01 TITLE

"ASSESSMENT OF EFFICACY OF ANUTAILA NASYA ON MUSCULE STRENGTH, ENDURANCE AND GIRTH IN HEALTHY REGULAR EXERCISING PERSONS WSR TO SHOULDER, CHEST AND PECTORAL GIRDLE"

For the Thesis of

Ph.D. (Ayurveda - **Swasthavritta)**

Submitted by

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Tilak Maharashtra Vidyapeeth, Pune – 37

Aug.2016

02 CERTIFICATE

CERTIFICATE

This is to certify that **Vd. Prachi Kavita Datta Dalvi**

PRN : Ph.D. (Ayurveda) **05611004593**

has prepared her Dissertation for Ph.D.(Ayurveda – Swasthavritta), titled **"Assessment of efficacy of anutaila nasya on muscule strength, endurance and girth in healthy regular exercising persons wsr toshoulder, chest and pectoral girdle"** under my supervision.

The research work done by her is Original. I recommend that the Dissertation can be submitted to the Faculty of Ayurveda, Tilak Maharashtra Vidyapeeth , Pune.

Signature Of Guide

Date :

Place :

03 ACKNOWLEDGEMENT

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INDEX

INDEX OF TABLES

CHAPTER 1

INTRODUCTION

Anagata badhapratishedha means "**Prevention is better than cure"** is one of the basic principles of Ayurveda. Maharshi Sushrut explains the effect of Vyayam on body with great detail. He says.[1.]

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Vyayam makes body stout and strong. It allows proper and ideal growth of limbs and muscles. It improves the complexion, texture of the skin and *Agni* i.e. digestive power. It doesn't allow laziness in the body and keeps the body light and glossy, firm and compact. It enhances the power of endurance against the fatigue and weariness and variations in temperature, provided it should be performed correctly. Or else one may land with musculoskeletal problems. The issues arising due to improper exercise, sports, injuries are handled in a specialized branch called Sports Medicine. Although it is one of the blooming branch, with the addition of Ayurvedic treatment we can definitely add some of the golden treatments and modalities to it. It will ultimately result in betterment to Indian Sports.

Activities like Sports and Exercise are essential part of human life. It helps in development of an individual's persona at physical, mental, social, cultural and spiritual level. It inculcates the spirit of friendship, endurance, forgiveness, acceptability and obedience which is a sportsman quality. Physical constitution as well as mental constitution plays a vital role to form a sportsperson. Neck and shoulder joints are primarily used in all activities. Shoulder joint has maximum possible movements. Along with the daily exercise, help of Ayurveda in training of a sportsman can give lucrative results.

Exercise plays a great role, not only in professional players but also in common man. In this era,busy life style, irregular eating habits, Stress are the major culprits behind lifestyle diseases.People are facing many health problems to which allopathy medicines cannot be a perfect solution. In order to avoid there adverse effects there should be something which can be incorporated in daily life style. Many persons are fitness freak and are very conscious about their health. The number of people are working out in the gym is increasing regularly.

तत्र यः स्नेहनार्थं शून्यशिरसां ग्रीवास्कंधोरसां च बलजननार्थं □□□□□□□□□□□□□□□□□□□□□ वा स्नेहो विधीयते तस्मिन वैशेषिको नस्यशब्दः II
सु.चि.४० / २२

Nasya is one of the effective ways to improve the musculature of the neck, shoulder and chest. Thus it can prevent the impact of injuries in these parts of the Body. Nasya tends to cure the diseases peculiar to the supraclavicular regions of the body , removes the cloudening or dullness of the sense-organs , imparts a sweet aroma to the mouth and strengthens the teeth, jaw, head, neck , shoulders, arms and the chest . It guards against an attack of baldness, premature greying of hair and premature appearance of wrinkles on face[2] i.e. signs of aging.

Generally the sportspersons or regular exercisers consume various health supplements to improve their muscle strength, endurance and girth, which ultimately may show adverse effects on the body in long term. Nasya can be used as an adjuvant therapy as a solution in above circumstances.

CHAPTER 2

AIMS AND OBJECTIVES

AIM :

To assess the effectiveness of *Anutaila Nasya* on muscle strength, endurance and girth in regular healthy exercising persons wsr to shoulder, chest and pectoral girdle.

OBJECTIVE :

- To quantify the shoulder muscles and chest muscles strength after *Anutaila Nasya* with the help of 1 RM of Overhead Press and 1 RM of Chest Press respectively.
- To quantify the shoulder muscles and chest muscles endurance after *Anutaila Nasya* by Push ups.
- To quantify the Arm girth and Chest girth after *Anutaila Nasya* with the help of measurement

CHAPTER 3

REVIEW OF PREVIOUS WORK DONE :

- **Vihad Gorakshanath** – Assesment of efficacy of *Anu- Tail Pratimarsha Nasya* as *Upakrama* in *Dincharya* w.s.r.to *Manyastambha*. - Tilak Ayurveda Mahavidyalaya, Pune.

- **Banamali Das, Ravi M Ganesh**, **P.K.Mishra and Gurucharan Bhayal**- A Study of *Avabahuk* and its management by *Laghumasha Taila Nasya- Ayu* International Quarterly Journal of Research in Ayurveda.- Internet

- **Shaligram S D** – A Study of *Asthigata Vata* w.s.r.to Cervical Spondylosis and role of *Snehana* and *Nasya Karma* in its management.- L-2398, Jamnagar, Gujrat.-1998

- **Bhadauria A K S** - Cervical Spondylosis Ayurvedic diagnosis and its management by *Pancha Karma* w.s.r. to *Abhyanga, Swedan and Nasya Karma*.-1996

CHAPTER 4

REVIEW OF LITERATURE

- ***ANUTAILA***
- ***NASYA***
- ***MAMSADHATU SHARIRRACHANA, SHARIRKRIYA***
- **ANATOMY OF MUSCLES**
- **PHYSIOLOGY OF MUSCLES**

ANUTAILA

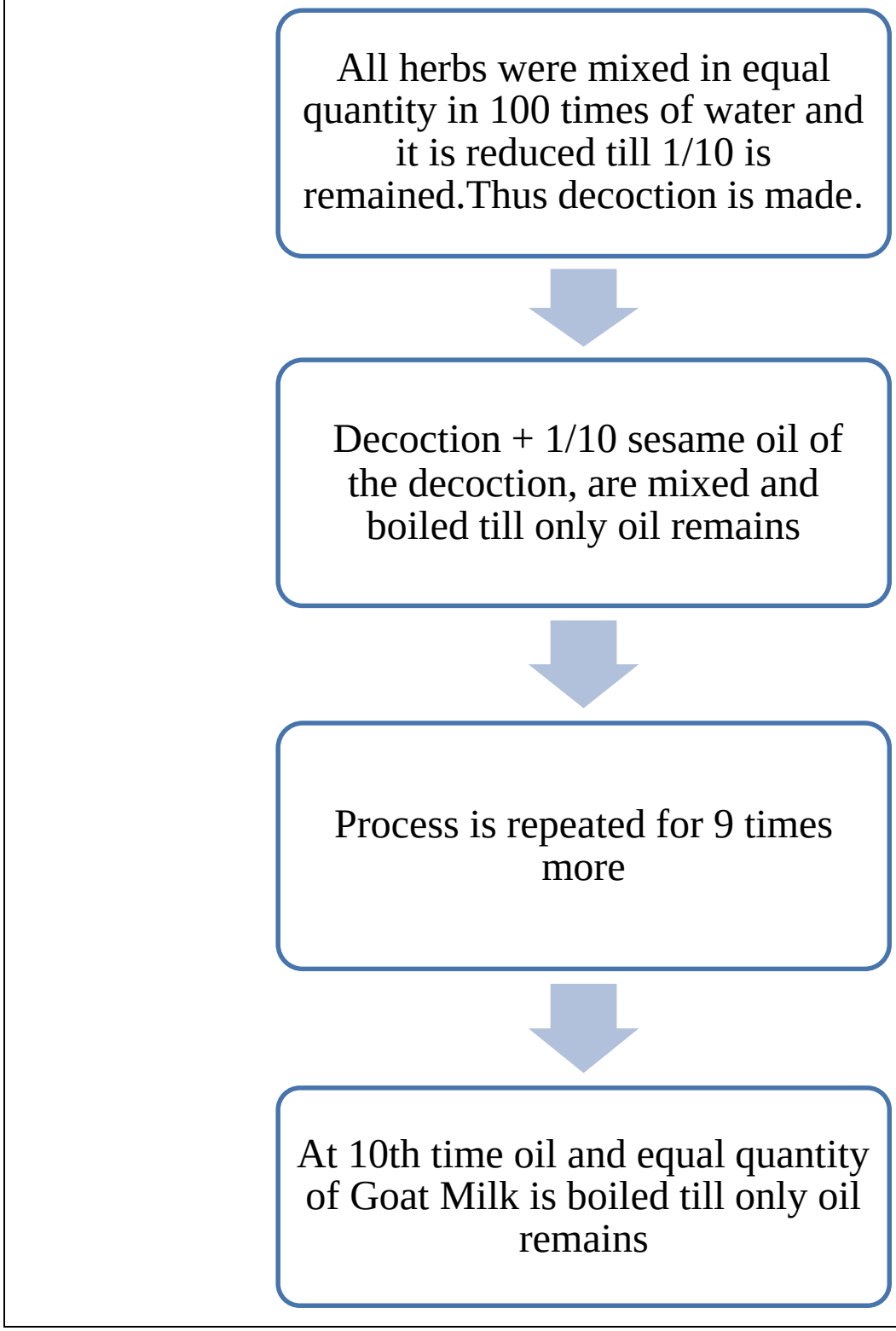
Brihattrayi cites *Anutaila* in the context of *Nasya* many times. *Anutaila* is described in *Charak Samhita su.* 5/63-70, *Sushrut Samhita* in *chi.* 4/28 and Ashtanga Hridaya in *su*. 20/36-39. Ashtang sangraha also described two types of *Anutaila* in *ssu*.29 /10-11 and in *Anandkand* it is cited in *Amrutikaran vishranti* 18/95-103. These Ayurvedic texts explain *Anutaila* in different contexts. *Charakacharya* has explained it in *Matrashitiyadhyaya*, *Sushrutacharya* in *Vatavyadhichikitsopakrama, Vagbhatacharya* in *Nasyavidhiradhyaya*, *Ashtanga Sangrahakar* in *Nasyavidhiradhyay* and in *Anadakanda* it is explained in the context of *Dincharya* (*Sadacharrasayanam Dincharya Ashtadashollas*). *Anutail* is greatly described in *Dincharya* and *Dincharya* is inseparable part of Swasthavritta Ayurvedic pharmaceutics offer a great range of medicaments. They actually aim at effective potentisation of medicaments with simple methods. *Anutaila* would be the best example of potentisation among Ayurvedic drugs. This potentisation helps *Anutaila* to penetrate deepest channels in the body [3]

Constituents of *Anutaialam* : (Table No.1)

CHARAK [5]	***SUSHRUT***[6]	***ASHTANG HRIDAYA***[7]	***ASHTANG SANGRAHA***		***ANANDKAND***[10]
			TYPE 1[8]	***TYPE 2***[9]	
Chandan	*Til Taila*	*Jeevanti*	*Manjishtha*	*Chandan*	*Jeewanti*
Agru	*Water*	*Sugandhabala*	*Prapaundrik*	*Agaru*	*Usheer*
Tejpatra	*Vataghna Medicines*	*Devdaru*	*Jeewak*	*Tejpatra*	*Twak*
Daruharidra twak		*Musta*	*Rishabhak*	*Daruharidra twak*	*Devdaru*
Yashti		*Twak*	*Kakoli*	*Yashtimadhu*	*Daruharidra Twak*
Bala		*Usheer*	*Kshirkakoli*	*Atibala*	*Sariwa*
Neelkamal		*Sariwa*	*Payasya*	*Bilwa*	*Yashti*
Sukshma Ela		*Chandana*	*Sariwa*	*Utpal*	*Chandan*

Vidanga		*Daruharidra*	*Anant*	*Padmakeshar*	*Bhadramusta*
Bilwa		*Yashtimadhu*	*Neelotpal*	*Widanga*	*Agaru*
Utpal		*Bhadramusta*	*Anja*	*Usheer*	*Shatawari*
Hariber		*Agaru*	*Rasna*	*Hriber*	*Prapoundrik*
Khas		*Shatawari*	*Widanga Tandul*	*Wanya*	*Utpal*
Bhadramusta		*Shwetakamal*	*Madhuparni*	*Twak*	*Bilwa*
Dalchini		*Bilwa*	*Shrawani*	*Prapaundrik*	*Rasna*
Musta		*Neelkamal*	*Meda*	*Musta*	*Shaliparni*
Sariva		*Brihati*	*Kakanasa*	*Sariwa*	*Brihati*
Shaliparni		*Kantakari*	*Saral*	*Brihat Kantakari*	*Kantakari*
Jeenvanti		*Rasna*	*Shal*	*Laghu Kantakari*	*Renukbeej*
Prushniparni		*Shaliparni*	*Bhadradaru*	*Anshumati dwaya*	*Ela*
Devdaru		*Prushniparni*	*Chandan*	*Jeewanti*	*Tejapatra*
Shatavari		*Widanga*	*Cow's Milk*	*Devdaru*	*Bala*
Kapikachchu		*Tejpatra*	*Til Taila*	*Surabhi*	*Kamal Keshar*
Renukbeej		*Sookshma Ela*		*Shatavari*	*Widanga*
Kantakari		*Renukbeeja*		*Rain Water*	*Ishwari*
Padmakeshar		*Padmakeshar*		*Aja Dugdha*	*Rain Water*
Til Taila		*Atibala*		*Til Taila*	*Ajadugdha*
Aja Dugdha		*Rainwater*			*Til Taila*
Rain Water		*Til Taila*			
		Aja Dugdha			

Method of Preparation of *Anutailam*[11,12,13]: (Table No.2)


All herbs were mixed in equal quantity in 100 times of water and it is reduced till 1/10 is remained.Thus decoction is made.
Decoction + 1/10 sesame oil of the decoction, are mixed and boiled till only oil remains
Process is repeated for 9 times more
At 10th time oil and equal quantity of Goat Milk is boiled till only oil remains

General contents of *Anutaila* are mentioned in Table No.1. The process of *Anutaila* preparation is explained in flow chart in Table no.2

.

Properties of *Anutaila*[14] :

Regular practice of *Anutaila Nasya* regains the sharpness of the sense-organs. It strengthens the muscles of neck, shoulders, and chest. It guards against an attack of premature greying of hair and premature appearance of wrinkles on face.

To achieve the benefits of ***Anutaila***, it is used best in *Nasya* form. *Nasya* is nasal insufflations of medicated oil, decoction or powder. The Nasal route is the only superior way to treat disease conditions of upper part of Sternum.

Anutaila is *vataghna, brihana* and *snehan*. It is *sukshma srtotogami*. Profuse secretions occur after administration of *Anutaila Nasya*. Chest, head, palate, throat is invaded with *Kapha Dosha. Anutaila* firstly mobilises the *kapha etc doshas* from these *sthanas* and then it acts there as *Bruhana.* Oil reaches to minute channels and removes all the *doshas*. The *sneha* reaches in the *srotasas,* oliation and strengthening action takes place on ligaments and tendons of upper part of the Body. Thus it is helpful in Wry neck, Facial Palsy, immobilisation of Jaw, headache, rhinitis, migraine and trembling of neck. It increases the efficiency of *Indriyas* e.g. *Nasa, Karna, Netra*. It cures hair fall and prevents premature greying of hair. Regular practice of *Anutaila* helps avail this benefit as well as clear perception of sense organs, clarity of voice and facial glow. Moreover diseases of the upper part of the body remain no more frequent with the regular use of Anutaila.[15]

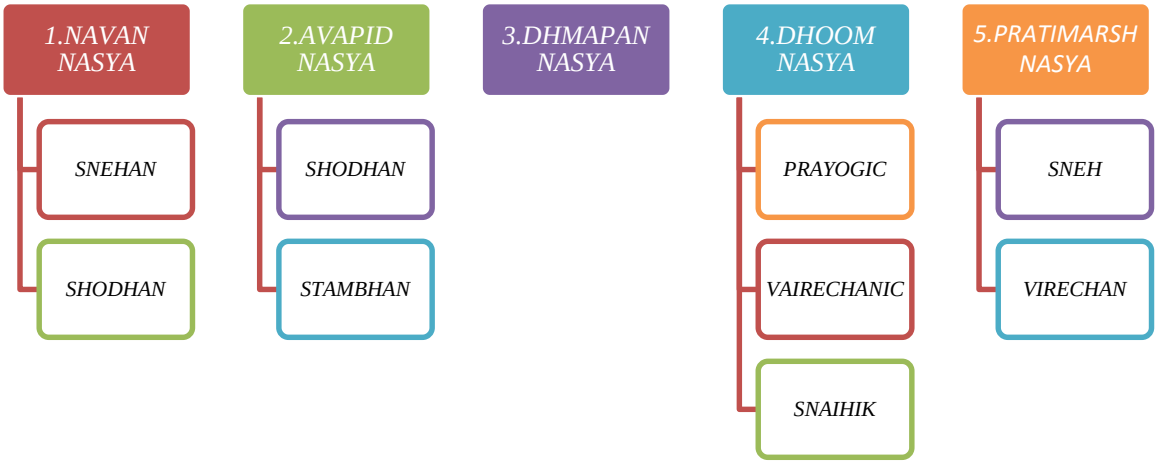
According to *Charakacharya* regular use of *Anutaila* liquefies the *Doshas*, extracts them from the site without destructing it and ultimately improves efficiency of *Indriyas*. This is due to the oleation action on *Siras and Kandaras* (tendons and ligaments) of shoulders, neck, and chest. These parts become strong[16]. However it is to be remembered that the most favourable season for Anutaila Nasya is Pravrut, *Sharad ritu*, and in *Varsha ritu* during clear sky.

NASYA

'नासा हि शिरसो द्वारम। अ.ह्र.सू.२०/१.

Ayurvedic School of thoughts says nose is a entrance of the Cranial Cavity. The nasal medicine enters in *Shringatak marma* and spreads in the cranial cavity, eyes, ears, throat and the minute capillaries of face and the *doshas* are removed from the site.[17]

According to ***Charkacharya t***ypes of Nasya are as follows [18]



According to action *Charkacharya* mentioned 3 types.

