP	Madhyama	Madhyama	Sound
131	12/4/14	32419	Nafeesa Banu	37	F	M	House wife	Urban	LMIG	Mixed	VP	Madhyama	Avara	Disturbed
132	06/4/14	35709	Shilpa Kavali	27	F	H	Engineer	Urban	HIG	Veg	PV	Madhyama	Madhyama	Sound
135	11/5/14	39321	Reshma Khan	27	F	M	House wife	Urban	LIG	Mixed	VP	Madhyama	Madhyama	Disturbed
139	02/6/14	43288	Shivappa Kajrol	36	M	H	Farmer	Rural	LIG	Veg	VP	Pravara	Pravara	Sound
142	15/6/14	46584	Darshana Patel	21	F	H	Student	Urban	HIG	Veg	VK	Madhyama	Madhyama	Sound
143	21/6/14	47827	Savitri Bhat	41	F	H	House wife	Urban	HIG	Veg	VP	Madhyama	Madhyama	Disturbed
144	28/6/14	48935	Shilpa Padashetti	23	F	H	Student	Urban	LMIG	Veg	VP	Madhyama	Avara	Disturbed
156	17/9/14	62807	Radhika Pandit	30	F	H	House wife	Urban	LMIG	Veg	VK	Madhyama	Madhyama	Sound
159	30/9/14	65081	Sajid Mohammed	28	M	M	Measseur	Urban	LIG	Mixed	VP	Madhyama	Madhyama	Sound
161	10/10/14	66837	Divya Naik	26	F	H	Office staff	Urban	LMIG	Veg	PK	Madhyama	Madhyama	Sound
163	18/10/14	68141	Raju Gouli	43	M	H	Photographer	Urban	LMIG	Mixed	KV	Madhyama	Madhyama	Sound
166	28/10/14	70158	Acchu jairaj	24	M	H	Student	Urban	HMIG	Mixed	VK	Madhyama	Madhyama	Sound
167	02/11/14	70934	Vaishali Hatti	29	F	H	House wife	Urban	LMIG	Veg	VP	Madhyama	Madhyama	Disturbed
169	09/11/14	72382	Padmavati Policepatil	34	F	H	Teacher	Urban	HMIG	Veg	KV	Madhyama	Madhyama	Sound
172	21/11/14	74259	Mahantesh Ghanashetti	36	M	H	Peon	Rural	LIG	Mixed	VP	Madhyama	Madhyama	Disturbed

Master chart

174	29/11/14	75681	Siddamma Naik	26	F	H	Aya	Urban	LIG	Veg	VK	Pravara	Madhyama	Sound
176	07/12/14	76563	Jayashri Desai	34	F	H	Teacher	Urban	HMIG	Veg	VK	Madhyama	Madhyama	Sound
177	11/12/14	77215	Sharada Bhat	48	F	H	House wife	Urban	LMIG	Veg	VP	Pravara	Pravara	Sound
179	20/12/14	78354	Sajid Mulla	22	M	M	Student	Urban	LIG	Mixed	VP	Madhyama	Madhyama	Sound
180	24/12/14	79023	Basamma Kerur	42	F	H	Aya	Urban	LIG	Veg	PK	Pravara	Avara	Sound
181	29/12/14	80501	Ashwini Kittur	20	F	H	Student	Urban	HIG	Veg	KV	Pravara	Madhyama	Sound
182	03/1/15	428	Mahantesh Kaprad	36	M	H	Peon	Rural	LMIG	Mixed	PK	Madhyama	Pravara	Sound
184	07/1/15	1097	Mansur Ali	22	M	M	Student	Urban	LMIG	Mixed	PV	Madhyama	Madhyama	Sound
185	11/1/15	1352	Jagadish Patel	21	M	H	Student	Urban	HMIG	Veg	KV	Madhyama	Madhyama	Sound
187	19/1/15	2284	Joseph Stalin	22	M	Ch	Student	Urban	HMIG	Mixed	VP	Madhyama	Madhyama	Sound
188	23/1/15	2676	Sneha Bagoji	22	F	H	Student	Urban	HIG	Mixed	VP	Madhyama	Avara	Sound
189	28/1/15	3398	Sharat Pandey	20	M	H	Student	Urban	HMIG	Veg	KP	Avara	Madhyama	Sound
190	01/2/15	3817	Raju Moolimani	54	M	H	Bank employee	Urban	HMIG	Veg	KV	Madhyama	Madhyama	Sound
193	12/2/15	4029	Vasant Rao	52	M	H	Teacher	Urban	HMIG	Veg	KP	Avara	Avara	Sound
196	26/2/15	5486	Goutami Shettar	24	F	H	Student	Urban	HMIG	Mixed	VP	Madhyama	Madhyama	Disturbed
197	03/3/15	6148	Sangeeta Hiregoudar	48	F	H	House wife	Rural	LMIG	Mixed	VP	Madhyama	Madhyama	Sound
198	10/3/15	7073	Shashikala Hiremath	24	F	H	House wife	Urban	LMIG	Veg	PV	Madhyama	Madhyama	Sound
199	15/3/15	7957	Janaki Lamani	45	F	H	House wife	Urban	LIG	Mixed	VP	Pravara	Madhyama	Sound
200	20/3/15	8487	Shilpa Rathi	20	F	H	Student	Urban	LMIG	Veg	KV	Madhyama	Madhyama	Sound