1. Rechan

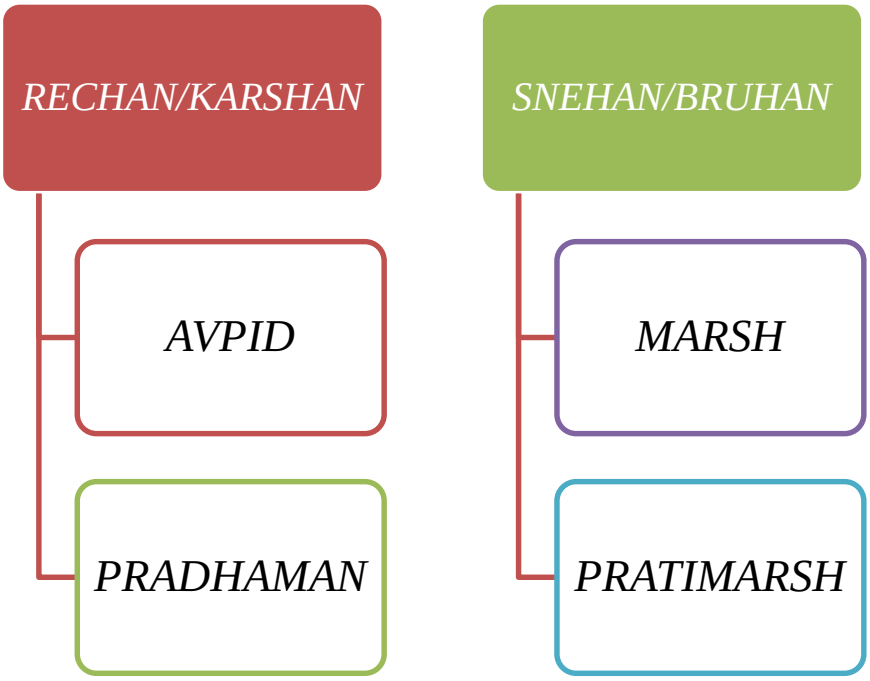
2. Tarpan

3. Shaman

According to ***Sushrutacharya*** types are as follows[19]

Shirovirechan and *Snehan*, they are further classified into 5 types

According to ***Sharangdhar*** the types are as follows [20]



(Table No.3) Types Of *Nasya* according to various *Acharya*

Sr. No.	***VAGBHAT*[21]**	***KASHYAP*[22]**	***BHOJ*[23]**	***VIDEHA*[24]**
1	*Virechan*	*Shodhana*	*Prayogic*	*Sandnyaprabodhan*
2	*Bruhan*	*Poorana*	*Snaihik*	*Stambhan*
3	*Shaman*	-	-	-

(Table No.4) Time Suitable for *Marsha* and *Pratimarsha Nasya* [25]:

Sushrutacharya and *Vagbhatacharya* described *kala* suitable for *Marsha* and *Pratimarsha Nasya*

1.	*Talpothit*	2.	*Prakshalit Dant*	3	*Gruhannirgachat*
4.	*Vyayamottar*	5.	*Vyavayottar*	6.	*Adhwaparishrant*
7.	*Mutravisarjanottar*	8.	*Malavisarjanottar*	9.	*Kavalottar*
10	*Anjanottar*	11	*Bhojanottar*	12	*Vamanottar*
13	*Divaswapottar*	14	*Sayankal*	15 16	*Hasyottar(Vagabhatacharya)* *Shiorobhyangottar----ii------*

Vagbhatacharya explained two additional *kala* for *Nasya*.ie after laughing and after head massage.

(Table No.5) As per diurnal variations[26]

Dosha	***Kala***
Kapha	Morning

Pitta	Mid Noon
Vata	Evening and Night
Swastha Purush	Early Morning

(Table No.6) As per *Rutu*[27]

Rutu	***Kala***
Shit Kala (Winter)	Mid Noon
Grishma (Summer)	Evening
Varsha (Rainy Season)	When Clear Sky Observed in the Day Time
Sharad and *Vasant*	Early in the Morning

(Table No.7) As per Frequency[28]

Condition	**Frequency**
Vataj Shirorog	Morning and Evening Daily
Hidhma , Apatanak	Morning and Evening Daily
Manyasthambha	Morning and Evening Daily
Swarbhramsha	Morning and Evening Daily
Other than above	Alternate Day but not more than 7 days.

(Table No.8) ***Nasya Arha* and *Nasya Anarha*[29]**

	Eligibility/ Indications		**Non eligibility/Contraindications**
1	*Shirstambha*	1	*Bhuktbhakt*

2	*Manyastambha*	2	*Ajirna*
3	*Dantstambh*	3	*Snehpan*
4	*Dantshoola*	4	*Jalpan*
5	*Hanugraha*	5	*Madyapan*
6	*Pinas*	6	*Shirsnat*
7	*Galshundika*	7	*Kshudhart*
8	*Galshaluk*	8	*Trushart*
9	*Timir*	9	*Shramart*
10	*Vartmarog*	10	*Madmatta*
11	*Vyanga*	11	*Dandshastrahat*
12	*Ardhavabhedak*	12	*Vyayamklant*
13	*Grivarog*	13	*Vyavayklant*
14	*Skandharog*	14	*Dattabasti*
15	*Ansashoola*	15	*Virechanottar*
16	*Mukharog*	16	*Garbhini*
17	*Karnashoola*	17	*Navpratishyay*
18	*Nasashoola*	18	*Durdin*
19	*Akshishoola*		-
20	*Shirshoola*		-
21	*Ardit*		-
22	*Apatantrak*		-
23	*Apatanak*		-
24	*Galgand*		-
25	*Dantharsha*		-
26	*Dantchal*		-
27	*Arbud*		-
28	*Swarbhed*		-
29	*Vakgraha*		-
30	*Gadgadatva*		-

Pravrut, *Sharad* and *Vasant* these three *Rutus* are best for *Nasya Karma*.In *Grishma rutu* one should do *Nasya* before noon, in cold season in the noon and in rainy season whenever the sky is clear. *Nasya* is not given to those who are less than 7 yr.old and more than 80 yr.old persons.

(Table No.9) *Nasya Matra*

Sr.No	***Nasya Prakar***	***Hraswa Matra Bindu***	***Madhyam Matra Bindu***	***Uttam matra Bindu***
1	*Shaman (Sushrut)*[30]	16 In Each Nostril 8	32 In Each Nostril 16	64 In Each Nostril 32
2	*Shodhan(Sushrut)*[31]	8 In Each Nostril 4	12 In Each Nostril 6	16 In Each Nostril 8
3	*Marsha (Ashtanga sangraha)*[32]	6	8	10
4	*Pratimarsha(Ashtanga sangraha)*[33]	2	2	2
5	*Kalka(Dalhan Commentry)*[34]	4	6	8

MAMSADHATU SHARIR RACHANA* AND *SHARIRKRIYA

In *Amarkosha* it is mentioned that the *dhatu* which give strength to the body and covers the body is *Mamsa dhatu*. *Sushrutacharya* and *Chakrapani* say *Mamsa* is derived from *Prithvi mahabhuta*. *Mamsadhatu* gives strength to the body.[35]

***Upadhatu*[36]** :

Rasadhatu produces *Raktadhatu* and *Stanya, Artav Upadhatu. Rakta* produces *Mamsa* and *Kandara, Sira upadhatu .Mamsa* produces *Meda* and *Vasa* and *Twacha Upadhatu*. *Meda* produces *Asthi and Snayu Upadhatu. Asthi* produces *Majja* and *Majjadhatu* produces *Shukra.*

(Table No.10)

Sr. No.	***DHATU***	***UPADHATU***
1	*Rasa*	*Stanya, Artava*
2	*Rakta*	*Kandara , Sira*
3	*Mamsa*	*Vasa , Twacha*
4	*Meda*	*Asthi , Snayu*

***Mala*[37] : (Table No.11)**

Sr. No.	***DHATU***	***MALA***
1	*Rasa*	*Kapha*
2	*Rakta*	*Pitta*
3	*Mamsa*	*Karna mala*
4	*Meda*	*Sweda*
5	*Asthi*	*Kesha , Loma*
6	*Majja*	*Akshi mala, Sneha on Twacha*

***Mamsa nirmiti* [38] :**

The heat of *Vayu, Jala* and *Tej mahabhut* gives stability to the liquid form of *Rakta dhatu* to produces *Mamsadhatu*.

Mamsadhatu Karya[39]*:*

Mamsadhatu give strength to the body and nourishes *Medadhatu*.

Dashapranayatan[40]:

Murdha, Kantha, Hridaya, Nabhi, Guda, Basti, Ooja, Shukra, Shonita and *Mamsa* are *Dashapranayatan.*

ANATOMY OF NOSE[40a]

The peripheral Olfactory organ consist of the external Nose and Nasal cavity which is latter divided by septum into right and left parts.

The External Nose : The External Nose is pyramidal in form and its upper angle or root is connected directly with forehead. Its free angle is termed the Apex. Its inferior aspect is perforated by two elliptical apertures, termed the nares or nostrils which are separated from each other by the Septum. The lateral surfaces of the nose form by their union in the median plane, the dorsum nasi, the shape and direction of which vary considerably in different individuals; the upper part of the external nose is supported by the Nasal bones and the frontal processes end below in the rounded alar nasi.

The framework of the external nose is composed of bones and hyaline cartilages. The bony framework which supports its upper part, consist of nasal bones, the frontal processes of the maxillae and the nasal part of the frontal bone. The cartilaginous framework consists of the sepatal cartilage, the upper and lower nasal cartilages and the small cartilages of ala. These are connected with one another and with the bone by continuity of the perichondrium and the periostium. The septal cartilage somewhat quadrilateral in form and thicker at its margins than at its centre forms almost the whole of the septum between the anterior parts of the nasal cavity. The upper part of its antero-superior margins than at its centre, forms almost the whole of the septum between the anterior parts of the nasal cavity. The upper part of its antero-superior margin is connected to the posterior border of the internasal suture; the middle part is continuous with the upper nasal cartilages.The lower part is attached to these cartilages by the perichondrium. Its anterio inferior border is connected on each side to the septal process of the lower nasal cartilage. Its posterosuperior border is joined to the perpendicular plate of the ethmoid bone and its postero-inferior border is attached to the vomer and to the nasal crest of the maxillae and the anterior nasal spine. The cartilage of the septum may extend backwards as a narrow process, termed the sphenoidal process, for some distance between the vomer and the perpendicular plate of ethmoid bone.The antero –inferior part of the nasal septum between the two nostrils is freely movable and hence is named the septal mobile nasi. It is not formed by the cartilage of the septum, but by the septal processes of the lower nasal cartilages and by the skin.

The upper nasal cartilage is triangular in shape. Its anterior margin is thicker than the posterior and its upper part is continous with the cartilage of the septum but its lower part is separated

from this cartilage by narrow fissure. Its superior margin is attached to the nasal bone and the frontal process of the maxilla. Its inferior margin is connected by fibrous tissue with lower nasal cartilage.

The lower nasal cartilage is a thin, flexible plate which is situated below the upper nasal cartilage and is bent acutely around the anterior part of the nares. The middle part of the plate is narrow and is termed septal process. The latter is loosly connected by fibrous tissue with that of the opposite cartilage, and to the antero-inferior part of the septal cartilage, thus helping to form the septam mobile nasi. The upper border of the lateral part of the lower nasal cartilage is attached by fibrous tissue to the lower border of the upper nasal cartilage. Its posterior, narrow end is connected with the frontal process of the maxilla by a tough fibrous membrane, in which three or four small cartilaginous plates, termed the small cartilage of ala are found. Its lower free edge falls short of the lateral margin of nares, the lower part of the ala nasi being formed by fatty and fibrous tissue covered with skin. In front, the lower nasal cartilages are separated by a notch which can be felt at the apex of the nose.

The skin of the dorsum and sides of the nose is thin and loosely connected with the subjacent parts; but over the tip and alae it is thicker and more firmly adherent and is furnished with a large number of sebaceous glands, the orifices of which are usually very distinct.

The arteries of the external nose are the alar and septal branches of the facial artery, which supply the ala and lower part of the septum and the dorsal nasal branch of the ophthalmic artery and the infra orbital branch of the maxillary artery, which supply the lateral aspects and the dorsum. The veins end in the facial and ophthalmic veins. The nerves for the muscles of the nose are derived from the facial nerve, while the skin receive branches from the ophthalmic nerve, through its infratrochlear branch and the external nasal nerve and from the infra orbital branch of the maxillary nerve.

Nasal Cavity: The nasal cavity is subdivided into right and left halves by the nasal septum. These two halves open on the face through the nares or nostrils and communicate behind with the nasal part of the pharynx through the posterior nasal apertures.The nares are somewhat pear shaped apertures, narrower in front than behind. Each measures about 1.5 cm to 2 cm. anteroposteriorly and about 0.5 cm to 1 cm transversely. The posterior nasal apertures or

chonchae are two oval openings each measuring about 2.5 cm in the vertical and 1.25 cm in the transverse direction.Each half of the nasal cavity has a floor, a roof, a lateral wall and a medial wall. It consist of three parts viz the Vestibule, the Olfactory region and the Respiratory region.The Vestibule is a slight dilatation just inside the aperture of the nostril bounded laterally by the ala and the lateral part of the lower nasal cartilage and medially by the septal process of the same cartilage.It extends as a small recess towards the apex of the nose .The vestibule is lined with skin and coarse hairs and sebaceous and sweat glands are found in its lower part; the hairs curve downwards and forwards to the naris and tend to arrest the passage of foreign substances carried with the current of inspired air. In the male, after middle age, they increase considerably in size. The vestibule is limited above and behind by a curved elevation, named the limen nasi, which corresponds to the upper margin of the lower nasal cartilage and along which the skin of the vestibule is continuous with the mucous membrane of the nasal cavity. The olfactory region comprises the rest of the cavity.

Walls Of The Nasal cavity: The lateral wall is marked by three elevations formed by the superior, middle and inferior nasal conchae and below and lateral to each concha by the corresponding nasal passage or meatus. Above the superior concha a triangular fossa named the sphenoethmoidal recess receives the opening of the sphenoidal sinus. Sometimes a fourth elevation,termed the highest nasal concha is present on the lateral wall of the sphenoethmoidal recess the highest or supreme nasal meatus related to it may present the opening of a posterior ethmoidal sinus. The superior meatus is a short oblique passage extending about half way along the upper border of the middle concha. The posterior ethmoidal sinuses open, usually by one aperture into the front part of this meatus. The middle meatus, deeper in front than behind, is below and lateral to the middle concha and is continued anteriorly into a shallow depression situated above the vestibule and named the atrium of the middle meatus.Above the atrium an ill defined curved ridge, termed the agar nasi runs forwards and downwards from the upper end of the anterior free border of the middle concha. It is better developed in the newborn child than in adult. When the middle concha is raised or removed, the lateral wall of this meatus is displayed fully. A rounded elevation termed the bulla ethmoidalis and below and extending upwards in front of it, a curved cleft, termed the hiatus semilunaris, form the principal features of this wall. The bulla ethmoidalis is caused by the bulging of the middle ethmoidal sinuses, which open on or immediately above it, and the size of the bulla varies with that of its contained sinuses. The

hiatus semilunaris ,which is bounded inferiorly by a sharp concave ridge produced by the uncinate process of the ethmoid bone ,leads forwards and upwards into a curved channel ,which is named the ethmoidal infundibulum . The anterior ethmoidal sinuses open into the infundibulam, which in rather more than 50% of subjects is continuous with the frontonasal duct or passage leading from the frontal sinus. In other cases the ethmoidal infundibulum ends blindly in front by forming one or more of the anterior ethmoidal sinuses and frontonasal duct opens directly into the anterior end of the middle meatus. The opening of the maxillary sinus is situated below edge of the hiatus semilunaris. In a coronal section of the nose this opening is seen to be placed near the roof of the sinus. An accessory opening of the maxillary sinus is frequently present below and lateral to the inferior nasal concha. The nasolacrimal duct opens into this meatus under cover of the anterior part of the inferior concha.

The medial wall or nasal septum : The nasal septum is often deflected from the median plane thus lessening the size of one half of the nasal cavity and increasing that of the other ridges or spurs of bone, sometimes project from the septum to one or other side. Immediately over the incisive canal at the lower edge of the cartilage of the septum a depression is sometimes seen It points downwards and forwards and occupies the position of a canal which connected the nasal with the buccal cavity in early foetal life. On each side of the septum close to this recess a minute orifice may be discerned. It leads backwards into a blind tubular pouch 2 to 6 mm long – the vestigial vomeronasal organ which is supported by a strip of cartilage named the vomeronasal cartilage. It is lined by epithelium consisting mainly of a single layer of tall columnar cells and contains many glands. This organ is well developed in many of the lower animals where it apparently plays a part in the sense of smell, since it is supplied by twigs of the olfactory nerve and is lined with epithelium similar to that in the olfactory region of the nose.

The roof of the nasal cavity is narrow from side to side, except at its posterior part and may be divided from behind forwards, into sphenoidal,ethmoidal and frontonasal parts, corresponding to the bones which enter into its formation. The ethmoidal part is almost horizontal but the frontonasal and sphenoidal part slope downwards and forwards and downwards and backwards respectively.The cavity is therefore deepest where its roof is formed by the cribriform plate of the ethmoid bone.

The floor is concave from side to side flat and almost horizontal antero-posteriorly. Its anterior three fourth are formed by the palatine process of the maxilla. Its posterior one fourth by the horizontal part of the palatine bone. About 2 cm behind the anterior end of the floor a slight depression in the mucous membrane overlies the incisive canal.

The Nasal mucous membrane lines the nasal cavities with the exception of the vestibules and is intimately adherent to the periosteum or perichondrium. It is continous with the mucous membrane of the nasal part of the pharynx through the posterior nasal apertures, with the conjunctiva through the nasolacrimal duct and lacrimal canaliculi and with the mucous membrane of the sphenoidal, ethmoidal frontal and maxillary sinuses through the openings of these sinuses.The mucous membrane is thickest and most vascular over the nasal conchae especially at their extremities. It is also thick over the nasal septum but very thin in the meatus, on the floor of the nasal cavity and in the various sinuses. The thickness of the membrane reduces materially the size of the bony cavity and the apertures communicating with it.

Structure of Mucous Membrane:

The Epithelium of the mucous membrane differs in its characteristics according to the functions of the part of the nose in which it is found. In the respiratory region it is columnar and ciliated. Goblet or mucous cells are interspersed among the columnar cells, while smaller pyramidal cells are found between the bases of the latter. Beneath the epithelium and its basement membrane there is a fibrous layer infiltrated with lymphocytes, forming in many parts a diffuse lymphoid tissue and under this a nearly continuous layer of mucous and serous glands the ducts which open upon the surface. The abundant amount of mucous secreted by the glands and goblet cells makes the surface of the mucous moist and sticky.Because of this the dust in the inspired air is deposited on the surface and the air is moistened. The vascularity of the membrane ensures warming of the inspired air. The contaminated mucus film covering the membrane is moved by ciliary action downward and backward away from the olfactory region and into and into the nasopharynx .Palate movements then transfer it to the oral pharynx and it’s swallowed .In the Olfactory region which extends over the upper 10 mm or so of the septum and over the superior concha and the lateral wall above it,the mucous membrane is yellowish in colour and the epithelial cells are of 3 types supporting (sustentacular) cell, basal cells and olfactory cells proper. The supporting cells are tall nonciliated, cylindrical cell, their oval nuclei lie in

approximately the same plane about the middle of the cells and the deep parts of the cells tapper as they extend to the basement membrane. The cytoplasm contains a yellowish brown pigment. The basal cells are pyramidal in shape and contain enzymes (phosphates and esterase). The Olfactory cells are bipolar nerve cells the cell bodies and spherical nuclei of which lie between the supporting cells a little deep to the plane of ficial process of each cell runs between the supporting cells and ends at the surface of the mucous membrane in a cup like expansion from the edge of which there arise one or more fine hair like processes called olfactory hairs. The deep process of the cell is frequently beaded and is continued as an olfactory nerve fibre. Beneath the epithelium and extending through the thickness of mucous membrane ,there is a layer of branched tubular serous glands (The Nasal Glands) which are rich in enzymes (Acid phosphatise ,Esterase,Lipase) Their ducts pass between the supporting cells to open on the surface. The gases responsible for odours dissolve in the fluid secretion of the glands and thus stimulate the olfactory hairs.