Master chart

Showing details of Incidence of clinical study

Control group- Diclofenac Group

Random No	Date	OPD No	Name	Age	Sex	Religion	Occupation	Desha	S E S	Diet	Prakruti	Vyayama Shakthi	Satva	Nidra
1	26/6/12	30142	Ramesh Athani	36	M	H	Businessman	Urban	LMIG	Veg	VP	Madhyama	Madhyama	Disturbed
4	13/7/12	32415	Ashwini Patil	23	F	H	Student	Urban	HIG	Mixed	PK	Madhyama	Madhyama	Sound
5	17/7/12	33286	Rashmi Kilekar	26	F	H	House wife	Urban	HMIG	Mixed	VP	Madhyama	Avara	Disturbed
6	25/7/12	34573	Geeta Patil	28	F	H	House wife	Urban	LMIG	Mixed	VP	Pravara	Madhyama	Sound
7	30/7/12	35612	Laxman Sutar	54	M	H	Saw mill worker	Urban	LMIG	Veg	KV	Madhyama	Pravara	Sound
10	13/8/12	37954	Raju Sutar	48	M	H	LIC agent	Urban	HMIG	Mixed	VP	Pravara	Pravara	Sound
11	17/8/12	38570	Kalpna Shinde	26	F	H	House wife	Urban	LMIG	Mixed	VP	Pravara	Pravara	Sound
15	03/9/12	41197	Kashavva Hiremath	33	F	H	Teacher	Urban	HMIG	Veg	KV	Madhyama	Madhyama	Sound
18	15/9/12	41735	Santosh Pattar	24	M	H	Student	Rural	LMIG	Mixed	VP	Pravara	Madhyama	Sound
20	23/9/12	43521	Tejaswini Mathad	21	F	H	Student	Urban	HMIG	Veg	PV	Madhyama	Madhyama	Sound
21	28/9/12	44689	Smita Deshmukh	22	F	H	Student	Urban	HMIG	Veg	VP	Madhyama	Madhyama	Disturbed
23	04/10/12	45633	Santosh Madar	30	M	H	Teacher	Rural	HMIG	Mixed	PK	Madhyama	Madhyama	Sound
26	12/10/12	47247	Shilpa Nair	22	F	H	Student	Urban	HMIG	Mixed	KP	Madhyama	Madhyama	Sound
31	01/11/12	50305	Kavya Mohan	21	F	H	Student	Urban	HIG	Mixed	KP	Madhyama	Madhyama	Sound
32	13/11/12	52780	Vidya Hosmani	30	F	H	Computer operator	Urban	LMIG	Veg	VP	Pravara	Madhyama	Sound
37	11/12/12	54858	Nanda Kalligud	27	F	H	Bank employee	Urban	HMIG	Veg	KV	Madhyama	Madhyama	Disturbed
38	18/12/12	55690	Ramesh Joshi	32	M	H	Business	Urban	HIG	Veg	VP	Madhyama	Madhyama	Sound
39	21/12/12	55978	Kaushik Pandit	28	M	H	Business	Urban	HMIG	Veg	VP	Madhyama	Madhyama	Sound

Master chart

40	26/12/12	56732	Sheela Dixit	24	F	H	Student	Urban	HMIG	Veg	VP	Madhyama	Avara	Sound
43	02/1/13	185	Maheswari Kamat	34	F	H	House wife	Urban	HIG	Mixed	PV	Avara	Avara	Disturbed
44	06/1/13	528	Yallappa Waliker	50	M	H	Farmer	Rural	LMIG	Mixed	VP	Pravara	Pravara	Disturbed
45	08/1/13	841	Pradeep Huveennavar	36	M	H	Teacher	Urban	HMIG	Veg	PV	Madhyama	Madhyama	Disturbed
50	19/1/13	2534	Sheetal Maiya	21	F	H	Student	Urban	HMIG	Veg	VP	Madhyama	Pravara	Sound
52	21/1/13	2983	Divya K.S	20	F	H	Student	Urban	HMIG	Mixed	VP	Madhyama	Pravara	Sound
56	05/2/13	4642	Hemant Katti	22	M	H	Student	Rural	LMIG	Mixed	VK	Madhyama	Madhyama	Disturbed
58	08/2/13	4989	Jyoti Melinmani	23	F	H	House wife	Urban	LMIG	Veg	PV	Madhyama	Madhyama	Sound
61	15/2/13	6995	Sampat kumar Rai	27	M	H	Bank employee	Rural	LMIG	Mixed	KV	Madhyama	Madhyama	Sound
66	01/3/13	7523	Santosh Adivече	26	M	H	Student	Urban	HMIG	Veg	KV	Madhyama	Madhyama	Sound
70	19/3/13	11728	Satish Sonnad	36	M	H	Policeman	Urban	LMIG	Mixed	VP	Madhyama	Madhyama	Sound
71	24/3/13	12507	Indrabai Kilekar	46	F	H	House wife	Urban	LIG	Mixed	VK	Madhyama	Avara	Sound
73	02/4/13	13954	Smita Halagekar	24	F	H	House wife	Urban	LMIG	Veg	VP	Madhyama	Madhyama	Sound
74	06/4/13	14536	Laxmi Naidu	23	F	H	Student	Urban	LMIG	Veg	PV	Madhyama	Madhyama	Sound
78	28/4/13	17457	Sanjay Patil	24	M	H	Computer operator	Rural	LIG	Veg	VP	Madhyama	Madhyama	Sound
80	04/5/13	20892	Jayashri Badiger	32	F	H	House wife	Urban	LIG	Veg	KV	Madhyama	Avara	Sound
83	12/5/13	22554	Sadanand Sutar	38	M	H	Saw mill worker	Urban	LMIG	Veg	PV	Pravara	Madhyama	Sound
84	20/5/13	26321	Anand Jigajjinni	42	M	H	Telephone operator	Urban	LMIG	Veg	KV	Madhyama	Madhyama	Sound
85	25/5/13	28351	Marry James	24	F	Ch	House wife	LMIG	Rural	Mixed	VP	Madhyama	Avara	Sound
87	01/6/13	30185	Sharangouda Teli	28	M	H	Postman	Urban	LMIG	Mixed	VP	Madhyama	Madhyama	Sound
89	05/6/13	30974	Sneha Moolimani	22	F	H	Student	Urban	HIG	Veg	VK	Avara	Avara	Sound

Master chart

91	15/6/13	32162	Nandini Pujar	26	F	M	House wife	Urban	LIG	Mixed	KV	Pravara	Pravara	Sound
92	19/6/13	32804	Laxmi Shastri	23	F	H	Student	Urban	LMIG	Veg	KV	Madhyama	Pravara	Sound
93	30/6/13	34618	Deepa Hugar	24	F	H	House wife	Urban	LMIG	Veg	PV	Madhyama	Madhyama	Sound
94	07/7/13	36327	Naveen Teli	23	M	H	Student	Urban	HMIG	Mixed	VP	Madhyama	Madhyama	Sound
95	15/7/13	37851	Darshana P	24	F	H	Student	Urban	HMIG	Veg	KP	Avara	Avara	Sound
96	26/7/13	39583	Praveen Patil	23	M	H	Student	Urban	LMIG	Mixed	PV	Madhyama	Madhyama	Disturbed
98	28/7/13	40315	Ropa Idagi	33	F	H	House wife	Urban	HMIG	Mixed	KP	Madhyama	Madhyama	Sound
101	24/8/13	46207	Saroja Kadlewad	36	F	H	BSNL employee	Urban	HIG	Veg	KV	Madhyama	Madhyama	Sound
102	29/8/13	47562	Rajeev Kamble	44	M	H	Store keeper	Urban	LMIG	Mixed	VP	Madhyama	Madhyama	Sound
103	07/9/13	49237	Kamala Shettar	48	F	H	House wife	Urban	HMIG	Veg	PV	Pravara	Pravara	Sound
108	18/10/13	57462	Sheela Desai	22	F	H	Student	Urban	LMIG	Veg	VP	Madhyama	Madhyama	Sound
109	29/10/13	59613	Yogesh Tikole	25	M	H	Student	Urban	HMIG	Mixed	VP	Madhyama	Madhyama	Sound
111	16/11/13	62781	Kishor Pandey	23	M	H	Student	Urban	LMIG	Veg	KP	Madhyama	Madhyama	Sound
112	26/11/13	63962	Kalpana Kilekar	30	F	H	House wife	Urban	LMIG	Mixed	VP	Madhyama	Madhyama	Disturbed
113	15/12/13	68539	Shanti Hiremath	22	F	H	Student	Urban	LMIG	Veg	VP	Madhyama	Madhyam	Sound
116	30/12/13	71246	Swapna Bhandari	26	F	H	Clerk	Urban	LMIG	Mixed	VP	Madhyama	Madhyama	Sound
117	05/1/14	920	Amrita Dandin	22	F	H	Student	Urban	HMIG	Veg	VP	Madhyama	Madhyama	Sound
118	13/1/14	2653	Sarita Sharma	23	F	H	Student	Urban	HMIG	Veg	VP	Madhyama	Madhyama	Sound
119	20/1/14	4885	Eranna Pattanshetti	38	M	H	Clerk	Rural	LIG	Mixed	PK	Madhyama	Madhyama	Sound
120	27/1/14	6034	GeetaToti	21	F	H	Student	Urban	LMIG	Veg	VP	Madhyama	Madhyama	Sound
122	04/2/14	7582	Kashavva Salimath	32	F	H	House wife	Urban	HMIG	Veg	KV	Madhyama	Madhyama	Sound
124	07/2/14	8061	Kapil Jadhav	29	M	H	Mechanic	Urban	LMIG	Veg	VP	Madhyama	Madhyama	Sound