Vessels and Nerves – The arteries of the nasal cavity are the anterior and posterior ethmoidal branch of ophthalmic artery which supply the ethmoidal and frontal sinuses and the roof of the nose. The sphenopalatine branch of the maxillary artery which supplies the mucous membrane covering the conchae,the meatuses and septum the terminal part of the greater palatine artery which ascend through the incisive canal the septal ramus of the superior labial branch of the facial artery which supplies the part of the septum in the region of the vestibule anastomosing with the sphenopalatine artery and is a common site of bleeding from the nose (epistaxis) the infra orbital and superior alveolar branches of maxillary artery which supply the lining membrane of themaxillary sinus and the pharyngeal branch of the same artery which is distributed to the sphenoidal sinus. Thus ramifunctions of these vessels form a close plexiform network beneath and in the substance of the mucous membrane.

The veins form a close cavernous plexus beneath the mucous membrane. Arterio venous communication are present.The plexus is especially marked over the lower part of the septum and over the middle and inferior conchae. Some of the veins open into the sphenopalatine vein others join the facial vein some accompany the the ethmoidal artery and end in the ophthalmic veins a few communicates with veins on the orbital surface of the frontal lobe of the brain

through the foramina in the cribriform plate of ethmoid bone.When the foramen caecum is patent it transmits a vein from the nasal cavity to the superior sagital sinus.

The Lymphatic drainage of the Nasal cavity: It can be injected from the subarchnoid space through communications which exist along the course of olfactory nerves. The lymph vessels from the anterior part of the nasal cavity pass superficially to join those who drain the skin covering the external nose and end in the submandibular lymph nodes.The remainder of the nasal cavity, the paranasal sinuses, the nasopharynx and the pharyngeal end of the auditory tube are drained by vessels which pass to the upper deep cervical lymph nodes, either directly or after traversing the retropharyngeal lymph nodes. It is probable that the posterior part of the floor of the nasal cavity is drained by vessels which enter the parotid group of lymph nodes. The lymph vessels of the mucous lining of the tympanic cavity and mastoid antrum pass to the paratid or upper deep cervical lymph nodes. Those from the tympanic end of the auditory tube probably end in the deep cervical lymph nodes.

The nerves of ordinary sensation that supply the nasal cavity are the anterior ethmoidal branch of the nasociliary nerve which supplies the anterior and upper part of the septum the anterior part of the roof and the anterior parts of the middle and inferior conchea with the lateral wall in front of these. The infra orbital nerve which supplies the vestibule the anterior superior alveolar nerve which supplies the part of septum and floor near the anterior nasal spine and the anterior part of the lateral wall as high as the opening of the maxillary sinus;the lateral posterior superior nasal and the medial posterior superior nasal nerve (including the nasopalatine nerve) which are branches of the pterygopalatine ganglion and the posterior inferior nasal branches of the anterior palatine nerve ,supply the posterior three quarters of the lateral wall ,roof,floor and septum ;branches from the nerve of the pterygoid canal which supply the upper and back part of the roof and septum. It is to be noted that with the exception of the nasociliary nerve all the nerves supplying the nasal cavity are derived from the maxillary division of the trigeminal nerve. The Olfactory nerves are distributed to the olfactory region.Their fibres arise from the bipolar olfactory cells and are destitute of myelin sheaths. They unite in fascicule which cross one another in various directions, thus giving rise to the appearance of a plexus in the mucous membrane and then ascend in grooves or canals in the ethmoid bone; they pass into the skull through thye foramina in the cribriform plate of the ethmoid and enter the under surface of the

olfactory bulbs, in which they ramify and form synapses with the dendrites of the mitral cells closely associated with the olfactory nerves are the nervi terminals.

The paranasal Sinuses: The paranasal sinuses are the frontal, ethmoidal sphenoidal and maxillary they vary in size and form in different individuals and are lined with mucous membrane resembles that of the respiratory region of the nasal cavity but is thinner less vascular and more loosely adherent to the bony walls of the sinuses. The mucus secreted by the glands in the mucous membrane is swept into the nose through the apertures of the sinuses by the movement of the cilia covering the surface.The cilia are not found uniformly in the lining mucous membrane but are always present near the opening into the nasal cavcity .The function of the sinuses is doubtful. They lighten the skull and add resonance to the voice. They vary considerably in size in different individuals,.most are rudimentary ,or even absent at birth they enlarge appreciably during the time of eruption of the permanent teeth and after puberty and this growth is a factor in the alteration in the size and shape of the face at these times.

The frontal Sinuses: They are 2 in numbers are situated behind the superciliary arches between the outer and inner tables of the frontal bone. When of average size they underlie a triangular area on the surface, the angles of which are formed by the nasion, a point about 3 cm above the nasion and the junction of the medial third because the septum between the outer and inner tables of the frontal bone. When of average size,they underlie a triangular area on the surface the angles of which are formed by the nasion a point about 3cm above the nasion and the junction of the medial third with the rest of the supra orbital margin. They are rarely symmetrical because the septum between them frequently deviates from the median plane. Their average measurements are as follows- height 3.16 cm breadth 2.58 cm depth from before backwards 1.8 cm. Each extends upwards above the medial part of the eyebrow and backward into the medial part of the roof of the orbit. The frontal sinus is sometimes divided into a number of intercommunicating recesses by incomplete bony partitions. Rarely one or both sinuses may be absent and the degree of prominence of the superciliary arches is no indication of the presence or size of the frontal sinuses. The part of the sinus extending upwards in the frontal bone may be small and the orbital part large or vice versa. Sometimes one sinus may overlap in front of the other.Each opens into the anterior part of the corresponding middle meatus of the nose, either through the ethmoidal infudibulam or through the frontonasal duct, which transverses the anterior part of the labyrinth

of the ethmoid. Rudimentary or absent at birth, they are generally fairly well developed between the seventh and eighth years but reach their full size only after puberty. The arterial blood supply of the sinus is from the supra orbital and anterior ethmoidal arteries and the venous drainage is into the anastomotic vein in the supra orbital notch connecting the supra-orbital and superior othalmic veins. The lymph drainage is to the submandibular nodes.The nerve supply is derived from the supra-orbital nerve.

The Ethmoidal sinuses: It consists of thin walled cavities in the ethmoidal labyrinth, completed by the frontal, maxillary, lacrimal, sphenoidal and palatine bones. They vary in number and size from 3 large to 18 small sinuses and their openings into the nasal cavity are very variable. They lie between the upper part of the nasal cavity and the orbits and are separated from the latter by the extremely thin orbital plates of the ethmoid. Infection may spread from the sinuses into the orbit and produce orbital cellulitis. On each side they are arranged in three groups' anterior middle and posterior. Through some anatomists divide them into 2 groups anterior and posterior, the anterior group including those described below as the anterior and middle groups. The three groups are not sharply delimited from each other and one group may encroach on the territory generally occupied by another. In each group the sinuses are partially separated by incomplete bony septa. The anterior group vary up to eleven in number and open into the ethmoidal infundibulum or the frontonasal duct by one or more orifices. One sinus frequently lies in the agger nasi and the most anterior sinuses may encroach upon the frontal sinus. The middle group (buller sinuses) generally comprise three sinuses and open into middle meatus by one or more orifices on or above the ethmoidal bulla. The posterior group vary from one to seven in number and usually open by one orifice into the highest meatus (when present) and one or more sometimes open into the sphenoidal sinus. The posterior group are very closely related to the optic nerve. The ethmoidal sinuses are small but of clinical importance at birth; they grow rapidly between the 6^{th} and 8^{th} yr. and after puberty. They derive their arterial blood supply from the sphenopalatine and the anterior ethmoidal and posterior ethmoidal arteries and are drained by the corresponding veins. The lymphatics of the anterior and middle group drain into the submandibular nodes and those of the posterior group into the retropharyngeal nodes. The ethmoidal sinuses are supplied by the anterior and posterior ethmoidal nerves and the orbital branches of the pterygo palatine ganglion.

The Sphenoidal Sinuses: They are 2 in number are placed behind the upper part of nasal cavity. Contained within the body of the sphenoid bone they are therefore related above to the optic chiasma and the hypophysis cerebri on each side to the internal carotid artery and the cavernous sinus. If the sinuses are small, they lie in front of the hypophysis cerebri. They vary in size and shape and owing to the lateral displacement of intervening septum are rarely symmetrical. Frequently one sinus is much the larger of the 2 and extends across the median plane behind the sinus of the opposite side. Occasionally one sinus may overlap above the other and rarely there is a communication between the two sinuses. The following are their average measurements vertical height 2 cm, transverse breadth 1.8 cm, anteroposterior depth 2.1 cm. When exceptionally large they may extend into the roots of the pterygoid process or greater wings of the sphenoid and may invade the basilar part of the occipital bone. Occasionally there are gaps in the bony wall and the mucous membrane may lie directly against the dura mater. Bony ridges, produced by the internal carotid artery and the pterygoid canal, may project into the sinuses from the lateral wall and floor respectively. A posterior ethmoidal sinus may extend into the body of the sphenoid and largely replace a sphenoidal sinus. Each sinus communicates with the spheno-ethmoidal recess by an aperture in the upper part of its anterior wall. They are present as minute cavities at birth, but their main development takes place after puberty. Their blood supply is by means of the posterior ethmoidal vessels and the lymph drainage is to the retropharyngeal nodes. Their nerve supply is from the posterior ethmoidal nerve and the orbital branches of the pterygopalatine ganglion.

The Maxillary Sinus: It is largest accessory air sinuses of the Nose are pyramidal cavities in the bodies of the maxillae The base of each formed by the lateral wall of the nasal cavity the apex extends into the zygomatic process of maxilla. The roof or orbital wall is frequently ridged bythe infra-orbital canal, while the floor is formed by the alveolar process and usually 1.25 cm below the level of the floor of nose on a line drawn laterally from the lower border of the ala. Several conical elevations corresponding with the roots of the first and second molar teeth project into the floor, which is sometimes perforated by one or more of these roots. Sometimes the roots of the first and second premolars and third molar and occasionally the root of the canin, also project into the sinus. The size of the maxillary sinus varies in different skulls and even on the two sides of the same skull; when large, its apex may invade the zygomatic bone. The following measurements are those of an average –sized air sinus: vertical height opposite the first molar

tooth, 3.5 cm, transverse breadth 2.5 cm; anteroposterior depth 3.2 cm. The sinus communicates with the lower part of the hiatus semilunaris through an opening in the anterosuperior part of its base. A second orifice is frequently seen in or immediately below the hiatus.The maxillary sinus appears as a shallow groove on the medial surface of the bone about the fourth month of intrauterine life, but does not reach its full size until after the eruption of all the permanent teeth. The blood supply of the sinus is by means of the facial, infra-orbital and greater palatine vessels; the lymph drainage is to the submandibular node. The nerve supply is derived from the infra-orbital and the anterior, middle and posterior superior alveolar nerves.

ANATOMY OF MUSCLES[41]

MUSCLES OF THE SHOULDER GIRDLE

The muscle of the shoulder girdle is classified as anterior and posterior.

ANTERIOR

Pectoralis minor: This muscle participates in several movements of scapula such as downward rotation, upward tilt, and depression and combined movements of abduction lateral tilt. When the scapulae stabilized by the adducts, contraction of the pectoralis minor elevates the 3rd, 4th, and 5th ribs.

Serratus anterior: The upper portion causes abduction and lateral tilt of the scapula close to the ribs. The upper and lower portion of the serratus anterior and trapezius combine to form a force couple for upward rotation of the scapula. Activity of this muscle is especially evident during elevation of the arm

Subclavius: Its chief function is to protect and stabilize the sternoclavicular articulation. It is also in a position to depress the scapula.

POSTERIOR

Levator Scapulae: It causes elevation and downward rotation of the scapula when the trunk is in the erect position

Rhomboids major and minor: They cause downward rotation, adduction and elevation of the scapula.

Trapezius : It has 4 parts , part I and II compose the upper trapezius , part III the middle and part IV the lower , It's action includes following

Part I – elevation

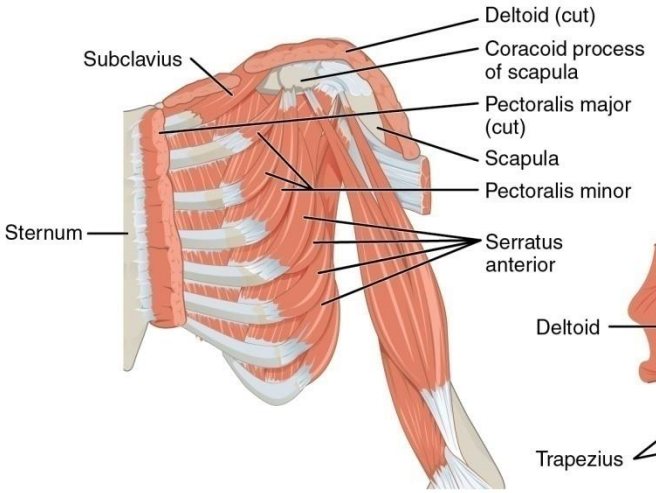
Part II – Elevation, upward rotation, adduction.

Part III –Adduction

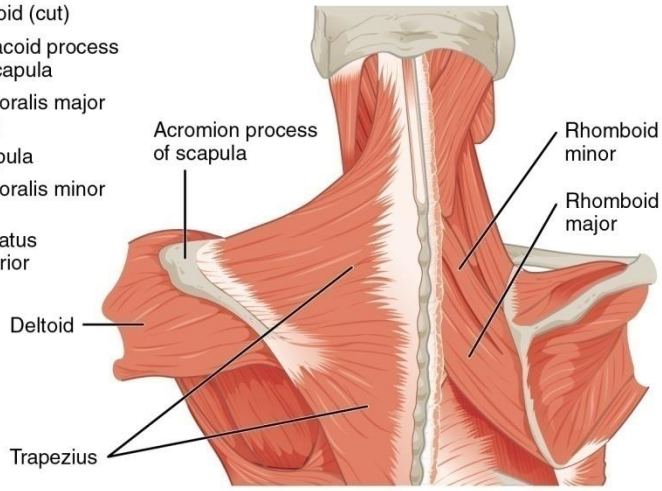
Part IV – Upward rotation, depression, adduction.

MUSCLES OF THE SHOULDER JOINT

The muscles of the shoulder joint are listed according to their position in relation to the joint. All muscles in this classification pass either from the trunk or the scapula to the arm.



Pectoral girdle muscle (left anterior lateral view)



Pectoral girdle muscles (posterior view)

ANTERIOR

Pectoralis major: The pectoralis major as a whole is most powerful for action in the saggital plane and is particularly important in all pushing, throwing punching activities.

Coracobrachialis: It participates in forward movements of the humerus.

Subscapularis: As one of the rotator cuff muscle the subscapularis contribute significantly to stabilization of the glen humeral joint. Its chief action as a mover is inward rotation.

Biceps brachi: Both heads are always active in flexion and short head sometimes participates in adduction against resistance and in medial rotation.

SUPERIOR

Deltoid: The middle portion of the muscle is a powerful abductor of the humerus. The middle portion has also been found to be active in horizontal abduction. The anterior portion of the deltoid aids in all forward movements of the arm and in inward rotation of the humerus. It is also active in abduction.

Supraspinatus: It also acts in flexion and horizontal extension, and important in preventing downward dislocation.

POSTERIOR

Infraspinatus and teres minor: Together with subscapular they depress the head of the humerus and thus prevent it from jamming against the acromion process during flexion and abduction of the arm. Their important function in this capacity is to present dislocation of the shoulder joint especially when the humerus is in the abducted position.

SUPERIOR

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Supraspinatus: It also acts in flexion and horizontal extension. It plays a significant part in the stability of the shoulder joint and is important in presenting downward dislocation.

POSTERIOR

Infraspinatus and Teres minor: Together with subscapularis they depress the head of the humerus and thus prevent it from jamming against the acromion process during flexion and abduction of the arm. Their important function in this capacity is to prevent dislocation of the shoulder joint especially when the humerus is in the abducted position.

INFERIOR

Latissimus dorsi: The muscle has a favorable angle of pull for extension and adduction of the arm. The action of the latissimus dorsi in extension and adduction during static and dynamic, resisted and unresisted movements.

Teres major: The teres major to be active during hyperextension and adduction when the arm is behind the back.

Tricep brachi: It is active in movements of the humerus because its long head crosses the shoulder joint. It assists in adduction, extension and hyperextension of the humerus.

Anatomy of Shoulder Joint

Shoulder Joint (Glenohumeral Joint) : The Glenohumeral joint is a synovial ball and socket articulation between the head of the humerus and the glenoid cavity of the scapula. It is multiaxial spheroidal joint possessing three degree of freedom between the roughly hemispherical humeral head and shallow scapular glenoid fossa, an arrangement allowing much movement but reducing security, skeletally this joint is weak and depends for support on the surrounding muscles more than on it's shape and ligaments, however the coracoacromial arch overhangs it.The ligaments of articulation are the glenoid labrum,fibrous capsule,gleno humeral,coracohumeral and transverse humeral.

The fibrous Capsule: The fibrous Capsule envelops the joint and is attached medialy to the glenoid labrum and encroaching on the coracoids process, to include the attachment of the long head of biceps. Laterally it is attached to the humeral anatomical neck, which is close to the articular margin except on the medial side where at the attachment descend for rather more than 1cm on the shaft of the bone . It is also lax that the bones can be distracted for 2-3 cm. This accords with a very wide range of movement, which is possible at the articulation.

Synovial Membrane: The Synovial membrane lines the inner surface of the fibrous capsule and covers the lower part and sides of the anatomical neck of the humerus as for the articular cartilage on the head of the bone. The tendon of the long head of biceps passes through the joint and is enclosed in a tubular sheath of synovial membrane, which is continued round the tendon in to the intertubular sulcus as far as the surgical neck of the humerus.

The Coracohumeral Ligament: The coracohumeral ligament is a broad thickening of upper capsular region, passes from the lateral bored of the root of the coracoids process to the front of

the greater tubercle, blending with supraspinatous tendon , its inferoposterior border blends with capsule

The transverse humeral ligament: The transverse humeral ligament is a broad band passing from the lesser and greater tubercles it converts the intertubular sulcus into a canal and its attachment lies above the epiphysial line and act as retinaculum for the long tendon of biceps.

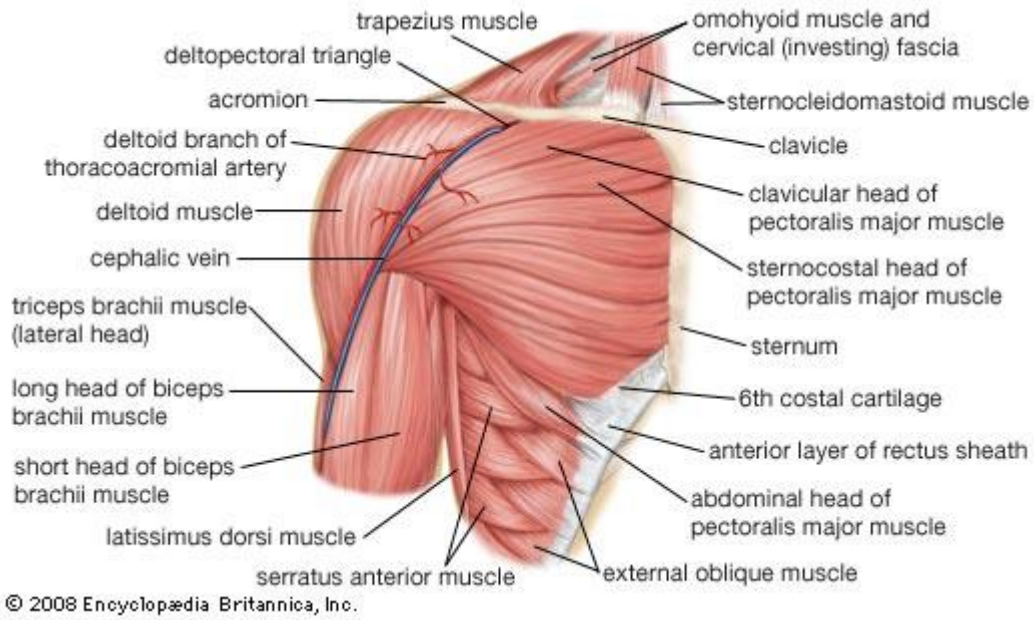
The Glenoid Labrum: It is fibrocartilaginous rim around glenoid fossa, it is triangular in section, base attached to the fossas margin, its thin margin projecting as a continuation of the curve of the glenoid. It blends above with two fasciculi from the long tendon of biceps. It depends the cavity, may protect bone and probably assist lubrication. Its attachment is some times partly deficient synovial membrane may protrude through such gaps.

The Bursae: Many bursaes adjoin the shoulder joint. A sac or pouch of synovial fluid located at friction points,especially above joints.

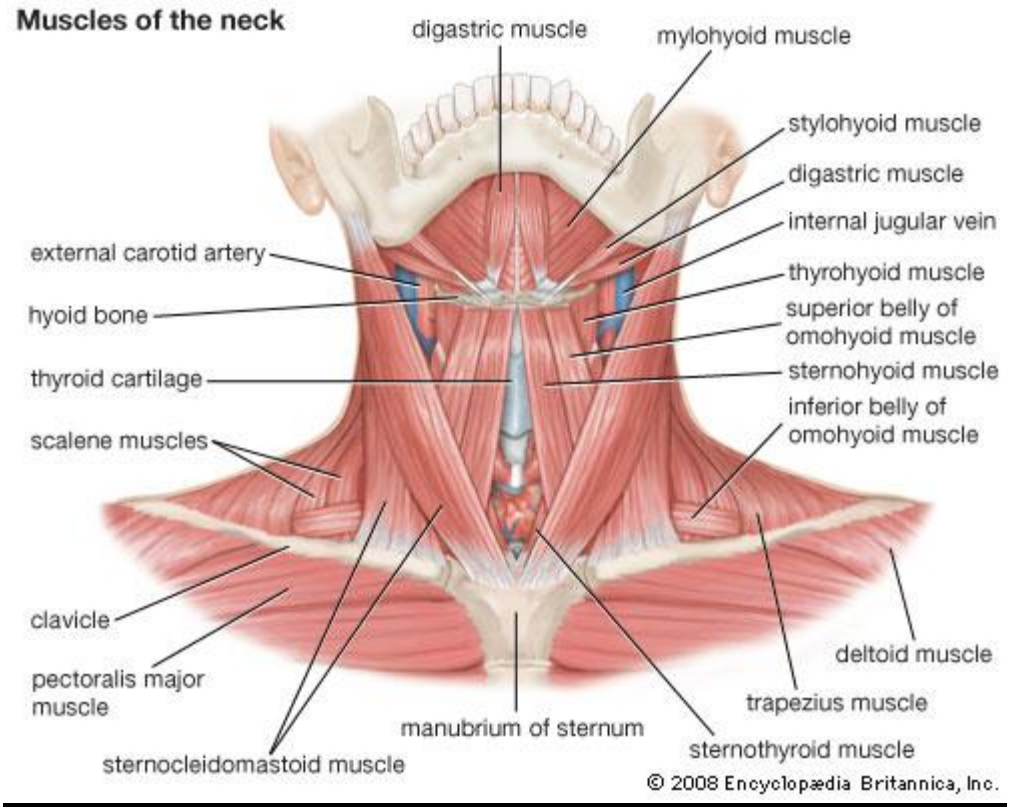
1. One between the subscapular tendon and articular capsule communicating with the joint between the superior and middle gleno humeral ligaments.
2. One sometimes between the infraspinatous tendon and capsule communicating with the joint between the superior and middle gleno humeral ligaments.
3. The subacromial bursa lies between deltoid and the capsule; it does not communicate with the joint but is prolonged under the acromion and coracoacromial ligament between them and supraspinatous.
4. One on the upper surface of the Acromion
5. One is frequently found between the coracoids process and the capsule.
6. One sometime exists behind the coracobrachialis.
7. One between the teres major and the long head of the triceps.
8. One in front of and another behind the tendon of the latssimus dorsi.

Muscles Related :

Muscles of the Chest



The Muscles related to shoulder jopint are supraspinatus above, long head of triceps below subscapularis in front infraspinatous and teres minor behind, long tendon of biceps intrascapular and deltoid covers the joint in front behind and laterally.



Blood Supply :

1. Anterior Circumflex humeral artery.
2. Posterior circumflex humeral artery
3. Supra scapular artery
4. Sub scapular artery

Tendon Sheaths :

In addition to bursae, structures called tendon sheaths also reduce friction at joint. Tendon sheaths are tube like bursae that wrap around tendons where there is considerable friction. This occurs where tendons pass through synovial cavities such as the tendon of the biceps brachi muscle at the shoulder joint.

Articular Ends :

Proximally – The glenoid fossa of scapula and distally the head of humerus.

1. Glenoid Fossa: It is pisiform in shape, its upper end being narrower than the lower end. It is slightly depressed in the center. Its area as well as concavity is increased by a fibro cartilaginous ribbon like structure- Glenoid Labrum.
2. The head of the humerus is hemispherical in shape and is also covered with the hyaline articular cartilage which is thicker in the center than at the periphery. The greater tubercle is a lateral projection distal to the anatomical neck. It is the most laterally palpable bony land mark of shoulder region.

Nerve Supply:

The Nerves of the Shoulder joint are derived mainly from

1. Axillary nerve
2. Musculocutaneous nerve
3. Suprascapular nerve

Nerves are mainly from the posterior brachial cord and from the suprascapular, axillary and the lateral pectoral nerves. The Suprascapular supplies the posterior and superior, axillary anterionferior and the lateral pectoral anterosuperior part of the capsule.

Physiology[42]

Movements: The Shoulder joint enjoys a great freedom of mobility at the cost of stability. There is no other joint in the body which is more mobile than the shoulder. The Joint as a multiaxial spheroidal joint, is capable of any combination of swing and spin over a very wide range, all movements analyzable as rotations around three orthogonal axes. It has three degrees of freedom, classically flexion-extension, abduction – adduction, circumduction and medial and lateral rotation are assigned to it laxity of the capsule and a humeral head which is large relative to the shallow glenoid fossa, afford a wide range of movement than any other joints. However with the arm dependent, even when moderately loaded, supraspinatous and tension in the upper capsule prevent down word displacement of the humerus

Flexion: There is a decrease in the angles between articulating bones. It occurs in sagittal plane. Max. Range permited – 180 degree.

Muscle, Nerve:

1. Ant. Deltoid – Axillary N C5 C6
2. Pectoralis Major (Clavicular Head) – Medial and Lateral Pectoral N C5C6
3. Pectoralis Major - Medial and Lateral Pectoral N C6 C7 (Sternocostal Head) C8 T1
4. Coraco Brachialis – Musculocutaneous N C6 C7.

Extension: Increase in the angle between articulating bones, often to restore a part of the body to the anatomical position after it has been flexed, occurs in sagital plane (Backward and slightly lateral movement of arm). Max range permited – 60 degree.

Muscle, Nerves :

1. Posterior Deltoid – Axillary N C5 C6
2. Infraspinatous – Suprascapular N C5 C6

3. Teres Major – Axillary N C5 C6
4. Teres Major – Lower Subscapular N C5 C6 C7
5. Latissimus Dorsi – Thoracodorsal N C6 C7 C8

Abduction: Ab – away, duct – to lead is the movement of a bone away from the midline. This movement occurs in the frontal plane. Moving the humerus laterally at the shoulder joint. Range permitted -180 degree.

First 15-30 degree of abduction by supraspinatus, 30-90 degree by the fibers of deltoid , 90 – 180 degree by lateral forward rotation of scapula caused by trapezius and serratus anterior.

Vertical Abduction:

Muscle, Nerves :

1. Deltoid – Axillary N C5 C6
2. Supraspinatous – Suprascapular N C5 C6

Horizontal Abduction :

Muscle, Nerves :

1. Post.Deltoid – Axillary N C5 C6

Adduction: Ad – Towards, Duct – To lead

Movement of the Bone towards the midline usually in the frontal plane. Returns of Abduction to the anatomical position is adduction. Range of Movement – 45 degree.

Vertical Adduction :

Muscle ,Nerves :

1. Pectoralis Major – Medial and lat. Pectoral N C6 C7 C8 (Sternocostal Head) T1
2. Latissimus Dorsi – Thoracodorsal N C6 C7 C8

3. Coraco Brachialis – Musculocutaneous N C5 C6 C7

Horizontal Adduction :

Muscle ,Nerves :

1. Pectoralis Major – Medial and lat. Pectoral N C6 C7 C8 (Clavicular Head)
2. Pectoralis Minor – Medial and lat. Pectoral N C5 C6 C7 C8 T1
3. Ant. Deltoid – Axillary N C5 C6

Medial Rotation :

Movement of a bone around its longitudinal axis. Rotation is defined relative to the midline. If the anterior surface of a bone of the limb is turned towards the midline. This movement is medial rotation. Max. range permitted – One quarter of a circle about a vertical axis.

Muscles ,Nerve :

1. Subscapularis – N C5 C6
2. Teres Major – Brachial Plexus C5 C6 C7
3. Latissimus Dorsi – Thoracodorsal N C6 C7 C8
4. Ant. Deltoid – Axillary N C5 C6

Lateral Rotation:

Movement of a bone around its longitudinal axis in a lateral way (away from the midline)

Muscles ,Nerve :

1. Infraspinatus – Supra Scapular N C5 C6
2. Teres Minor – Axillary N C5 C6
3. Post Deltoid – Axillary N

Circumduction :

Flexion,Abduction,Extension,and Adduction in succession, in which the distal end of a body part moves in a circle.

PHYSIOLOGY OF MUSCLE

Muscular Strength

It may be defined as the force or tension a muscle or muscle group can exert against a resistance in one maximal effort.

Muscular Endurance

It is usually defined as the ability or capacity of a muscle group to perform repeated contractions against a load or sustain a contraction for an extended period of time.

Muscular strengths are highly correlated with muscular endurance. Muscular strength is created by the summation of forces produced by the contraction of individual muscle fibers. It is highly graded strength with in a given muscle as per the requirement of the quality of the movement. Whether a fine graded movement (delicate work) is to be performed as that of eye muscle or heavy work is to be performed as in the case of lifting heavy weight. There are 660 skeletal muscles in the adult human being These muscles constitute approx. 45% of body weight

Skeletal muscle is not only the major site of energy transduction but it is also a major site of energy storage.

Gross structure of skeletal Muscle

Muscle in the body consist of thousand of cylindrical muscle cells called fibres This fibres lie parallel to each other and the force of contraction is along the long axis of the fibre. Each fiber is separated from each other by neodymium. Another layer of connective tissue called paramecium surrounds a bundle of up to 150 fibres called fasciculus. Surrounding the entire muscle is a fascia of fibrous connective tissue known as the epimysium. The protective sheath is tapered at its distal end as it bends into joins the intramuscular tissuesheath to form the dense, strong connective tissue of the tendons. The region where the tendon joins a relatively stable skeletal part is the origin of the muscle the point of attachment to the moving bone is the insertion. Beneath the endomysium and surrounding each fiber is the sarcolemma this thin elastic membrane encloses the fibers cellular contents. The aqueous protoplasm or sarcoplasm of the cell contains the contractile proteins enzymes, fat and glycogen particles the nuclei and various specialized cellular organelles. Embedded within the sarcoplasm is an extensive interconnecting network of tubular channels and vesicles known as the sarcoplasmic reticulum. This highly specialized system provides the cell with structural integrity and also serves important functions in muscular contraction.

Chemical composition

Approx. 75% of skeletal muscle is water, 20% is protein and the remaining 5% is made up of inorganic salts and other substances that include high energy phosphate, urea, lactic acid ,the mineral calcium, magnesium, phosphorous, various enzymes and pigments , ions of sodium ,potassium, chloride, amino acids, fats and carbohydrates. The most abundant muscle proteins in relation to the muscle's total protein content are myosin, actin and tropomysin. Also about 700 mg of the conjugated protein myoglobin are incorporated into each 100 gm of muscle tissue.

Blood supply

During exercise that requires an oxygen uptake of 4 lit./ min. the muscle's oxygen consumption increases nearly 70 times to about 11 ml / 100 gm / min. or a total of about 3,400 ml/ min. to accommodate this large oxygen requirement of exercising muscles, the local vascular bed must channel large quantities of blood through the active tissues. In rhythmic exercise such as running, swimming , or cycling the blood flow fluctuates. It decreases during the muscle's contraction phase and increases during the relaxation period. This provides a milking action that facilitates blood flow through the muscle and back to the heart complementing this pulsatile flow is the rapid dilatation of previously dormant capillaries so that in strenuous exercise more than 4,000 capillaries may be delivering blood to each square millimeter of muscle cross- section. Straining type activities present a somewhat different picture when a muscle contracts to about 60% of its force generating capacity , blood flow to the muscle in occluded due to elevated intramuscular pressure with a sustained static or isometric contraction , the compressive force of the contraction can actually stop the flow of blood . Under such conditions energy for continued muscular effort is generated mainly from the stored phosphangens and through the anaerobic reactions of glycolysis.

Capillarization of muscle

One factor often proposed for the improved exercise capacity with training is an increase in capillary density of the trained muscles. Besides its role in delivering oxygen , nutrients and hormones , the capillary circulation also provides the means for removing heat and metabolic by products from the active tissues. All of these functions would be enhanced by a higher capillary density in muscle tissue. Several investigations show favorable effects of endurance training on the capillarization of skeletal muscle. In one study using the electron microscope, the number capillaries / muscle (as well as the capillaries per square millimeter of muscle tissue) averaged about 40% greater in endurance athletes than in untrained counterparts. This was almost identical to the 41% different in maximal oxygen uptake between the 2 groups. One research group cited unpublished observations that skeletal muscle capillaries can be easily increased and that the

increase is closely related to the activity level of the muscle. They also reported a high positive relationship for both men and women between maximal oxygen uptake and the average no. of muscle capillaries the functional significance of this relationship is that increased capillarization enhances the oxygenation of the entire muscle cell. This would be beneficial during strenuous exercise that requires a high level of steady – rate aerobic metabolism.

Ultra structure of skeletal muscle

The myofibrils –

The myofibrils are characterized by alternating light and dark areas. In fact it is geometrical arrangement of all these light and dark areas of the myofibrils that gives the fiber its overall striated appearance. The light areas are called I bands, the dark areas A bands .In the middle of each I band is a dark line, the Z line. The bands which are composed of protein filaments are so named because of what happens to the velocity of a light wave as it passes through them e.g. when a light wave passes through the A band it's velocity is not equal in all directions i.e. it is an isotropic, when a light wave is passed through the I band the velocity of the emerging light is the same in all direction and thus is isotropic.

The sarcoplasmic reticulum and T-tubules –

Surrounding the myofibrils is a net like system of tubules and vesicles collectively referred to as the sarcoplasmic reticulum, the longitudinal tubules of the SR are so named because they run parallel to myofibrils. The longitudinal tubules terminate at either end into vesicles sometimes referred to as the outer vesicles or cisterns. The outer vesicles are where calcium ions (Ca++) as stored, one of the substances required for contraction with in the myofibrils. This reticular pattern is repeated regularly along the entire length of the myofibrils. The outer vesicles of one reticular pattern are separated from those of another by a group of tubules called the transverse tubules (because they run transversely to the myofibril) the T-system or simply the T- tubules. The t-tubules although functionally associated with the sarcoplasmic reticulum are known to be anatomically separate from it. They are extensions or investigations of the muscle cell membrane, the sarcolemma the 2 outer vesicles and the T-tubule seprating them are known as a triad. The entire function of the sarcoplasmic reticulum and T- tubules is not known however , it is known that the triad is of particular importance in

muscular contraction e.g. T-tubules are responsible for spreading the nervous impulse from the sarcolemma inward to the deep portion of the fiber. The outer vesicle of the reticulum contain large amount of calcium (Ca++) as the impulse trave3ls over the T-tubules and communicates with the outer vesicles, Ca++ is released into cytoplasm. The fractional volume of the reticulum system and tubules has been determined to be about 5% of the total of a muscle fiber with chronic exercise training this volume increases by about 12% on the average, providing for a more effective spread of depolarization and Ca++ release. We will discuss shortly the importance of both the spreading of Ca++ in the actual contractile process.

MICROSCOPIC STRUCTURE OF MUSCLE

The protein Filament -

The I and A bands are made up of 2 different protein filaments a thinner filament called actine and a thicker one called myosin. The I band is composed entirely of the thinner actine filaments. They are not continuous with in one sarcomere i.e. between two 'Z' line rather they are anchored to the 'Z' lines at each end of the sarcomere and partly extend into the A band region. The latter band although composed mainly of the thicker myosin filaments also contains a small amount of actin. The so-called H zone is caused by the slight variation in shading resulting from the absence of actin filaments in the middle of the A band. The Z lines adhere to the sarcolemma lending stability to the entire structure and presumably keep the actin filaments in alignment. The Z lines may also play a role in the transmission of nervous impulses from the sarcolemma to the myofibrils. The protein actin consist of globular molecules linked together to form a double helix such a pattern is very similar in appearance to a twisted strand of beads. Actins do not merely participate as passive 'cables' to be pulled on during muscular contraction but are chemically and mechanically involved in the contraction process and although the thin filament is called the actin filament. It actually contains two other important proteins, Tropomyosin and Troponin. The Tropomyosin is a long, thin, molecule that lies on the surface of the actin strand. The ends of the Tropomyosin molecules are embedded in globular molecules of Troponin. The myosin filaments have tiny protein projection on each end that extends towards

the actin filaments. These are called cross-bridges and together with the actin filaments they play a very important role in the contraction process. They are actually two cross-bridge heads attached to one long tail in each myosin molecule. The tails aggregate to form the backbone of the thick filament. The heads are globular in appearance and contain the sites for actin binding and ATP spitting (hydrolysis). These cross-bridges are the energy transuding (chemical to mechanical) components of the contractile machinery. The cyclic interaction of the cross-bridges is responsible for the sliding of the actin filaments, past the myosin filaments during muscle force generation.

The sliding filament theory of muscular contraction

The structural arrangement of skeletal muscle presented above has led to sliding filament theory of muscular contraction proposed by H-E Haxley. As the name of the theory implies one set of filaments is thought to slide over the other thus shorting the muscle. The length of the actin and myosin filaments does not change during contraction but rather the former merely slide over the latter towards the center of the sarcomere. This leads to a shortening of the I band but not of the A band and to disappearance of the H zone. The sliding filament theory is somewhat analogous to the way in which a telescope shortens. The overall length of the muscle decreases as one section (actin) slides over the other (myosin) with neither section itself shortening. The exact manner in which this sliding process is affected has yet to be completely elucidated; however it is thought that the myosin cross-bridges form a type of chemical bonds with selected sites on the actin filaments. This forms a protein complex called actomyosin. When it is extracted from muscle an ATP is added, it will contract as it does in living muscle. The mechanical and physiological events underlying the sliding filament theory of muscular contraction can be conveniently divided into 5 phases.