Master chart

126	24/2/14	11752	Savitri Hegde	45	F	H	House wife	Urban	HMIG	Veg	VP	Madhyama	Avara	Sound
128	13/3/14	14470	Sudha Nidagundi	29	F	M	Teacher	Urban	HMIG	Mixed	VK	Madhyama	Madhyama	Sound
130	01/4/14	19732	Gangamma Badiger	48	F	H	House wife	Urban	LIG	Veg	KV	Avara	Avara	Sound
133	28/4/14	36175	Basamma Hugar	28	F	H	Typist	Urban	LMIG	Veg	KV	Madhyama	Madhyama	Sound
134	05/5/14	37987	Kallavva Kalligud	54	F	H	House wife	Urban	LMIG	Veg	KV	Avara	Madhyama	Sound
136	18/5/14	41216	Veena Potdar	25	F	H	Student	Urban	HIG	Mixed	VP	Pravara	Madhyama	Sound
137	22/5/14	41942	Venkatesh Shinde	36	M	H	Hotel owner	Urban	HIG	Mixed	VP	Pravara	Madhyama	Sound
138	30/5/14	42533	Shivamma Lingsur	58	F	H	Vegetable sellar	Urban	LIG	Veg	KV	Madhyama	Madhyama	Sound
140	05/6/14	43996	Rekha Idagi	25	F	H	Engineer	Urban	HMIG	Mixed	PV	Madhyama	Madhyama	Sound
141	11/6/14	45478	Eranna Nashi	36	M	H	Peon	Rural	LIG	Mixed	VP	Madhyama	Madhyama	Sound
145	02/7/14	49731	Renuka Dessai	38	F	H	Aya	Urban	LIG	Mixed	VP	Madhyama	Madhyama	Sound
146	13/7/14	51842	Iramma Bellad	29	F	H	House wife	Rural	LMIG	Veg	PV	Madhyama	Madhyama	Sound
147	24/7/14	52395	Praveen Benakatti	25	M	H	Student	Rural	LMIG	Veg	VP	Madhyama	Madhyama	Sound
148	29/7/14	53456	Vaishali Gadad	38	F	H	Clerk	Urban	LMIG	Mixed	KV	Madhyama	Madhyama	Sound
149	08/8/14	55815	Prashant Goudar	38	M	H	Computer operator	Urban	HMIG	Veg	KV	Madhyama	Madhyama	Sound
150	14/8/14	57023	Akshay Gavkar	20	M	H	Student	Urban	HIG	Mixed	VP	Madhyama	Madhyama	Sound
151	20/8/14	58358	Kavita Naik	38	F	H	House wife	Urban	LMIG	Mixed	VP	Madhyama	Avara	Sound
152	26/8/14	59137	Hemant Karant	23	M	H	Student	Urban	HIG	Veg	VP	Madhyama	Avara	Sound
153	04/9/14	60206	Rani Shastri	23	F	H	Engineer	Urban	HIG	Veg	KV	Madhyama	Madhyama	Sound
154	10/9/14	61428	Prateek Bhagat	23	M	H	Student	Urban	LMIG	Veg	KV	Madhyama	Madhyama	Sound
155	14/9/14	62315	Shivayogi Ganesh	43	M	H	Waiter	Urban	LIG	Veg	KV	Madhyama	Madhyama	Sound
157	23/9/14	63954	Kavita Patil	32	F	H	House wife	Urban	LMIG	Veg	PV	Madhyama	Madhyama	Disturbed