- Rest
- Excitation-coupling
- Contraction (shortening and tension development)
- Recharging
- Relaxation

Keep in mind that this is a theoretical model and researchers continue to verify and refute various aspects of the model e.g. there is an ongoing search for the actual mechanism by which depolarization of the sarcolemma is communicated across the small gap between the T-Tubules and the cisterns of the SR system so Ca++ is released to the cytoplasm. Other researchers are interested in which specific part of the cross-bridge is involved in the contractile process and how to account for the elastic nature of cross-bridges. Still others are researching the possibility that the major role of Troponin, Tropomyosin complex is to present the weakly binding ATP cross-bridge found in relaxed fibers from going on to more strongly binding states in the presence of Ca++ and so the search continues.

1. Rest: Under resting condition the cross-bridges of the myosin filaments extend toward but do not interact with the actin filaments. An ATP molecule is bound to the end of the cross-bridge. At rest this complex is referred to as an uncharged ATP cross-bridge complex. As mentioned previously calcium as Ca++ is stored in large quantities in the vesicles of the sarcoplasmic reticulum. In the absence of free Ca++ , the Troponin and Tropomyosin of the actin filament work together to inhibit the myosin cross- bridge from binding with actin (i.e. actin and myosin are said to be uncoupled).

2. Excitation – coupling: When an impulse from a motor nerve reaches the motor endplate acetyl choline is released stimulating the generation of an impulse quickly spread throughout the fiber by way of the T-tubules. Enrout they trigger the release of Ca++ from the vesicles of the reticulum the Ca++ is immediately bound (taken up) by the Troponin molecules on the actin filaments This results in what is referred to as the turning on of active sites on the actin filament. The turning on is a result of the Ca++ ions triggering changes in the conformation (structure) of both Troponin and Tropomyosin simultaneously but in an unknown manner the uncharged ATP cross-bridge complex. The turning on by Ca++ of the active sites on the actin filament and the charging of the ATP Cross bridge complex mean that the 2 proteins are mutually attracted to each other. This results in a physical-chemical coupling of actin and myosin (i.e. in the formation of the actomyosin complex). Such a complex is force – generating.

3. <u>Contraction</u>: The formation of actomyosin activates an enzyme component of the myosin filament called myosin ATPase. Myosin ATPase causes ATP to be broken down into ADP and Pi (inorganic phosphate) with the release of large amounts of energy. This released energy allows the cross-bridge to swivel to a new angle or to collapse in such a way that the actin filament to which it is attached slides over the myosin filament toward the center of the sarcomere. This muscle develops tension and shortens.

4. <u>Recharging</u>: A single myosin cross-bridge may make and break with active sites on the actin filament hundreds of times in the course of 1 sec. contraction. To do this, the myosin cross-bridge must be recharged. The first step in recharging is the breaking of the old bond between the actin and the myosin cross-bridge. This is accomplished by reloading the myosin cross-bridge with a new ATP molecule. Once a new ATP is reloaded, the bond between the myosin cross-bridge and the active site on the actin filament is broken. The ATP cross-bridge is freed from the actin (if ATP is not available , as in the case after death the cross- bridge remain attached to the actin and the muscle is said to be in rigor mortis . This is thought to be maximal force producing state.) The cross-bridge is as well as the active site is thus made available for recycling.

5. <u>Relaxation</u>: When the flow of nervous impulses over the motor nerve innervating the muscle causes Ca++ to unbound from Troponin and disactively pumped (calcium pump) back into storage in the outer vesicles of the sarcoplasmic reticulum. Removal of Ca++ alters the Troponin –Tropomyosin interaction, turning off the actin filament such that ATP cross-bridge complexes are no longer able to form. The ATPase actively of myosin is also turned off and no more ATP is broken down. The muscle filaments return to their original position and the muscle relaxes in shortening contractions where the Z lines are pulled towards the middle of the sarcomere called **concentric contraction**. This would be the type of contraction performed by the biceps muscles of the upper arm during lifting or **positive work (against gravity)** portion of chin-up by contrast , during the lowering or **negative work (assisted by gravity)** portion , The actin filaments are viewed as sliding outwards from the middle of the sarcomere. That is to say controlled elongation of muscles back toward their original resting length also is possible. This muscle action is called **Eccentric contraction**. In both cases the ATP cross-bridge complexes are made and broken as the actin filaments are either pulled in or let out depending on need. In **isometric contraction or static contraction**, where there is no visible muscle shortening, the actins remain

in their same relative position while ATP cross- bridges are recycled to provide tension. Other question about the relative positioning of actins, myosins, and the formation of cross-bridges should be addressed because we know that muscle tone is present in relaxed muscle, does this mean that some cross-bridges have formed and are recycling without producing movements? The likely answer is yes, with perhaps as many as 30% of cross-bridges being attached when muscle is in a state of relaxation. When muscle sarcomere are stretched out or compressed, does this hinder the number of cross-bridges that can be attached? This also seems true as only 50% of the cross-bridges are functional. When the sarcomere is stretched too far so as to eliminate overlap of the actins and myosin or when they are progressively hindered under conditions of osmotic compression finally, do the cross-bridges recycle (make and break) at faster rate and use proportionally more ATP when they are exerting more isometric tension? Once again the answer appears to be yes. When the Huxel model is considered and it is assumed that one molecule of ATP is hydrolyzed per cycle of the cross-bridge the rate constant for dissociation (breaking) the cross-bridge is proportional to the ratio of acto-myosin ATPase to isometric tension. This means that when exerting higher levels of static tension, the cross-bridges recycle more quickly. By way of summary, the contractile events of muscle can be compared to the firing of a gun. The gun must first be loaded by placing an appropriate cartridge(ATP) in a specific chamber (myosin and cross-bridge) This combination (uncharged ATP cross bridge) is converted to readied form by cocking the gun (charged ATP cross bridge) , When the trigger is squeezed (calcium turning on actin sites), the ATP is rapidly broken down , releasing large amounts of energy . Work is done on the bullet (myosin cross-bridge). The process is completed by ejection of the spent cartridge (ADP + Pi) and reloading with another cartridge (ADP)

Blood supply

Muscles are richly supplied with blood vessels Arteries and Veins enter and exit the muscle along with the connective tissues and are oriented parallel to the individual muscle fibers. The branch repeatedly into numerous arterioles, capillaries and venules forming vast network in and around the endomysium in this manner each fiber is assured of an adequate supply of freshly oxygenated blood from the arterial system and of the removal of waste products such as carbon-di-oxide via the venous system. In sedentary men and women an average of 3-4 capillaries surrounds each muscle fiber, whereas in male and female athletes 5-7 capillaries surround each

fiber. This is a most important adaptation for aerobic endurance performance. The amount of blood required by skeletal muscle depends, of course, on its state of activity. During maximal exercise the muscle may require as much as 100 times more blood than when resting besides the large number of capillaries that supply each muscle fiber. There are other ways in which this blood flow requirement can be met e.g. the alternating contraction and relaxation of active muscle causes periodic squeezing of the blood vessels. This pumping as milking action called muscle pump, speed up the return of blood to the heart ultimately increasing the amount of fresh blood that can be oxygenated and then returned to the muscles During exercise, constriction of the arteries supplying blood to the inactive areas of the body (such as the gut, kidney, and skin) and dilation of those to the active skeletal muscles also aid in regulating muscle blood flow.

Nerve supply

The nerve supplying a muscle contains both motor (efferent) and sensory (afferent) fibers and usually enters and leaves the muscle along with the blood vessels. The efferent fiber branch out repeatedly throughout the connective tissue framework of the muscle, thus reaching all the muscle fibers. The motor nerves which when stimulated cause muscle fibers to contract, originate in the CNS (spinal cord and brain). The point of termination of a motor nerve (axon) on a muscle fiber is known as the neuromuscular junction or the motor endplate by definition. A motor nerve and all of the individual muscle fibers it innervates is called a motor unit. Motor nerves constitute about 60% of the nerves associated with a muscle. The sensory nerves which make up the remaining 40% convey information concerning pain, tension and muscle contraction from the muscle and tendon sensory receptors to the CNS.

Different kinds of motor units type 1 (slow twitch) and type 2

(Fast twitch) fibers

Skeletal muscle is not simply a homogeneous group of fibers with similar metabolic and functional properties. Although considerable confusion has existed concerning the methods and terminology for classifying human skeletal muscle, two distinct fiber types have been identified and classified by their contractile and metabolic characteristics. All skeletal muscle motor units function in the same general manner as described previously. However not all motor units contains muscle fibers that have the same metabolic or functional capabilities e.g. where as all

motor units and thus all muscle fibers can perform under both aerobic and anaerobic conditions, some are better equipped biochemically and structurally to work aerobically, while others are better equipped to work anaerobically in humans.

Aerobic type fibers -

- Type I, red, tonic, slow twitch or slow oxidative

Anaerobic type fibers -

- Type II, white , phasic, fast twitch or fast glycolytic

These fibers are again divided into 3

1. IIa (FTa,fast oxidative glycolytic , Fog)
2. IIb (FTb, fast glycolytic, FG)
3. IIc(FTc undifferentiated, unclassified , intermediate, interconversion)

The usefulness of corresponding designation system that indicates the relative speed of contraction and predominant sources of energy production associated with each phenotype.

Structural and Functional characteristics of type I, IIa, IIb fibers (Table No.12)

CHARACTERISTICS		**FIBER TYPES**	
	I	**IIa**	**IIb**
NEURAL ASPECT			
MOTORNEURON SIZE	SMALL	LARGE	LARGE
MOTORNEURON RECRUITMENT THERSHOLD	LOW	HIGH	HIGH
MOTOR NERVE CONDUCTION	SLOW	FAST	FAST

VELOCITY			
STRUCTURAL ASPECT			
MUSCLE FIBER DIAMETER	SMALL	LARGE	LARGE
SARCOPLASMIC RETICULUM DEVELOPMENT	LESS	MORE	MORE
MITOCHONDRIAL DENSITY	HIGH	HIGH	LOW
CAPILLARY DENSITY	HIGH	MEDIUM	LOW
MYOGLOBIN CONTENT	HIGH	MEDIUM	LOW
ENERGY SUBSTRATES			
PHOSPHOCREATINE STORES	LOW	HIGH	HIGH
GLYCOGEN STORES	LOW	HIGH	HIGH
TRIGLYCERIDE STORES	HIGH	MEDIUM	LOW
ENZYMATIC ASPECT			
MYOSIN-ATPase	LOW	HIGH	HIGH

ACTIVITY			
GLYCOLYTIC ENZYME ACTIVITY	LOW	HIGH	HIGH
OXIDATIVE ENZYME ACTIVITY	HIGH	HIGH	LOW
FUNCTIONAL ASPECTS			
TWITCH (CONTRACTION TIME)	SLOW	FAST	FAST
RELAXATION TIME	SLOW	FAST	FAST
FORCE PRODUCTION	LOW	HIGH	HIGH
ENERGY EFFICIANCY 'ECONOMY'	HIGH	LOW	LOW
FATIGUE RESISTANCE	HIGH	LOW	LOW
ELASTICITY	LOW	HIGH	HIGH

MODERN ASPECT OF EFFECTIVENESS OF NASAL DRUG DELIVERY[43]

The nasal mucosa is the only location in the body that provides a direct connection between the central nervous system and atmosphere. The nasal mucosal surface provides a site for rapid and relatively painless drug absorption resulting in rapid central nervous system effects. Drug delivered onto the olfactory mucosa are rapidly absorbed by three routes

1. Olfactory neurons route
2. Supporting cells and the surrounding capillary bed route
3. Directly absorbed in to the cerebrospinal fluid (CSF)

Out of above three routes the tras-neuronal absorption is generally slow whereas absorption by the supporting cells and the capillary bed is rapid.

Possible drug absorption and path way: The same can be explained with the help of Anatomy as given below .The drug administered intranasally enters the nasal cavity through superior, middle and inferior meatus which further has six sinus openings

The olfactory cells get stimulated by the drug administered

↓

Stimulation carried further through olfactory axons

↓

Cross the cribriform plate of ethmoid bone

↓

Axons form olfactory bulbs

↓

These bulbs form the Axons synapses with dendrils of the mitral cells

↓

Many such synapses form olfactory glomerulai

↓

From olfactory glomerulai, axons of mitral cells continue to form olfactory tract

↓

They finally end in olfactory cortex

Because of the stimulation all through, *dosavilayana* is readily seen, along with absorption of drug essence to exert the action.

The Pharmacodynamics of *Nasyakarma* can be explained according to modern anatomical and physiological studies as follows[43a]

- Neurological Pathway
- Diffusion Method
- Vascular Pathway

The nose is connected pharmacodynamically through vascular system, nerve plexus, Olfactory Nerve and ophthalmic and maxillary branches of trigeminal nerves to the brain

Neurological Pathway: A great extent with association of olfactory stimuli, the major divisions of olfactory tract leads directly to a portion of the amygdale called corticomedial nuclei that lies immediately beneath the cortex in the pyriform area of temporal lobe.The experimental stimulation of olfactory nerves causes stimulation in cells of hypothalamus and amygdaloidal complex. Electrical stimulation of hypothalamus in animals is capable of inducing secretions in the anterior pituitary.

The peripheral olfactory nerves are chemoreceptor in nature. The olfactory nerve differs from other cranial nerves in its close relation with the brain. The Olfactory nerves are connected with the higher centers of brain ie Limbic system , consisting mainly of amygdaloidal complex, hypothalamus, epithalamus, anterior thalamic nuclei parts of basal ganglia etc. So the drugs administrated here stimulate the higher centers of brain which shows action on regulation of endocrine and nervous system functions.

Thus Hypothalamus regulates Control of autonomic nervous system:

The Hypothalamus controls and integrates activities of ANS which regulates contraction of smooth and cardiac muscles and secretions of many glands. Axons extend from the hypothalamus to sympathetic and parasympathectic nuclei in the brain stem and spinal cord. Through ANS, it is a major regulator of visceral activities includes heart rate, movement of food through the gastrointestinal tract and contraction of bladder.

Regulation of hormone synthesis:

The hypothalamus is considered to be responsible for integrating the functions of the endocrine system and the nervous system. It is known to have direct nerve connection with the posterior lobe of pituitary.In addition hypothalamus is connected with anterior lobe of pituitary through portal vessels which supply blood to the glands conveying chemical message through inhibitory and releasing hormone.

Regulation of Emotional and behavioural patterns:

Together with Limbic System participate in expression of rage, aggression, pain, pleasure and behavioural pattern relating to sexual arousal etc.

Regulation of eating and drinking through the arcuate and paraventrical nuclei and thirst centre thus regulating osmotic pressure.

Regulates Body temperature, regulation of circadian rhythm and states of consciousness

Effect of stimulating amygdaloidal:

In general, stimulation of amygdale can cause almost all the same effect as those elicited by direct stimulation of the hypothalamus.

Epithalamus consisting of pineal gland and habenular nuclei-Pineal gland is a part of endocrine system secreting melatonin and also contributes to the setting of the body's biological clock. Habenular nuclei are involved in olfaction, especially emotional response to odours. Sub thalamus-contains the sub thalamus nuclei and portions of red nucleus and the substantia nigra. These regions communicate with the basal ganglia help to control body movements.The drug administration even enters into the intracranial region by vascular path.

Diffusion of Drug:

Lipid soluble substances have greater affinity for passive absorption through the cell walls of nasal mucosa.Thus navana nasya is superior to all the varieties.

The cilia of the olfactory cells and perhaps the portions of the body of olfactory cells contains relatively large quantities of lipid materials .This could explain why a substance must be lipid soluble to cause marked stimulation of an olfactory cell.

Non-Polar hydrophobic molecules diffuse through the lipid bilayer of the plasma membrane, into and out of cell such molecules include oxygen, carbon dioxide and nitrogen gases, fatty acids steroids and fat soluble vitamins. It is a route of absorption of some nutrients and excretion of waste by body cells which are lipid soluble.Further drug absorption can also be enhanced by local massage and fomentation.

Vascular Path:

Vascular path transportation is possible through the pooling of nasal venous blood into facial vein, which naturally occurs, at the opposite entrance. The inferior ophthalmic vein also pools into the facial vein. The facial vein has no valves .It communicates freely with the intracranial circulation, not only at its commencement and by the supra orbital veins which are connected with the ophthalmic vein, a tributary of the deep facial vein, which communicates through the pterygoid plexus with the cavernous venous sinus. Such a pooling of blood from nasal veins to venous sinuses of the brain is more likely to occur in head lowering position due to gravity. The absorption of drug into meninges and related intracranial organ is a point of consideration.

Keeping in the view of the above said facts *Nasya dravya* is reaching the brain and acting on important centers controlling different neurological, endocrine and circulatory functions and thus showing the systemic effects.

CHAPTER 5

MATERIALS AND METHODS

- **AIMS AND OBJECTIVES**
- **STUDY DESIGN**
- **SETTING OF THE STUDY**
- **SELECTION CRITERIA**
- **ANALYSIS METHOD**

AIMS AND OBJECTIVES :

AIM :

To assess the effectiveness of *Anutaila Nasya* on Muscle Strength, Endurance and Girth in regular healthy exercising persons wsr to Shoulder, Chest and Pectoral Girdle.

OBJECTIVES :

- To quantify the Shoulder muscles and Chest muscles strength after *Anutaila Nasya* with the help of 1 RM of Overhead Press and 1 RM of Chest Press respectively.
- To quantify the Shoulder muscles and Chest muscles Endurance after *Anutaila Nasya* by Push ups.
- To quantify the Arm Girth and Chest Girth after *Anutaila Nasya* with the help of measurement

STUDY DESIGN : An open Randomized controlled clinical Study .

SETTING OF THE STUDY

MATERIALS:

1. Experimental group: Exercising Healthy Subjects.

Equipments need for measuring Strength, Endurance of Shoulder and Chest muscles and Arm, Chest Girth are as follows:

- Dumbbells
- Bench
- Mat
- Measuring Tape

Medicines:

- *Anutailam* of AVP-(Arya Vaidya Pharmacy – Coimbatore).Approved by FDA It purchased from AVP distributor, near Sion Hospital, Mumbai.

2. Control Group: Exercising Healthy Subjects.

Equipments need for measuring Strength, Endurance of Shoulder and Chest muscles and Arm, Chest Girth are as follows:

- Dumbbells
- Bench
- Mat
- Measuring Tape

Medicines: This group did not received any medicine they were only put on their regular exercise

METHODOLOGY:

SAMPLE SIZE: 150 Exercisers were selected including dropouts.

GROUPING: Study trial consist of 2 groups of 50 male candidates in each group

1. EXPERIMENTAL GROUP: This Group received Anutaila Nasya along with their regular Exercise.

2. CONTROL GROUP: This Group was continued on only Exercise without Nasya

DOSAGE: 2 Drops of *Anutaila* per nostrils daily in the morning.

FOLLOW – UP: Day 0- Visit 1
Day 30= Visit 2 =1st Follow up after 1st Month,
Day 60= visit 3 = Second Follow up after 2nd month
Day 90 = visit 4 = Third Follow up after 3rd Month.

TOTAL DURATION OF STUDY: 3 Months.

ETHICS COMMITTEE APROVAL: Study trial was started after Institutional Ethics committee approved and informed consent of all the subjects was obtained and documented.

SELECTION CRITERIA

INCLUSION CRITERIA**:**

- Male Exercisers between age gr. 20 yr. – 30 yr.
- Regular exercisers working out in the Gym at least for 6 months for minimum 1 hr. 6 days per week.
- Exercisers with no health complaints and having no systemic Diseases.
- The Exercisers those who are willing to give informed Consent and ready to abide with the trial procedures.