Master chart

158	28/9/14	64732	Srinivas Patil	38	M	H	Teacher	Urban	HIG	Mixed	VP	Madhyama	Madhyama	Sound
160	06/10/14	66144	Gayatri Shekar	46	F	H	Teacher	Rural	HMIG	Veg	VP	Madhyama	Madhyama	Disturbed
162	15/10/14	67541	Shalini Goswami	22	F	H	Student	Urban	LMIG	Veg	KV	Madhyama	Madhyama	Sound
164	23/10/14	69057	Sangeeta Pandit	35	M	F	Student	Urban	LMIG	Veg	KV	Madhyama	Madhyama	Sound
165	26/10/14	69613	Lavanya Shirol	20	F	M	Student	Urban	LMIG	Mixed	VP	Avara	Avara	Sound
168	05/11/14	71561	Sharanya P	22	F	H	Student	Urban	LMIG	Mixed	VP	Madhyama	Avara	Sound
170	12/11/14	72935	Kartik Bellad	25	M	H	Peon	Urban	LIG	Mixed	VP	Madhyama	Madhyama	Sound
171	19/11/14	73817	Chaitanya Goudar	29	F	H	Computer operator	Urban	LMIG	Mixed	KV	Madhyama	Avara	Sound
173	27/11/14	75421	Savita Pattanshetti	30	F	H	Lecturer	Urban	LMIG	Veg	VP	Madhyama	Madhyama	Sound
175	01/12/14	75983	Sneha Gaikwad	21	F	H	Student	Urban	HMIG	Veg	VP	Madhyama	Madhyama	Sound
178	15/12/14	77635	Joseph Martin	38	M	Ch	Clerk	Urban	LMIG	Mixed	VK	Madhyama	Madhyama	Sound
183	06/1/15	1018	Shweta Bhushetti	23	F	H	House wife	Rural	HMIG	Mixed	KP	Avara	Avara	Sound
186	17/1/15	2037	Narayan Palled	58	M	H	Hotel owner	Urban	LMIG	Veg	KV	Madhyama	Madhyama	Sound
191	03/2/15	3151	Raju Benahatti	40	M	H	Dhobi	Urban	LIG	Mixed	VP	Madhyama	Madhyama	Sound
192	07/2/15	3934	Saleema Mulla	32	M	M	Mechanic	Urban	LMIG	Mixed	VP	Pravara	Pravara	Sound
194	06/2/15	4659	Mahantesh Gavimath	21	M	H	Student	Rural	HMIG	Veg	KV	Madhyama	Madhyama	Sound
195	23/2/15	5074	Mahammed Nadaf	28	M	M	Vegetable seller	Urban	LIG	Mixed	VP	Pravara	Pravara	Disturbed

FINDINGS OF TRAIL GROUP- MANJISTHADI GROUP

SL. NO.	RANDOM No	MECHANISM OF INJURY	PAIN	TENDERNESS	SWELLING	LOSS OF FUNCTION	DISCOLORATION
1	2	INVERSION	MILD	MILD	MILD	MILD	ABSENT
2	3	INVERSION	MILD	MILD	MILD	MILD	ABSENT
3	8	INVERSION	MODERATE	MODERATE	MILD	MILD	ABSENT
4	9	EVERSION	MILD	MODERATE	MODERATE	MILD	ABSENT
5	12	INVERSION	MILD	MODERATE	MILD	MILD	ABSENT
6	13	INVERSION	SEVERE	MODERATE	SEVERE	MODERATE	PRESENT
7	14	INVERSION	SEVERE	MODERATE	MODERATE	MODERATE	ABSENT
8	16	INVERSION	MILD	MILD	MODERATE	MILD	ABSENT
9	17	EVERSION	SEVERE	MODERATE	SEVERE	MODERATE	PRESENT
10	19	INVERSION	SEVERE	SEVERE	SEVERE	MODERATE	PRESENT
11	22	INVERSION	MILD	MILD	MILD	MILD	ABSENT
12	24	INVERSION	SEVERE	MODERATE	SEVERE	MODERATE	PRESENT
13	25	INVERSION	MODERATE	MODERATE	MODERATE	MODERATE	ABSENT
14	27	INVERSION	SEVERE	MODERATE	SEVERE	MODERATE	PRESENT
15	28	INVERSION	MILD	MILD	MILD	MILD	ABSENT
16	29	EVERSION	MILD	MLID	MILD	MILD	PRESENT
17	30	INVERSION	MILD	MILD	NILD	MILD	ABSENT
18	33	INVERSION	MODERATE	MODERATE	MODERATE	MILD	PRESENT
19	34	INVERSION	MODERATE	MODERATE	SEVERE	MILD	ABSENT
20	35	INVERSION	MODERATE	SEVERE	SEVERE	MODERATE	ABSENT

21	36	INVERSION	MODERATE	MODERATE	SEVERE	MILD	ABSENT
22	41	INVERSION	MILD	MILD	MILD	MILD	ABSENT
23	42	EVERSION	MILD	MILD	MODERATE	MILD	ABSENT
24	46	INVERSION	SEVERE	MODERATE	SEVERE	MODERATE	ABSENT
25	47	INVERSION	SEVERE	MODERATE	MODERATE	MILD	PRESENT
26	48	INVERSION	MODERATE	MODERATE	MODERATE	MILD	PRESENT
27	49	INVERSION	MILD	MODERATE	MILD	MILD	ABSENT
28	51	INVERSION	MODERATE	MODERATE	MODERATE	MODERATE	ABSENT
29	53	INVERSION	MILD	MILD	MILD	MILD	ABSENT
30	54	EVERSION	MILD	MODERATE	MODERATE	MODERATE	ABSENT
31	55	INVERSION	MODERATE	MODERATE	SEVERE	MODERATE	ABSENT
32	57	INVERSION	MILD	MILD	MILD	MILD	ABSENT
33	59	INVERSION	MODERATE	MILD	MODERATE	MILD	ABSENT
34	60	EVERSION	MILD	MILD	MILD	MILD	ABSENT
35	62	INVERSION	MILD	MILD	MILD	MILD	ABSENT
36	63	INVERSION	MODERATE	MODERATE	SEVERE	MILD	ABSENT
37	64	INVERSION	MILD	MILD	MILD	MILD	ABSENT
38	65	INVERSION	SEVERE	MODERATE	SEVERE	MILD	ABSENT
39	67	INVERSION	MODERATE	MODERATE	MILD	MILD	ABSENT
40	68	INVERSION	MILD	MILD	MILD	MILD	ABSENT

Master chart

41	69	INVERSION	MODERATE	MODERATE	MODERATE	MILD	ABSENT
42	72	INVERSION	MILD	MILD	MILD	MILD	ABSENT
43	75	EVERSION	MODERATE	MODERATE	MODERATE	MODERATE	ABSENT
44	76	INVERSION	MILD	MILD	MILD	MILD	ABSENT
45	77	INVERSION	MILD	MILD	MODERATE	MILD	ABSENT
46	79	INVERSION	MILD	MILD	MILD	MILD	ABSENT
47	81	INVERSION	MODERATE	MODERATE	MODERATE	MODERATE	ABSENT
48	82	INVERSION	MILD	MILD	MODERATE	MILD	ABSENT
49	86	EVERSION	MODERATE	MODERATE	MODERATE	MILD	ABSENT
50	88	EVERSION	MILD	MILD	MODERATE	MILD	ABSENT
51	90	INVERSION	MILD	MILD	MILD	MILD	ABSENT
52	97	EVERSION	MILD	MODERATE	MILD	MILD	PRESENT
53	99	INVERSION	MODERATE	MODERATE	MODERATE	MILD	ABSENT
54	100	EVERSION	MODERATE	MODERATE	SEVERE	MODERATE	PRESENT
55	104	INVERSION	MODERATE	MODERATE	MILD	MILD	ABSENT
56	105	INVERSION	MODERATE	MODERATE	MODERATE	MILD	PRESENT
57	106	INVERSION	MODERATE	MODERATE	MODERATE	MILD	ABSENT
58	107	INVERSION	MODERATE	MODERATE	MODERATE	MODERATE	ABSENT
59	110	EVERSION	MILD	MILD	MILD	MILD	ABSENT
60	114	INVERSION	MILD	MILD	MILD	MILD	ABSENT
61	115	INVERSION	MODERATE	MODERATE	MODERATE	MILD	ABSENT

62	121	INVERSION	MILD	MILD	MILD	MILD	ABSENT
63	123	INVERSION	MILD	MILD	MODERATE	MILD	ABSENT
64	125	INVERSION	MODERATE	MODERATE	SEVERE	MODERATE	PRESENT
65	127	INVERSION	MODERATE	MODERATE	MODERATE	MODERATE	PRESENT
66	129	EVERSION	MILD	MILD	MODERATE	MILD	ABSENT
67	131	INVERSION	MODERATE	MODERATE	MILD	MILD	ABSENT
68	132	INVERSION	MILD	MILD	MILD	MILD	ABSENT
69	135	INVERSION	MODERATE	MODERATE	MODERATE	MODERATE	PRESENT
70	139	INVERSION	SEVERE	SEVERE	SEVERE	MODERATE	PRESENT
71	142	EVERSION	MILD	MILD	MILD	MILD	ABSENT
72	143	INVERSION	MODERATE	MODERATE	MODERATE	MILD	PRESENT
73	144	INVERSION	MILD	MILD	MILD	MILD	ABSENT
74	156	INVERSION	MILD	MILD	MILD	MILD	ABSENT
75	159	INVERSION	MODERATE	MODERATE	MODERATE	MILD	ABSENT
76	161	INVERSION	MILD	MILD	MILD	MILD	ABSENT
77	163	INVERSION	MILD	MILD	MILD	MILD	ABSENT
78	166	EVERSION	MILD	MODERATE	MODERATE	MILD	ABSENT
79	167	INVERSION	MODERATE	MILD	MODERATE	MILD	ABSENT
80	169	INVERSION	MILD	MODERATE	MILD	MILD	ABSENT
81	172	EVERSION	MODERATE	MODERATE	MODERATE	MILD	PRESENT