EXCLUSION CRITERIA:

- All *Nasya Anarha* individuals.
- The Exercisers who are not willing to give Consent.
- Muscle related pathology.
- Neurological problems.
- Those who were taking Nutritional Supplements.

DROP OUTS:

- Exercisers who have not taken *Nasya* continuously for more than a week were excluded from the Study.
- The Exercisers those who have not continued their regular work- out more than a week were excluded from the Study.

ANALYSIS METHODS[44] :

- Muscular Strength of the Shoulders, Pectoral Girdle and Chest.
- Muscular Endurance of the Shoulders, Pectoral Girdle and Chest
- Arm and Chest Girth.

1. Muscular Strength :

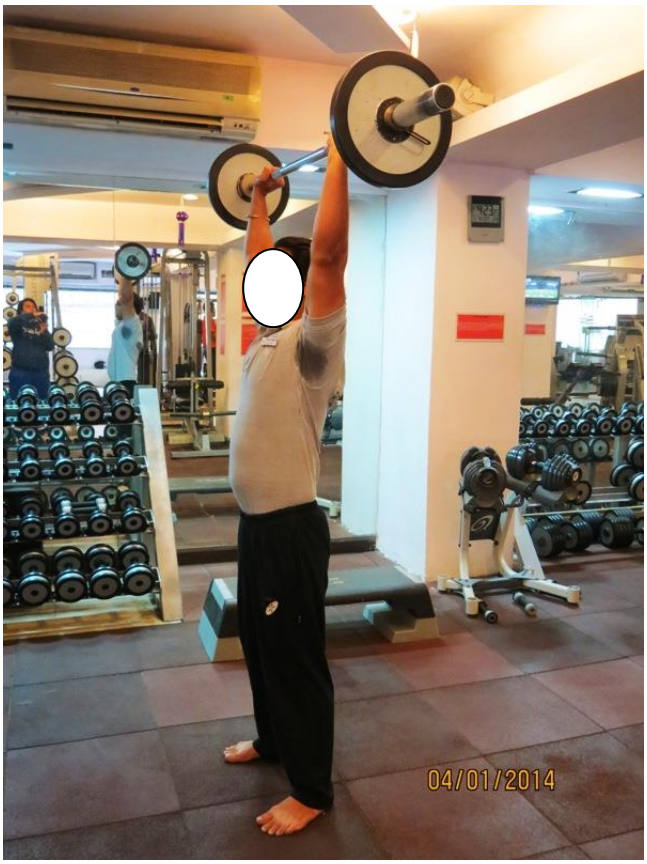
It is defined as the capacity to use muscle activity to develop internal tension and exert resistance against external force.

Traditionally the one repetition maximum (1 RM), the greatest resistance that can be move through the full range of motion in a controlled manner with good posture, has been the standard for dynamic strength assessment.

The following represents the basic steps in 1 RM

- Patients were explained the procedure thoroughly and they were asked about their usual weight training.
- Patients were made to stand in erect posture.
- They were asked to lift one of the dumbbells of small capacity that they generally lift in correct form.
- They were asked to increase the weight by 2.5 to 20 kg until the volunteer can't complete the selected repetition.
- It is made sure that all repetitions should be performed in same speed of the movement and same range of motion with the interval of 3-4 minutes in between.
- The maximum final weight lifted by the volunteer was considered as 1 repetition max or absolute 1 RM.
- Determine the 1 RM within 4 trial

The Shoulder Muscle Strength was measured by Overhead press 1 RM.



The Chest Muscle Strength was measured by Chest Press 1RM

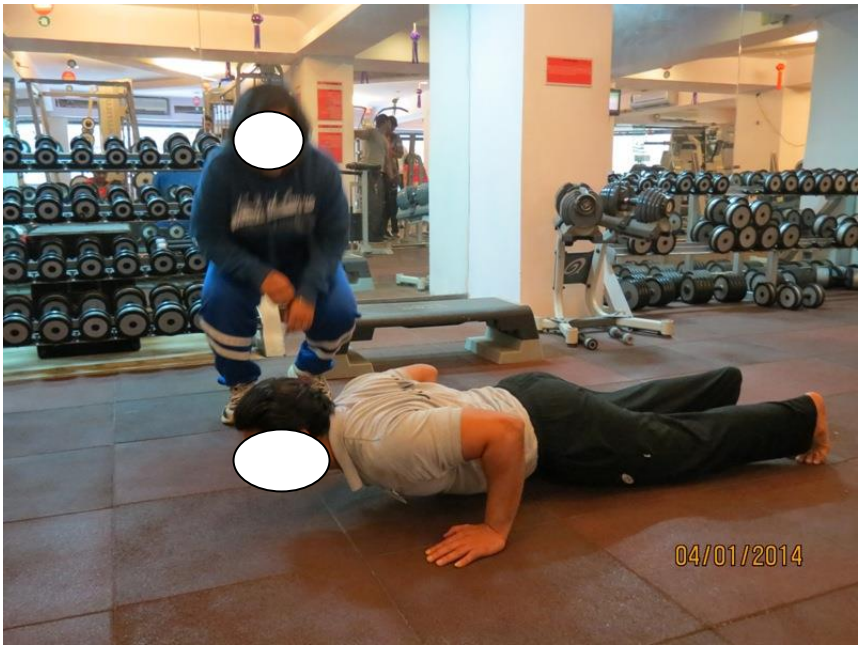
2. Muscular Endurance:

It is a capacity to resist fatigue in strength performance over relatively long duration.

The maximum number of push-ups that can be perform without rest may be use to evaluate the endurance of upper body muscles.

The following test procedure are use to measure Muscular Endurance

- Male exerciser were asked take the standard down position and push test was carried out which comprises of hands pointing forward under the shoulder, back straight,t head up . This push should be carried out using toes as the pivotal joint.
- The exerciser were ask to raise the body using palm until the full strengthening of Elbows is achieved and return down till chin touches the mat. During the whole procedure stomach must not touch the mat and back should be straight all the time
- The total number of push ups performed effortlessly was counted and this is the Score.
- The test is stopped when movement of the exerciser occurs with extra efforts and appropriate technique is lost for successively two repetitions.
- Maximum number of push- ups were noted as Shoulder and Chest muscle Endurance



3 Arm Girth and Chest Girth : Arm girth and Chest Girth was measured by Measuring Tape.

Defination : The circumference of freely hanging upper-arm measured midway between the point acromiale and radiale is known as upper-arm circumference.

Landmark: Acromiale is the lateral most point on the superior and external border of the acromion process of scapula.Radiale is the superior most point on the lateral border of the head of the radial bone.

Equipment: Measuring Tape.

Method:

- The Exercisers were asked to stand in erect position with equal distribution of weight on the Feet with hand hanging by side freely.
- They were ask to stand in ease
- Upper arm circumference was measure at the mid point of Acromiale and radial points which were already mark horizontally with the help of skin marking Pencil on naked arm.
- The measurement was taken with tape wrapped horizontally at the marked level and lightly touching the Arm and circumference of the arm was noted.

CHAPTER 6

OBSERVATION

Statistical Analysis

After collecting data, it was analyzed by employing appropriate statistics to derive conclusions regarding effectiveness of *Nasya* treatment to the regular exercisers. There were different variables measured before and after the study, purpose of the study was to find the effectiveness of *Anutaila Nasya* on Strength Endurance and Girth of Chest, Neck and Shoulder Muscles. Each variable is separately analyzed and presented in this Chapter.

Table 13.1

Descriptive Statistics for Overhead Press Pre Test and Post Test of Control and Experimental Groups

	EXPERIMENTAL		**CONTROL**	
	Overhead press Pre test	**Overhead press Post test**	**Overhead press Pre test**	**Overhead press Post test**
Mean	35.51	39.18	33.39	37.62
Median	33.50	37.50	30.00	35.00
Std. Deviation	14.91	14.38	6.38	7.07
Minimum	10.00	14.00	10.00	15.00

Maximum	80.00	82.00	50.00	55.00

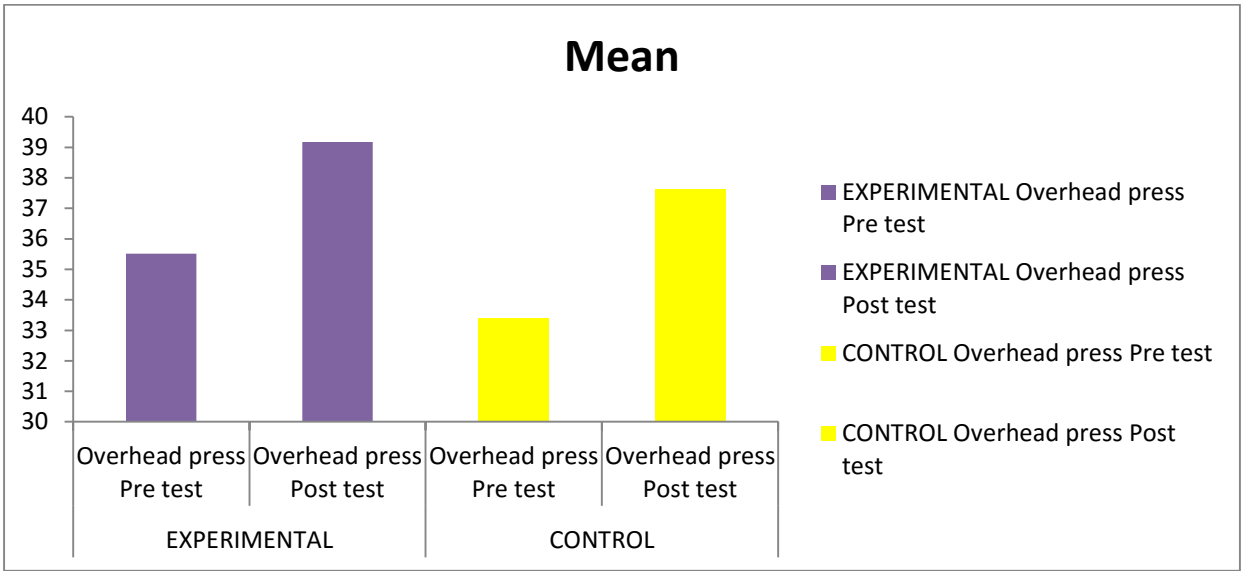


Fig.13.1 Graphical representation of Shoulder Muscle Strength measured by Overhead Press

13.1 Shoulder Muscle Strength by Overhead Press :

The Shoulder muscles strength was measured by overhead press is shown in Table No. 13.1.The Result obtained from table no.13.1 reveal that the mean at Pre - test of Experimental group score was 35.51(SD=14.91) while that of control group was found 33.39 (SD=6.38).

From the table no 13.1 the minimum score of Experimental group in Pre-test was 10 and that of Post- Test was 14. Maximum score Pre-test was 80 and that of post test was 82

For Control group the minimum score for pre-test was 10 and that of Post test was 15.Maximum score Pre-test was 50 and that of Post-test was 55.

From the above values of minimum and maximum scores of Pre-test and Post-tests of Experimental and Control group, it is interpreted that there is an improvement in both groups.

To compare the difference between the means t test technique was applied and the results are given in table no 13.2

Table 13.2

Summary of Group Statistics of Difference between Overhead Press Pretest & Posttest

	Mean	**SD**	**t**	**df**	**Sig. (2-tailed)**	**Decision**
Experimental	-0.224	1.445	-1.699	98	0.092	**Null Hypothesis is retained**
Control	0.224	1.180				

13.2 Description of t Test for comparing the difference between the means

After collecting data t test was applied to compare the shoulder muscle pre-test and post test Strength between experimental and control group, from table no.13.2 it is clear that t value is 0.092 which is >0.05.it interprets that there is no significant difference in shoulder muscles strength in Experimental as well as Control group.

Table No.14.1

Descriptive Statistics for Chest Press Pre Test and Post Test of Control and Experimental Groups

	EXPERIMENTAL		**CONTROL**	
	Chest Press Pre test	**Chest Press Post test**	**Chest Press Pre test**	**Chest Press Post test**
Mean	44.40	48.14	37.50	41.66
Median	40.00	45.00	35.00	40.00
Std. Deviation	22.44	29.95	7.58	7.54
Minimum	12.00	12.00	15.00	20.00
Maximum	120.00	122.00	60.00	65.00

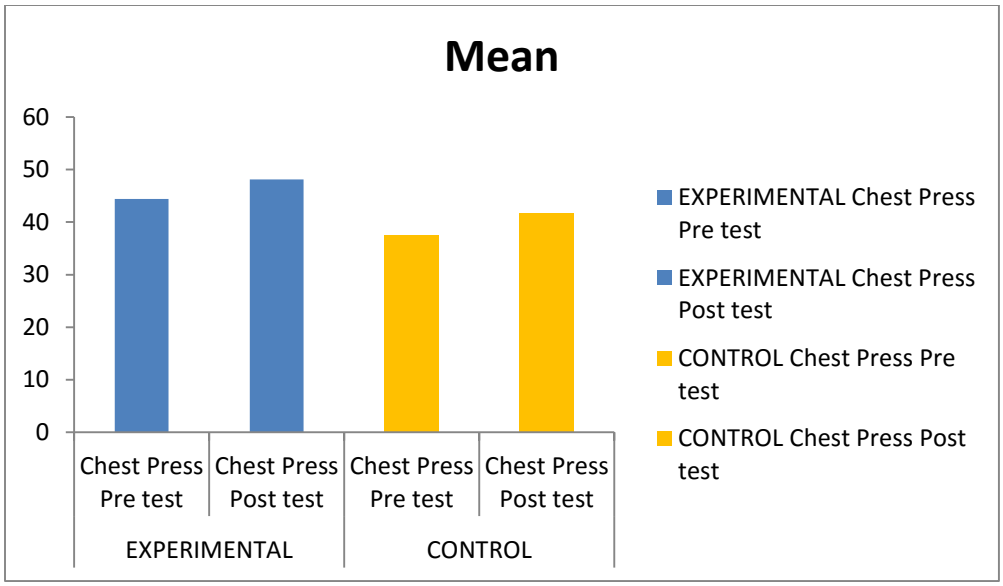


Fig.14.1 Graphical representation of Chest Muscle Strength measured by Chest Press

The Chest muscles strength was measured by Chest press is shown in Table No. 14.1.The Result obtained from table no.14.1 reveal that the mean at Pre - test of Experimental group score was 44.40(SD=22.44) while that of control group was found 37.50 (SD=7.58).and the Post-test mean of Experimental group was 48.14(SD=29.95) and that of control group was 41.66(SD=7.54)

From the table no 14.1 the minimum score of Experimental group in Pre-test was 12 and that of Post- Test was 12. Maximum score Pre-test was 120 and that of post test was 122

For Control group the minimum score for pre-test was 15 and that of Post test was 20.Maximum score Pre-test was 60and that of Post-test was 65

From the above values of minimum and maximum scores of Pre-test and Post-tests of Experimental and Control group, it is interpreted that there is an improvement in both groups.

To compare the difference between the means t test technique was applied and the results are given in table no 14.2

Table No.14.2

Summary of Group Statistics of Difference between Chest Press Pre Pretest & Posttest

	Mean	**SD**	**t**	**df**	**Sig. (2-tailed)**	**Decision**
Experimental	-.0816	1.00044	-.897	98	0.372	**Null Hypothesis is retained**
Control	.0816	.80806				

14.2 Description of t Test for comparing the difference between the means

After collecting data t test was applied to compare the Chest muscle pre-test and post test Strength between experimental and control group, from table no.14.2 it is clear that t value is 0.372 which is >0.05.it interprets that there is no significant difference in Chest muscles strength in Experimental as well as Control group.

Table No.15.1

Descriptive Statistics for Chest Endurance by Push-Ups Pre Test and Post Test of Control and Experimental Groups

	EXPERIMENTAL		**CONTROL**	
	Chest Endurance Push Ups Pre test	**Chest Endurance Push Ups Post test**	**Chest Endurance Push Ups Pre test**	**Chest Endurance Push Ups Post test**
Mean	28.22	32.68	25.26	29.72
Median	25.00	30.00	25.00	30.00
Std. Deviation	11.81	11.66	6.78	6.98
Minimum	10.00	12.00	15.00	20.00
Maximum	70.00	72.00	50.00	55.00

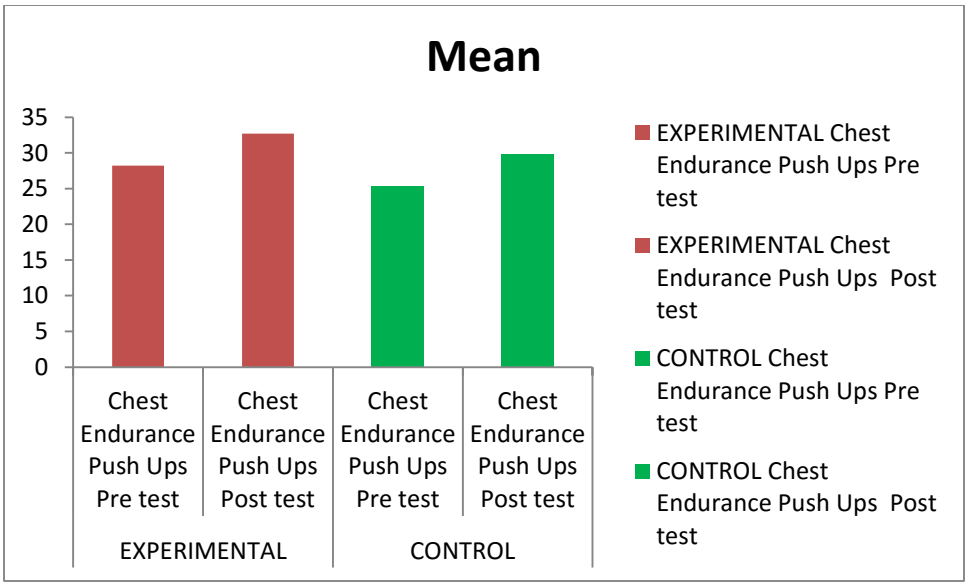


Fig.15.1 Graphical representation of Chest Muscle Endurance measured by Push - Ups

The Chest muscles endurance was measured by Push-ups is shown in Table No. 15.1.The Result obtained from table no.15.1 reveal that the mean at Pre - test of Experimental group score was 28.22(SD=11.81) while that of control group was found 25.26 (SD=6.78).and the Post-test mean of Experimental group was 32.68(SD=12) and that of control group was 29.72(SD=6.98)

From the table no 15.1 the minimum score of Experimental group in Pre-test was 10 and that of Post- Test was 12. Maximum score Pre-test was 70 and that of post test was 72

For Control group the minimum score for pre-test was 15 and that of Post test was 20.Maximum score Pre-test was 50 and that of Post-test was 55

From the above values of minimum and maximum scores of Pre-test and Post-tests of Experimental and Control group, it is interpreted that there is an improvement in both groups.