82	174	INVERSION	MILD	MODERATE	MODERATE	MILD	ABSENT
83	176	INVERSION	SEVERE	SEVERE	SEVERE	MODERATE	PRESENT
84	177	INVERSION	MILD	MILD	MILD	MILD	ABSENT
85	179	INVERSION	MILD	MILD	MODERATE	MILD	ABSENT
86	180	INVERSION	MODERATE	MODERATE	MODERATE	MILD	ABSENT
87	181	INVERSION	MILD	MODERATE	MODERATE	MILD	ABSENT
88	182	INVERSION	MODERATE	MILD	MODERATE	MILD	ABSENT
89	184	EVERSION	SEVERE	MODERATE	SEVERE	MODERATE	PRESENT
90	185	INVERSION	MILD	MILD	MILD	MILD	ABSENT
91	187	INVERSION	MILD	MILD	MODERATE	MILD	ABSENT
92	188	INVERSION	SEVERE	SEVERE	SEVERE	MODERATE	PRESENT
93	189	EVERSION	MODERATE	MODERATE	MODERATE	MILD	ABSENT
94	190	INVERSION	SEVERE	SEVERE	SEVERE	MODERATE	PRESENT
95	193	EVERSION	MODERATE	MODERATE	MODERATE	MILD	PRESENT
96	196	INVERSION	MODERATE	MILD	MILD	MILD	ABSENT
97	197	EVERSION	MILD	MILD	MILD	MILD	ABSENT
98	198	INVERSION	MILD	MILD	MODERATE	MILD	ABSENT
99	199	INVERSION	MILD	MILD	MILD	MILD	ABSENT
100	200	EVERSION	MILD	MILD	MILD	MILD	ABSENT

FINDINGS OF CONTROL GROUP- DICLOFENAC GROUP

SL. NO.	RANDOM NO	MECHANISM OF INJURY	PAIN	TENDERNESS	SWELLING	LOSS OF FUNCTION	DISCOLORATION
1.	1	INVERSION	SEVERE	SEVERE	SEVERE	MODERATE	PRESENT
2.	4	INVERSION	MODERATE	MODERATE	MODERATE	MILD	ABSENT
3.	5	INVERSION	MODERATE	MODERATE	MODERATE	MODERATE	ABSENT
4.	6	INVERSION	MODERATE	MODERATE	MODERATE	MODERATE	ABSENT
5.	7	EVERSION	MILD	MILD	MODERATE	MILD	ABSENT
6.	10	INVERSION	MILD	MILD	MODERATE	MILD	ABSENT
7.	11	INVERSION	MODERATE	MODERATE	MODERATE	MODERATE	ABSENT
8.	15	INVERSION	MILD	MILD	MILD	MILD	ABSENT
9.	18	INVERSION	MODERATE	MODERATE	MODERATE	MILD	ABSENT
10.	20	INVERSION	MILD	MILD	MILD	MILD	ABSENT
11.	21	INVERSION	SEVERE	SEVERE	SEVERE	MODERATE	ABSENT
12.	23	EVERSION	MODERATE	MODERATE	MODERATE	MILD	ABSENT
13.	26	INVERSION	MODERATE	MODERATE	MODERATE	MILD	ABSENT
14.	31	INVERSION	MILD	MILD	MILD	MILD	ABSENT
15.	32	INVERSION	MILD	MLID	MILD	MILD	ABSENT
16.	37	EVERSION	SEVERE	SEVERE	SEVERE	MODERATE	PRESENT
17.	38	EVERSION	MILD	MILD	NILD	MILD	ABSENT
18.	39	INVERSION	MODERATE	MODERATE	MODERATE	MILD	PRESENT
19.	40	INVERSION	SEVERE	SEVERE	SEVERE	MODERATE	PRESENT
20.	43	INVERSION	SEVERE	SEVERE	SEVERE	MODERATE	PRESENT

21	44	INVERSION	MILD	MILD	MILD	MILD	ABSENT
22	45	INVERSION	MILD	MILD	MODERATE	MILD	ABSENT
23	50	INVERSION	MILD	MILD	MODERATE	MILD	ABSENT
24	52	EVERSION	MILD	MILD	MILD	MILD	ABSENT
25	56	INVERSION	SEVERE	SEVERE	SEVERE	MODERATE	PRESENT
26	58	EVERSION	MODERATE	MILD	MODERATE	MILD	ABSENT
27	61	INVERSION	MILD	MILD	MILD	MILD	ABSENT
28	66	EVERSION	MODERATE	SEVERE	MODERATE	MODERATE	PRESENT
29	70	INVERSION	MILD	MILD	MILD	MILD	ABSENT
30	71	INVERSION	MILD	MILD	MILD	MILD	ABSENT
31	73	INVERSION	MODERATE	MODERATE	MODERATE	MILD	ABSENT
32	74	EVERSION	MILD	MILD	MILD	MILD	ABSENT
33	78	INVERSION	MODERATE	MODERATE	MODERATE	MILD	ABSENT
34	80	INVERSION	MILD	MILD	MILD	MILD	ABSENT
35	83	INVERSION	MILD	MILD	MILD	MILD	ABSENT
36	84	INVERSION	MILD	MILD	MODERATE	MILD	ABSENT
37	85	EVERSION	MODERATE	MODERATE	MODERATE	MILD	ABSENT
38	87	INVERSION	MILD	MILD	MODERATE	MILD	ABSENT
39	89	INVERSION	MILD	MILD	MILD	MILD	ABSENT
40	91	INVERSION	MILD	MILD	MILD	MILD	ABSENT
41	92	EVERSION	MODERATE	MODERATE	MODERATE	MILD	ABSENT
42	93	INVERSION	MILD	MILD	MODERATE	MILD	ABSENT