To compare the difference between the means t test technique was applied and the results are given in table no 15.2

TableNo.15.2

Summary of Group Statistics of Difference between Chest Endurance by Push-Ups Pre Pretest & Posttest

	Mean	**SD**	**t**	**df**	**Sig. (2-tailed)**	**Decision**
Experimental	.0008	1.87083	.010	98	.992	**Null Hypothesis is retained**
Control	-.0026	1.65088				

15.2 Description of t Test for comparing the difference between the means

After collecting data t test was applied to compare the Chest muscle endurance pre-test and post test

Endurance between experimental and control group, from table no.15.2 it is clear that t value is 0.992 which is >0.05. It interprets that there is no significant difference in Chest muscles strength in Experimental as well as Control group

Table No.16.1

Descriptive Statistics for Shoulder Endurance by Push-Ups Pre Test and Post Test of Control and Experimental Groups

	EXPERIMENTAL		CONTROL	
	Shoulder Endurance Push Up Pre test	**Shoulder Endurance Push Up Post test**	**Shoulder Endurance Push Up Pre test**	**Shoulder Endurance Push Up Post test**
Mean	28.22	32.68	25.26	29.72
Median	25.00	30.00	25.00	30.00
Std. Deviation	11.81	11.66	6.78	6.98
Minimum	10.00	12.00	15.00	20
Maximum	70.00	72.00	50.00	55

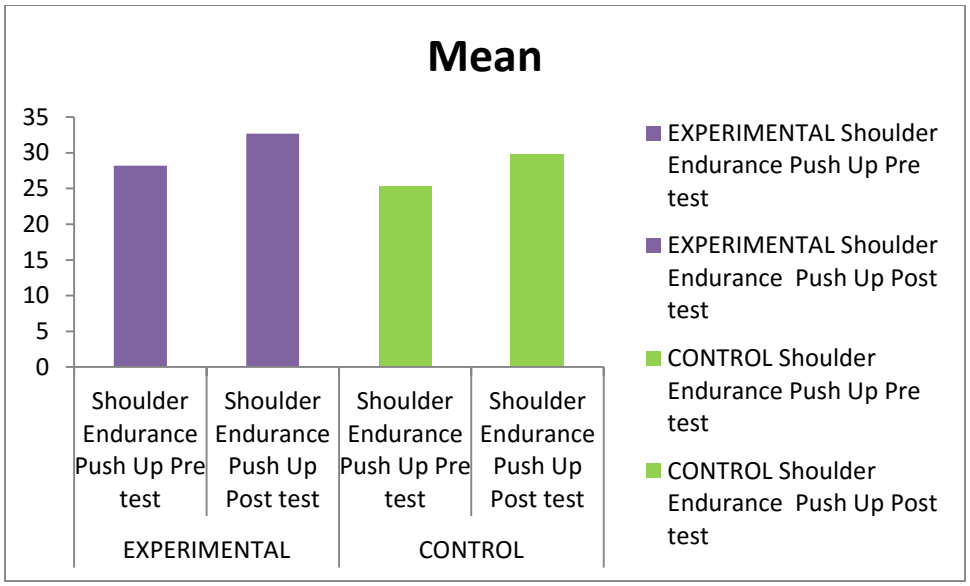


Fig.16.1 Graphical representation of Shoulder Muscle Endurance measured by Push - Ups

The Shoulder muscles endurance was measured by Push-ups is shown in Table No. 16.1.The Result obtained from table no.16.1 reveal that the mean at Pre - test of Experimental group score was 28.22(SD=11.81) while that of control group was found 25.26 (SD=6.78).and the Post-test mean of Experimental group was 32.68(SD=11.6) and that of control group was 29.72(SD=6.98)

From the table no 16.1 the minimum score of Experimental group in Pre-test was 10 and that of Post- Test was 12. Maximum score Pre-test was 70 and that of post test was 72

For Control group the minimum score for pre-test was 15 and that of Post test was 20. Maximum score Pre-test was 50 and that of Post-test was 55.

From the above values of minimum and maximum scores of Pre-test and Post-tests of Experimental and Control group, it is interpreted that there is an improvement in both groups.

To compare the difference between the means t test technique was applied and the results are given in table no 16.2

TableNo.16.2

Summary of Group Statistics of Difference between Shoulder Endurance by Push-Ups Pretest & Posttest

	Mean	**SD**	**t**	**df**	**Sig. (2-tailed)**	**Decision**
Experimental	.0008	1.87083	.010	98	.992	**Null Hypothesis is retained**
Control \	-.0026	1.65088				

16.2 Description of t Test for comparing the difference between the means

After collecting data t test was applied to compare the Chest muscle endurance pre-test and post test

Endurance between experimental and control group, from table no.16.2 it is clear that t value is 0.992 which is >0.05.it interprets that there is no significant difference in Chest muscles strength in Experimental as well as Control group.

Table No.17.1

Descriptive Statistics for Right Arm Girth Pre Test and Post Test of Control and Experimental Groups

	EXPERIMENTAL		**Control**	
	Rt Arm Girth Pre test	**Rt Arm Girth Post test**	**Rt Arm Girth Pre test**	**Rt Arm Girth Post test**
Mean	11.22	11.08	11.75	11.75
Median	11.00	10.85	12.00	12.00
Std. Deviation	1.23	1.23	1.29	1.29
Minimum	9.00	8.70	9.00	9.00
Maximum	14.00	14.00	14.00	14.00

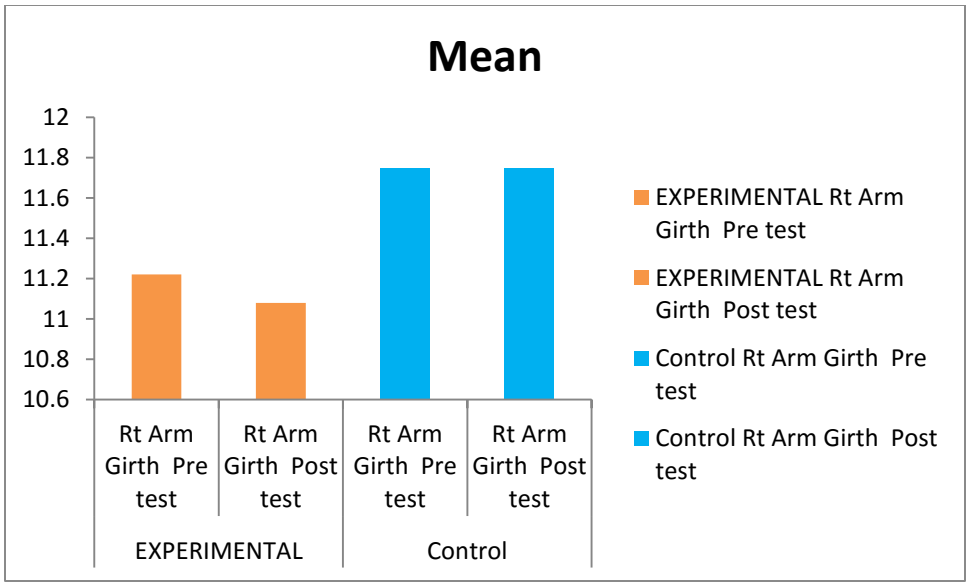


Fig.17.1 Graphical representation of Right Arm Girth measured Measuring Tape

The Right Arm Girth was measured by measuring tape is shown in Table No. 17.1.The Result obtained from table no.17.1 reveal that the mean at Pre - test of Experimental group score was 11.22(SD=1.23) while that of control group was found 11.75 (SD=1.29).and the Post-test mean of Experimental group was 11.08(SD=1.23) and that of control group was 11.75(SD=1.29)

From the table no 17.1 the minimum score of Experimental group in Pre-test was 9 and that of Post- Test was 8.70. Maximum score Pre-test was 14 and that of post test was 14

For Control group the minimum score for pre-test was 9 and that of Post test was 9.Maximum score Pre-test was 14 and that of Post-test was 14

From the above values of minimum and maximum scores of Pre-test and Post-tests of Experimental and Control group. It is interpreted that there is no Pre-test and Post-test significant difference in both groups.

To compare the difference between the means t test technique was applied and the results are given in table no 17.2

Table No.17.2

Summary of Group Statistics of Difference between Right Arm Girth Pre Pretest & Posttest

	Mean	**SD**	**t**	**df**	**Sig. (2-tailed)**	**Decision**
Experimental	-.5134	2.89682	-2.505	98	.014	**Null Hypothesis is Rejected**
Control	.5142	.14619				

After collecting data t test was applied to compare the Right Arm Girth pre-test and post test between experimental and control group, from table no.17.2 it is clear that t value is 0.014 which is <0.05. It interprets that there is significant difference in Right Arm Girth of Experimental and Control group.

Table No.18.1

Descriptive Statistics for Left Arm Girth Pre Test and Post Test of Control and Experimental Groups

	EXPERIMENTAL		CONTROL	
	Lft Arm Girth Pre test	**Lft Arm Girth Post test**	**Lft Arm Girth pre test**	**Lft Arm Girth Post test**
Mean	11.24	11.08	11.76	11.76
Median	11.00	10.85	12.00	12.00
Std. Deviation	1.23	1.25	1.30	1.30
Minimum	9.00	8.70	9.00	9.00
Maximum	14.10	14.10	14.00	14.00

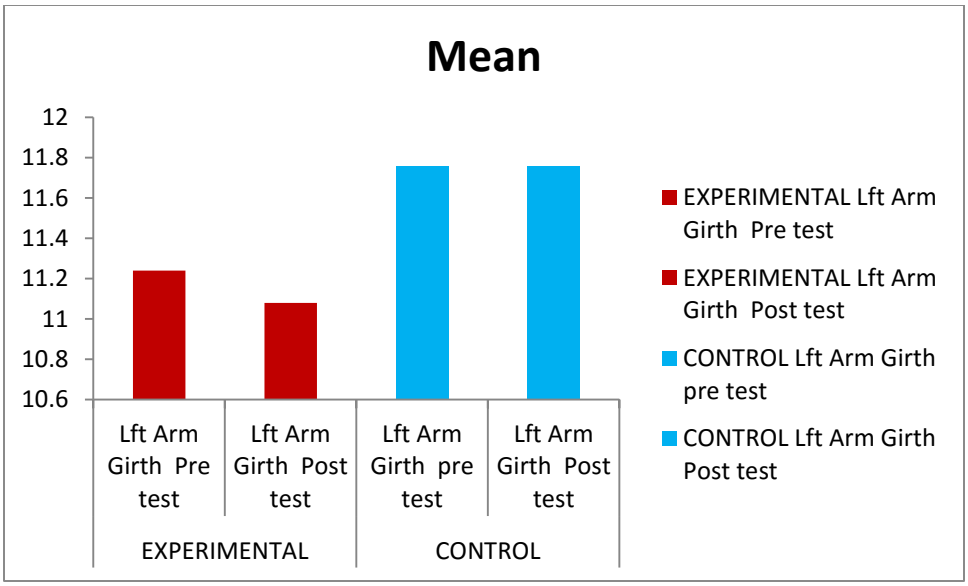


Fig.18.1 Graphical representation of Left Arm Girth measured Measuring Tape

The Left Arm Girth was measured by measuring tape is shown in Table No. 18.1.The Result obtained from table no.18.1 reveal that the mean at Pre - test of Experimental group score was 11.22(SD=1.23) while that of control group was found 11.75 (SD=1.29).and the Post-test mean of Experimental group was 11.08(SD=1.23) and that of control group was 11.75(SD=1.29)

From the table no 18.1 the minimum score of Experimental group in Pre-test was 9 and that of Post- Test was 8.70. Maximum score Pre-test was 14 and that of post test was 14

For Control group the minimum score for pre-test was 9 and that of Post test was 9.Maximum score Pre-test was 14 and that of Post-test was 14

From the above values of minimum and maximum scores of Pre-test and Post-tests of Experimental and Control group. It is interpreted that there is no Pre-test and Post-test significant difference in both groups To compare the difference between the means t test technique was applied and the results are given in table no 18.2

Table No.18.2

Summary of Group Statistics of Difference between Left Arm Girth Pre Pretest & Posttest

	Mean	**SD**	**t**	**df**	**Sig. (2-tailed)**	**Decision**
Experimental	-.5446	3.04192	-2.527	98	.013	**Null Hypothesis is Rejected**
Control	.5454	.22009				

After collecting data t test was applied to compare the Right Arm Girth pre-test and post test between experimental and control group, from table no.18.2 it is clear that t value is 0.013 which is <0.05. It interprets that there is significant difference in Right Arm Girth of Experimental and Control group.

Table No.19.1

Descriptive Statistics for Chest Girth Pre Test and Post Test of Experimental and Control Groups

	EXPERIMENTAL		**CONTROL**	
	Chest Girth Pre test	**Chest Girth Post test**	**Chest Girth Pre test**	**Chest Girth Post test**
Mean	34.32	34.40	33.03	33.03
Median	34.55	34.75	33.00	33.00
Std. Deviation	3.34	3.30	2.24	2.24
Minimum	24.00	24.00	28.00	28.00
Maximum	42.00	42.00	44.00	44.00

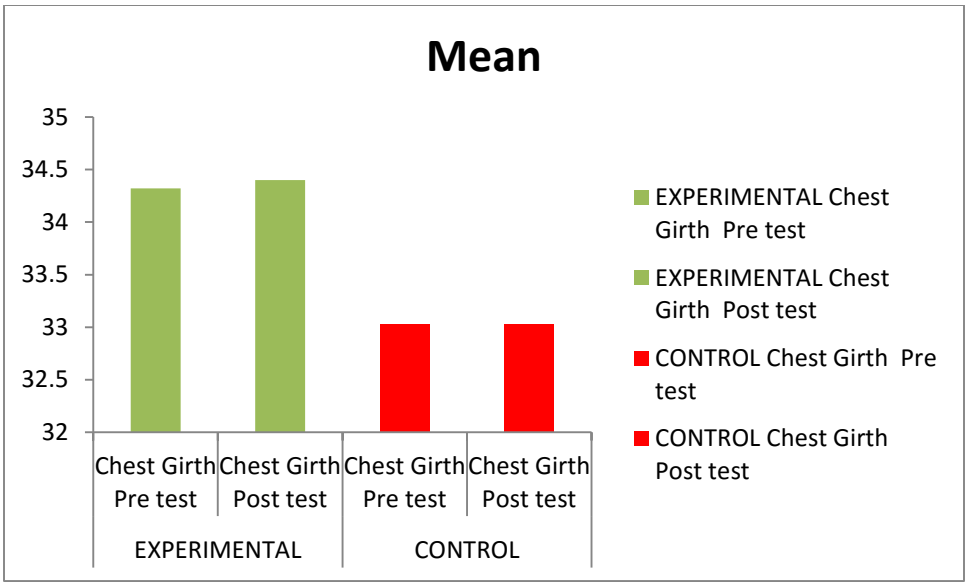


Fig.19.1 Graphical representation of Chest Girth measured Measuring Tape

The Chest Girth was measured by measuring tape is shown in Table No. 19.1.The Result obtained from table no.19.1 reveal that the mean at Pre - test of Experimental group score was 34.32(SD=3.34) while that of control group was found 33.03 (SD=2.24).and the Post-test mean of Experimental group was 34.40(SD=3.30) and that of control group was 33.03(SD=2.24)

From the table no 19.1 the minimum score of Experimental group in Pre-test was 24 and that of Post- Test was 24. Maximum score Pre-test was 42 and that of post test was 42

For Control group the minimum score for pre-test was 28 and that of Post test was 28.Maximum score Pre-test was 44 and that of Post-test was 44

From the above values of minimum and maximum scores of Pre-test and Post-tests of Experimental and Control group. It is interpreted that there is no Pre-test and Post-test significant difference in both groups To compare the difference between the means t test technique was applied and the results are given in table no 19.2

Table No.19.2

Summary of Group Statistics of Difference between Chest Girth Pre Pretest & Posttest

	Mean	**SD**	**t**	**df**	**Sig. (2-tailed)**	**Decision**
Experimental	.1572	.93076	2.330	98	.022	**Null Hypothesis is Rejected**
Control	-.1498	.04502				

After collecting data t test was applied to compare the Right Arm Girth pre-test and post testbetween experimental and control group, from table no.19.2 it is clear that t value is 0.022 which is <0.05. It interprets that there is significant difference in Chest Girth of Experimental and Control group.

There are different variables such as Strength, Endurance and Girth so the Data score was converted in Composite – Score as shown in table no.20.1

Table No. 20.1

SUMMARY OF STATISTICS OF COMPOSITE SCORE OF STRENGTH, ENDURANCE PRE TEST POST TEST AND ANTHROPOMERTY PRE TEST POST TEST

Group		StrengthNEndurancePretest	StrengthNEndurancePosttest	AnthroPretest	AnthroPosttest
Experimental	Mean	205.9928	205.6920	148.1224	147.2172
	Median	201.3650	201.2700	144.3800	145.4750
	Std. Deviation	41.52584	40.97452	26.16852	25.74378
	Std. Error Mean	5.87264	5.79467	3.70079	3.64072
	Minimum	139.51	144.06	99.68	102.56
	Maximum	374.91	369.05	207.87	208.24
Control	Mean	194.0066	194.3086	151.8780	152.7832
	Median	189.0900	191.5900	153.2850	154.0800
	Std. Deviation	21.30907	22.03711	23.77476	23.45452
	Std. Error Mean	3.01356	3.11652	3.36226	3.31697
	Minimum	139.51	151.65	99.68	101.12
	Maximum	256.43	259.60	196.82	197.15

The Composite Score of Strength,Endurance and Anthropometry is shown in Table No. 20.1.The Result obtained from table no.20.1 reveal that the mean at Strength,Endurance Pre - test of Experimental group score was 205.99(SD=41.52) while that of control group was found 194 (SD=21.30).and the Strength,Endurance Post-test mean of Experimental group was 205.69(SD=40.97) and that of control group was 194.30 (SD=3.11)

The mean at Anthropometry Pre-test of Experimental group was 148.12(SD=26.16) while that of Control group was found 151.87 (SD= 23.77).The Anthropometry Post-test mean of Experimental group was 147.21 (SD=25.74) and that of Control group was found 152.78 (SD=23.45)

From the table no 20.1 the minimum score Strength, Endurance of Experimental group in Pre-test was 139.51 and that of Post- Test was 144.06. Maximum score Pre-test was 374.91 and that of post test was 369.05

For Control group the Minimum score for pre-test was 139.51 and that of Post test was 151.65. Maximum score Pre-test was 256.43 and that of Post-test was 259.60

The minimum score Anthropometry of Experimental group Pre-test was 99.68 and that of post –test was 102.56. The maximum score Pre-test was 207.87 and that of post – test 208.24

For Control group Minimum Score for Pre-test was 99.68 and that of Post-test was 101.12.For Post test Maximum Score Pre-test was 196.82 and that of Post – test 197.15

From the above values of minimum and maximum scores of Pre-test and Post-tests of Experimental and Control group ,it is interpreted that there is no Pre-test and Post-test significant difference in both groups

In Table no.20.2 Data score is converted to t score and the sum of all t score to make compile score

Table No. 20.2

PAIRED SAMPLES TEST

GROUP		PAIRED DIFFERENCES			
		Mean Difference	t	df	Sig. (2-tailed)
Experimental	StrengthNEndurancePretest – StrengthNEndurancePosttest	.30080	.440	49	.662
	AnthroPretest – AnthroPosttest	.90520	1.110		.273
Control	StrengthNEndurancePretest – StrengthNEndurancePosttest	-.30200	-.487	49	.629
	AnthroPretest – AnthroPosttest	-.90520	-18.131	49	.000

After converting data to t score, t test was applied to compare the Strength,Endurance and Anthropometry pre-test post test between experimental and control group. From table no.20.2 it is clear that t value of both groups are > 0.05.It interprets that there is no significant difference in Strength,Endurance and Anthropometry pre-test post test of Experimental as well as Control group.