43	94	INVERSION	MODERATE	MODERATE	MODERATE	MODERATE	ABSENT
44	95	INVERSION	MILD	MILD	MILD	MILD	ABSENT
45	96	EVERSION	SEVERE	SEVERE	SEVERE	MODERATE	PRESENT
46	98	INVERSION	MILD	MILD	MILD	MILD	ABSENT
47	101	INVERSION	MILD	MODERATE	MODERATE	MILD	ABSENT
48	102	EVERSION	MILD	MILD	MILD	MILD	ABSENT
49	103	INVERSION	MODERATE	MODERATE	MODERATE	MILD	ABSENT
50	108	INVERSION	MILD	MILD	MLID	MILD	ABSENT
51	109	INVERSION	MILD	MILD	MILD	MILD	ABSENT
52	111	INVERSION	MILD	MILD	MILD	MILD	ABSENT
53	112	EVERSION	SEVERE	SEVERE	SEVERE	MODERATE	ABSENT
54	113	INVERSION	MILD	MILD	MILD	MILD	ABSENT
55	116	INVERSION	MODERATE	MODERATE	MODERATE	MILD	PRESENT
56	117	INVERSION	MILD	MLID	MILD	MILD	ABSENT
57	118	INVERSION	MILD	MDERATE	MODERATE	MILD	ABSENT
58	119	EVERSION	MILD	MILD	MILD	MILD	ABSENT
59	120	INVERSION	MILD	MILD	MILD	MILD	ABSENT
60	122	INVERSION	MILD	MILD	MODERATE	MILD	PRESENT
61	124	INVERSION	MILD	MILD	MODERATE	MILD	ABSENT
62	126	TRAUMA	MODERATE	MODERATE	MODERATE	MILD	ABSENT
63	128	INVERSION	MILD	MILD	MILD	MILD	ABSENT
64	130	INVERSION	MILD	MILD	MILD	MILD	ABSENT
65	133	EVERSION	MILD	MILD	MILD	MILD	ABSENT
66	134	INVERSION	MILD	MILD	MODERATE	MILD	ABSENT
67	136	INVERSION	MILD	MILD	MLD	MILD	ABSENT
68	137	INVERSION	MODERATE	MODERATE	MODERATE	MILD	ABSENT

69	138	INVERSION	MILD	MILD	MODERATE	MILD	ABSENT
70	140	INVERSION	MILD	MILD	MILD	MILD	ABSENT
71	141	EVERSION	MILD	MILD	MILD	MILD	ABSENT
72	145	INVERSION	MODERATE	MODERATE	MODERATE	MILD	ABSENT
73	146	INVERSION	MILD	MILD	MILD	MILD	ABSENT
74	147	INVERSION	MILD	MILD	MILD	MILD	ABSENT
75	148	TRAUMA	MILD	MILD	MILD	MILD	ABSENT
76	149	INVERSION	MILD	MILD	MILD	MILD	ABSENT
77	150	INVERSION	MODERATE	MODERATE	MODERATE	MILD	ABSENT
78	151	INVERSION	MILD	MILD	MILD	MILD	ABSENT
79	152	INVERSION	MILD	MILD	MILD	MILD	ABSENT
80	153	INVERSION	MILD	MILD	MILD	MILD	ABSENT
81	154	EVERSION	MILD	MILD	MILD	MILD	ABSENT
82	155	INVERSION	MODERATE	MODERATE	MODERATE	MILD	ABSENT
83	157	INVERSION	MILD	MILD	MILD	MILD	ABSENT
84	158	INVERSION	MILD	MILD	MODERATE	MILD	ABSENT
85	160	INVERSION	MILD	MILD	MILD	MILD	ABSENT
86	162	INVERSION	MILD	MILD	MILD	MILD	ABSENT

87	164	INVERSION	MILD	MODERATE	MODERATE	MILD	ABSENT
88	165	INVERSION	MILD	MILD	MILD	MILD	ABSENT
89	168	INVERSION	MILD	MILD	MILD	MILD	ABSENT
90	170	EVERSION	MILD	MILD	MILD	MILD	PRESENT
91	171	EVERSION	MODERATE	MODERATE	MODERATE	MILD	ABESENT
92	173	INVERSION	MILD	MILD	MILD	MILD	ABSENT
93	175	INVERSION	MILD	MILD	MILD	MILD	ABSENT
94	178	INVERSION	MILD	MILD	MODERATE	MILD	ABSENT
95	183	INVERSION	SEVERE	SEVERE	SEVERE	MODERATE	PRESENT
96	186	INVERSION	MILD	MILD	MILD	MILD	ABSENT
97	191	INVERSION	MODERATE	MODERATE	MODERATE	MILD	ABSENT
98	192	INVERSION	MODERATE	MODERATE	MODERATE	MILD	PRESENT
99	194	EVERSION	MILD	MILD	MILD	MILD	ABSENT
100	195	INVERSION	MODERATE	MODERATE	MODERATE	MILD	PRESENT