CHAPTER 7

RESULT

1. There were no significant difference observed in Experimental and Control Group in Shoulder Muscles Strength after 90 days of Nasya Therapy (Table No.13.1 & 13.2)

2. There were no significant difference observed in Experimental and Control Group in Chest Muscles Strength after 90 days of Nasya Therapy (Table No.14.1 & 14.2)

3. There were no significant difference observed in Experimental and Control Group in Chest Muscle Endurance after 90 days of Nasya Therapy (Table No.15.1 & 15.2)

4. There were no significant difference observed in Experimental and Control Group in Shoulder Muscles Endurance after 90 days of Nasya Therapy (Table No.16.1 & 16.2)

5. There were significant difference observed in Experimental and Control Group in Right Arm Girth after 90 days of Nasya Therapy (Table No.17.1 & 17.2)

6. There were significant difference observed in Experimental and Control Group in Left Arm Girth after 90 days of Nasya Therapy (Table No.18.1 & 18.2)

7. There were significant difference observed in Experimental and Control Group in Chest Girth after 90 days of Nasya Therapy (Table No.19.1 & 19.2)

CHAPTER 8

DISCUSSION

Discussion on Nasya : Why *Pratimarsh Nasya* choose for the Study ?

As explained in *Ashtang Sangraha Sutrasthana 29/19, matra* (Dose) of *Pratimarsha nasya* is 2 *bindu* (2 drops) which is very less ie *Shaman Matra*. Hence we can perform this *Pratimarsha Nasya* procedure for a longer duration without aggravating *doshas* .*Pratimarsha Nasya* doesn't show any adverse effect if performed daily. Rather it gets habitual and shows effects like *Marsha Nasya* and the main thing is while taking *Pratimarsha Nasya*. No need of any special precautions to be taken hence we choose *Pratimarsha Nasya* in regular exercisers.

Ashtang Sangraha, Sushrut and *Vagbhat* explain about *Pratimarsha Nasya Kal*. They mentioned around 15 *kala* for *nasya*.

1.	*Talpothit*	2.	*Prakshalit Dant*	3	*Gruhannirgachat*
4.	*Vyayamottar*	5.	*Vyavayottar*	6.	*Adhwaparishrant*
7.	*Mutravisarjanottar*	8.	*Malavisarjanottar*	9.	*Kavalottar*
10	*Anjanottar*	11	*Bhojanottar*	12	*Vamanottar*
13	*Divaswapottar*	14	*Sayankal*	15 16	*Hasyottar(Vagabhatacharya)* *Shiorobhyangottar----ii------*

We choose *Pratahkal* for *Pratimarsha Nasya* because it is *Dardhyakrut* as explained in *Charak Siddhisthana* 9/116.

In some diseases like *Manyasthambha, Hanugraha, Grivaroga, Skandharoga, Ansashool Nasya* is recommended and in body building sport chest, shoulder, muscles are very important and neck is connected to these part of the body. So ultimately *Nasya* helps to improve health of these parts of the body.

Discussion on *Vyayam* *:* *Vyayam* is a part of *Dincharya*. Regular exercise makes body strong, tone the muscles and increase the stamina. But as explained in *Samhitas*, a man seeking his own good should take physical exercise everyday only to half extent of his capacity (*Balardha*) as otherwise it may prove fatal. But now- a- days the exercisers don't follow this rule and do their

work out around 1 hr. daily and *Shushrutacharya* explained that the amount of exercise which makes the *Prana Vayu* come out through the mouth ie as soon as hard breathing would set in is known as *balardha*.The Location (Sthana) of *Pranavayu* is *Murdha* and *Nasya karma* exactly act on *Murdha.* It pacifies *prakupit pranavayu* and help to prevent the adverse effects of excessive exercise.

Discussion On Anutaila :

"अणुषु तैलम् अणु तैलम् अणुनीन्द्रियस्रोतांसिप्रविशतीत्यर्थः अ.ह्र.सू.२०/३८ टिका

Anutaila is best used for *Nasya Karma*. The process of heating oil 10 times gives effective potantisation ie it's dynamic and curative propertirs are enhanced. *Aja ksheer* (Goat Milk) is also used in the last cycle as it is indicated in disorders like *Shwas, Kasa, and Rajayakshma*. Goat's Milk has the ability to reduce inflammation improve bioavability of nutrients (Sukshama srotogami) strengthens bones increase immunity improves metabolism and prevents toxins accumulation in Body. Hence it is said that *Anutaila* is having property of ***Mahagunama, sarvottam gunam.*** (Excellence over other of Oils used for *Nasya karma*).[4]

The herbs and the method of preparation which are mentioned by *Maharshi Charak* and *Vagbhat* are quite similar to each other but *Maharshi Sushrut* states totally different herbs and the method of preparation. He advises to use the wood of *Kolhu* (manual oil extractor machine) which was in use for long time. He orders to make a fine powder of its wood and boil it in water. One can collect the oil which is accumulated on the surface of water at the end of the process. This oil is used as base for *Anutaila* preparation. This oil will possess the quality to penetrate the deeper tissues, as that is separated from finally grounded wood of oil extractor in droplets form .The idea behind this is to use minute fine oil which has a quality to penetrate the *sukshma srotas* i.e. most fine channels and can be called as ***Anutaila.***

Discussion on Methodology: This study is randomised controlled clinical trial. The study was carried out in 2 groups, of only 50 male regular healthy exercisers, because strength of male exercisers are more than females and male exercisers are very regular in their exercise schedule than the females to avoid drop outs we decided to work on only male candidates. We selected the age group between 20 yr – 30 yr because this age is *Tarunyavastha* (Completely grown Adult) and maximum youngsters of this age group hit the gym regularly. These regular

exercisers were working out in the gym 1hr. daily for 6 days a week at least for 6 months and having no systemic diseases. Group A volunteers received *Anutaila Nasyam* for 3 months, 2 drops in each Nostril daily in the Morning. We used *Anutaila* of AVP (*Arya Vaidya* Pharmacy – Coimbatore). It is a well known GMP recognised, FDA approved pharmacy. This AVP Pharmacy's *Anutaila* is already standardised. Group B did not receive any treatment but it was kept under observation and the follow-up was taken at a month interval.

The **Shoulder Muscle strength** was measured by 1 RM max of Overhead Press, **Chest Muscle strength** was measured by 1RM max of Chest Press. **Muscular Endurance of Chest and Shoulder** was measured by maximum number of repetition of push –ups and **Forearm Girth, Chest Girth** was measured by Measuring Tape. After 3 months both the groups were compared for evaluation of effect of Nasya. As explained in Charak Samhita '*Balam Vyayamshaktya Parikshet*'. Hence we took help of 1 RM of Overheadpress, 1RM of Chest Press for Strength and Push-up for Shoulder muscle and Chest muscle Endurance. The synonym of *Pushti* is *Upachay, Vruddhi*. The synonym of *bala* is *dehopachaya*. Hence we can conclude that *Pushti* is *Bala*. By considering above *Mamsadhatu* is responsible for *sharirpushti* and *bala* can be correlated to muscle strength and endurance.

Discussion on Clinical Trial: The Clinical trial was carried out in the gym. Previously the volunteers were not ready to participate in the study because of the fear of some side effect but after taking few lectures regarding *Nasya* and its effect on the body, after showing some video clips and some demonstration the exercisers started enrolling themselves in clinical trials. Consent form was given to the volunteers. The daily diary were given to the enrolled volunteers on every follow up so that we can keep a good track of volunteers, with the help of daily dairy we immediately come to the conclusion that whether the volunteers were doing *Nasya* and Exercise regularly or not. Those who have a gap of a week that candidate were droped out from the study.

Discussion on Observation : After a treatment of *Nasya* for 3 months girth, endurance and strength of muscles increased significantly. This is according to what is told about Nasya ie. regular practice of *Anutaila Nasya* regains the sharpness of the sense-organs. It strengthens the muscles of neck, Shoulders, and Chest. It guards against an attack of premature greying of hair and premature appearance of wrinkles on face.

Whereas the group which was not treated with *Nasya* also showed improvement in girth endurance and strength of muscles significantly after 3 months. This could be because of regular exercise as quoted by *Sushrut*. However both the groups showed significant improvement in girth tests the non-*nasya* treated group shown much better improvement than the *Nasya* treated group. So the study should be carried out in the same person with *Nasya* and Without *Nasya* because the strength, endurance depends on his *Prakruti.* There was no statistically significant difference found in the action of *Nasya* in regular exercisers and the group of exercisers without *Nasya.*

This study also makes point that increasing awareness and acceptability of *Nasya* was better than expected. All the volunteers took their *Nasya,* according to schedule and prescribed doses without fail. None of the volunteers showed any of the side effects with *nasya* treatment. This proves safety of the *Nasya* treatment.

There were no side effects observed during and after study. Most of the volunteers were Non-Vegetarian.

Discussion on mode of Action for establishing hypothesis:

Ayurvedic School of thoughts says nose is a entrance of the Cranial Cavity the nasal medicine enters in *Shringatak marma* and spreads in the cranial cavity, eyes, ears, throat and the minute capillaries of face and the *doshas* are removed from the site. After removal of *doshas* the *poshan* (rejuvenation) of the neck chest and shoulder muscles take place. Now- a- days in gym nobody follows the rule of *Vyayamah ardhashaktya*. So ultimately it hampers the *prakrut vata gati,* vitiation of *doshas* takes place and *Snayu* loses its *drudhata* (tone) and due to this some injuries or pain may occur. But by taking *nasya* we are pacifying *vikrut vata* and once *doshas* come in *saamyavastha,* the pain and injuries can be prevented. Although we didn't get satisfactory result in the form of strength, endurance and girth but the ill effects of excessive exercise, injuries can be prevented by *Nasya.*

Limitation and Scope of Study:

This thesis is of *Swasthavritta.* So we couldn't take any other type of *nasya* other than *Pratimarsha*. The large *matra* (Dose) may lead to desired result in the form of strength

endurance and girth. This should be kept in mind that *Anutaila* has its domain of action on neuromuscular that means this study should be reconstructed with a group of non- regular exercisers. *Anutail* is told to be used in *pratimarsha matra* as a practice of *Dincharya.* So this topic can be evaluated with *Mash taila, Bala taila, Mansarasa* in larger doses with a group of non regular exercisers treated with *Nasya* which is outside the domain of *Swasthavritta*.

If we had chosen older age group (*vatadhikya*), then the picture would have been different. We might get positive result in this age group as in *vrudhavastha, vatadhikya* is more in the body and *Nasya* pacifies *vata*.

If we had done this study in *Shishir* or *Hemant Rutu*, we might get some improvement in strength, endurance and girth.

CHAPTER 9

CONCLUSION

- Muscle Strength and Endurance were increased in the group treated with *Nasya*.

- Muscle Strength and Endurance were increased in the group not treated with *Nasya* hence the effect offered by *Nasya* treatment was similar to the effect offered by regular untreated exercising group.

- The Muscular Girth in control group showed significant difference.

CHAPTER 10

SUMMARY

The study was proposed to see the effect of *Nasya* on Strength, Endurance and Girth of regular exercising people.

Regular exercisers were chosen randomly and they were again divided into 2 groups of 50 each.

One group received *Anutaila Nasya* 2 drops in each nostril daily along with exercise and another group did not receive *Nasya* treatment but they are told to continue their regular exercises.

After 3 months both the group were evaluated for change in Strength, Endurance, and Girth.

Both the groups showed significant improvement after the study period

However the effect shown by treated group was similar with the *Nasya* untreated group.

CHAPTER 11

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APPENDIX

ABBREVATIONS

Su.	**Sushruta samhita**
su.	**Sutrasthana**
Chi.	**Chikitsasthana**

CONSENT FORM

I willingly desire to participate in the trial," **Assessment of efficacy of anutaila nasya on muscule strength, endurance and girth in healthy regular exercising persons wsr to shoulder,chest and pectoral girdle.**" as a patient. It is fully explained by the concerned doctor to me about the benefits and complications of the therapy in the language best understood by me. I also permit to perform any kind of investigations necessary for the studies and allow using the results in future for scientific purpose. I reserve my right to withdraw my presence from the study at any time.

Date :-

Place :- Signature & Name of the patient

अनुमती पत्र

मी स्वेच्छेने " **Assessment of efficacy of anutaila nasya on muscule strength, endurance and girth in healthy regular exercising persons wsr to shoulder,chest and pectoral girdle.**" या वैज्ञानिक अनुसंधानांतर्गत औषधोपचाराबाबत संमती देत आहे. औषधोपचार करणाऱ्या डॉक्टरांनी मला समजेल अशा भाषेत औषधामुळे होणारे उपद्रव व लाभ या विषयी पूर्ण माहिती दिली आहे. उपचारासाठी लागणाऱ्या सर्व प्रकारच्या तपासण्या करून घेण्यास मी तयार आहे. तसेच या चाचण्यांचे निष्कर्ष वैज्ञानिक अनुसंधानासाठी वापरण्याची संमती देत आहे.माझ्यावर होणारे उपचार कधीही थांबवण्याचा हक्क मी अबाधित ठेवत आहे.

दिनांक :-

ठिकाण :- रुग्णनाम व सही

अनुमती पत्र

मै स्वेच्छा से "**Assessment of efficacy of anutaila nasya on muscule strength, endurance and girth in healthy regular exercising persons wsr to shoulder,chest and pectoral girdle.**" इस वैज्ञानिक अनुसंधानांतर्गत औषध उपचार के लिए संमती देती / देता हूँ । औषध उपचार से होनेवाले सभी उपद्रव एवम् लाभ की जानकारी मेरे समझ मे आए इस भाषा मे संबंधित डॉक्टरने मुझे दी है । उपचार के लिए लगनेवाली सभी जांच करने के लिए एवम् निष्कर्ष वैज्ञानिक अनुसंधान हेतु उपयोग मै लाने के लिये तैयार हूँ । मुझपर होनेवाले उपचार कभीभी स्थगित करने का मेरा अधिकार मै अबाधित रखता / रखती हूँ ।

तारीख :-

स्थान :- रुग्णनाम एवम हस्ताक्षर्

CASE RECORD FORM

NAME :

ADDRESS :

AGE :

SEX :

HEIGHT :

WEIGHT :

DATE :

OCCUPATION :

SAMANYA PARIKSHANA :

Nadi :

Mala :

Mutra :

Jihva :

Sparsha :

Druk :

Akruti :

AHAR :

KULVRUTTA :

DARSHAN :

SPARSHAN:

PRASHAN :

SROTAS PARIKSHANA :

Pranavaha :

Udakvaha :

Annavaha :

Rasavaha :

Raktavaha :

Mansavaha :

Medovaha :

Asthivaha :

Majjavaha :

Shukravaha :

Artavavaha :

Swedovaha :

Purishavaha :

Mutravaha :

H/O Exercise :

Present Exercise :

Diet :

Observations

Muscle Strength , Muscle Endurance, Forearm Girth.

	Test parameter	**Observations**
DAY 0	1 repetition max of Overhead Press	
	1 repetition max of Chest Press	
	Shoulder muscles Endurance by maximum repetitions of Push- ups	
	Chest muscles Endurance by maximum repetitions of Push- ups	
	Forearm Girth	Rt. Lf.
	Chest Girth	
DAY 30	1 repetition max of Overhead Press	

	1 repetition max of Chest Press	
	Shoulder muscles Endurance by maximum repetitions of Push- ups	
	Chest muscles Endurance by maximum repetitions of Push- ups	
	Forearm Girth	Rt.- Lf.-
	Chest Girth	
DAY 60	1 repetition max of Overhead Press	
	1 repetition max of Chest Press	
	Shoulder muscles Endurance by maximum repetitions of Push- ups	
	Chest muscles Endurance by maximum repetitions of Push- ups	
	Forearm Girth	Rt.- Lf.-
	Chest Girth	
DAY 90	1 repetition max of Overhead Press	

	1 repetition max of Chest Press	
	Shoulder muscles Endurance by maximum repetitions of Push- ups	
	Chest muscles Endurance by maximum repetitions of Push- ups	
	Forearm Girth	Rt.- Lf.-
	Chest Girth	

Readings	**Gradations Before *Nasya* Treatment,(Day 0)**	**Gradations After *Nasya* Treatment, (Day 90th)**
1 repetition max of Overhead Press		
1 repetition max of Chest Press		
Shoulder muscles Endurance by maximum		

repetitions of Push- ups		
Chest muscles Endurance by maximum repetitions of Push- ups		
Forearm Girth	Rt. Lf.	Rt. Lf.
Chest Girth		

Signature of Guide

Signature of Student

DAILY DAIRY

NAME:

AGE :

DATE OF ISSUE DAILY DAIRY :

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Have you done your Nasya today with proper technique?																							
Have you done your exercise today as per the schedule?																							
Duration of exercise																							
Have you taken any Nutritional supplements																							

ANY OTHER NOTABLE THINGS DONE?

DATE :

SIGNATURE OF THE EXERCISER

स्थापना) ।। जय कोलदेव प्रसन्न।। (१९३२

आगळे (आगरी) क्रिडा मंडळ

नोंदणी क्र. : रजि. नं. ई-३०८४ (बी) दि. १३-०९-१९६५

कार्यालय : ९३ एच. खजुरीभट्टी गांव मार्ग, चुनाभट्टी, शीव, मुंबई - ४०० ०२२.

संदर्भ क्र. : दिनांक :

Date: - 03/01/2013

To

Dr. DALVI PRACHI DATTA

Sub:- Permission for their work Gymnasium

Dear Madam

With refer to your request letter we are allowing you to Work in our Gymnasium.

For AGLE (AGRI) KIRDA MANDAL

Security

स्थापना)

।। जय कोलदेव प्रसन्न।।

(१९३२

आगळे (आगरी) क्रिडा मंडळ

नोंदणी क्र. : रजि. नं. ई-३०८४ (बी) दि. १३-०९-१९६५

कार्यालय : ९३ एच. खजुरीभट्टी गांव मार्ग, चुनाभट्टी, शीव, मुंबई - ४०० ०२२.

संदर्भ क्र. :

दिनांक :

Date: - 30/03/2015

To

Dr. DALVI PRACHI DATTA

To whom so ever it may concern this is to certify that Dr. DALVI PRACHI has worked in our gymnasium for her PAD WORK.

For AGLE (AGRI) KIRDA MANDAL

Security

9619792444
9987932972

Pinacal Gymnasium

Add : Nehru Nagar, Opp. Kedarnath Mandir, Kurla (E), Mumbai - 400 024.

Date : 04 /01 / 2012

प्रति,
कु. दळवी प्राची दत्ता

विषय : परवानगी देणेबाबत....

महोदया,

आपल्या विनंती अर्जानुसार आपणास आपल्या पी. एच. डी.(Ph.D) च्या प्रबंधासाठी माझ्या कुर्लाच्या (Pinacal Gymnasium) तथा दिव्याच्या युनिक फिटनेस सेंटर (Unique Fitness Centre) येथे काम करण्याची परवानगी देत आहे.

आपला नम्र

श्री मदन कडू
(संचालक)

9619792444
9987932972

Pinacal Gymnasium

Add : Nehru Nagar, Opp. Kedarnath Mandir, Kurla (E), Mumbai - 400 024.

Date : 28 / 12 / 2014

महोदया,

कु. दळवी प्राची दत्ता यांनी माझ्या कुर्लाच्या (Pinacal Gymnasium) तसेच दिव्याच्या (Unique Fitness Centre) येथे त्यांच्या (Ph.D) प्रबंधाचे काम केले आहे.

आपला नम्र

श्री मदन कडू

(संचालक)