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A COMPREHENSIVE STUDY OF *SNAAYU SHAAREERA* W.S.R TO *ADHO SHAAKAAGATA SNAAYU*

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ABSTRACT

The detailed explanation of snaayu is available in Bruhatrayees, Laghutrayees. Ayurvedic classics has mentioned anatomical idioms in the subject of Rachana Shareera which needs further exploration. There is still a paucity in interpreting anatomical idioms referred to as in the classics such as Snaayu. There is a demurral between Ayurvedic classics and contemporary science regarding the concept, classification and enumeration of Snaayu. Structural description of Snaayu is found inadequate as compared to its description regarding clinical significance. So to give a cut and dried point about the structure of Snaayu in contemporary science with the help of life science this study has been taken. Objective of this study is to study the literature on snaayu shareera w.s.r to adho shaakaagata snaayu in the light of modern science by literature review cadaveric study. Hence the present work, A Comprehensive Study of Snaayu Shareera w.s.r to Adho Shaakaagata Snaayu was taken.

KEYWORDS: *Snaayu, Adho Shaakaa.*

INTRODUCTION

Paribhasha shareera is one of the concept of *Rachana Shareera* which is adequately characterized and explained thoroughly in terms of understanding the concept. Anatomical words used in classics texts like *snaayu* still have a lacuna in understanding with regards to contemporary science. The notion, classification, enumeration of *snaayu* are areas where modern science and the classics of *Ayurveda* diverge. It is determined that *snaayu's* structural description fall short of its clinical significance.

The Sanskrit word *Snaayu* is a fibrous structure that bind.[1] In the past *snaayu's* where used as string of a bow. *Snaayu*, are fibrous structures that connect the *asthi's* in the region of joints and enable the body to bear weight.[2] Formed from the *Sneha* of *Medas* through *Khara Paka* which provides support and stability.[3]

In *Ayurveda*, *Snaayu* are categorized into four types: *Pratanavati Snaayu* which is found in all *Shakha* and *Sandhi*, *Vrutta Snaayu* are considered equivalent to *Kandara*, *Sushira Snaayu* located at the distal ends of *Amashaya*, Pakwashaya, *Basthi*, *Prithula Snaayu* found in *parshwa*, *Uras*, *Prushta*, *Siras*.[4] This classification highlights the complexity of *Snaayu* in *Ayurvedic* physiology, emphasizing their role in maintaining structural integrity and facilitating movement.

Snaayu is considered the essence of *Medas*[5] and its *Upadhatu*.[6] The *Moolasthana* of *Snaayu* is said to be the *Masthulunga*[7], situated in the *Masthishka*.

The diverse interpretations from various scholars have led to ambiguity regarding the classification of *Snaayu* that is either fibrous tissue component, Muscle tissue or Nervous tissue. This ambiguity stems from the complex and nuanced nature of *Ayurvedic* concepts, highlighting the need for further clarification and contextual understanding. In Ayurveda, *Snaayu* seems to have multiple connotations, making its classification challenging. Scholars continue to debate its precise nature, reflecting the complexity of traditional Indian medical knowledge.

While the *Ayurvedic* classics provide limited information on the *Rachana Shareera* of *snaayu*. There is a need of extensive research to understand the types, number of *snaayu* by doing dissection in the lower limb to conclude concerning about the distinct architect in terms of modern science. Therefore, the anatomical study of *snaayu* is taken based on cadaveric dissection.

AIMS AND OBJECTIVES

1. To study the literature on *Snaayu Shaareera* w.s.r. to *Adho Shaakaagata Snaayu*.

2. To identify the *Sankhya* & *Prakara* of *Adho Shaakaagata Snaayu* by cadaver dissection.

METHODS OF COLLECTION OF DATA

- Literature regarding *Snaayu* with special reference to *Adho Shaakaagata Snaayu* were collected from Bruhatrayees, Laghutrayees and other classical books, including journals, presented papers and previous work done, on the concept related to the subject.
- *Sankhya* & *Prakara* of *Adho Shaakaagata Snaayu* were studied by dissecting 4 cadavers.

OBSERVATION

The dissection of *adho shaakha* has been carried out in 4 cadavers as per the Cunningham's Manual of practical. Dissection procedure was carried out layer by layer and structures were observed and studied thoroughly.

Inguinal Region

After removing the skin, the surface fascia, the subcutaneous fat was removed from the groin fold where the inguinal ligament was discovered.

An incision is created in the gluteal region, and the skin is flapped laterally, exposing the gluteal maximus. Furthermore, the maximus is sliced and reflected, exposing the big Sciatic nerve that originates in the sacral plexus and goes via the lower section of the sciatic foramen into the gluteal region. Furthermore, a strong band sacrotuberous ligament, sacrospinous ligament is visualized.

Hip Joint

Cut made through the femoral vessels and nerves directly below the inguinal ligament. Divided the Sartorius and Rectus Femoris about 5 cm from their roots and turned them down. Cut made through the iliopsoas near its insertion and turned them into two pieces upwards and downwards to expose the capsule of the hip joint. The pubofemoral, ischiofemoral ligament is discovered.

The fibrous capsule is uncovered. The Iliofemoral ligament is revealed by creating incisions through the articular capsule. The capsular ligament is cut, and the intra-capsular ligaments, including the acetabular labrum, transverse acetabular ligament, and femoral head ligament, become apparent and are analysed.

Thigh Region

After reflecting the superficial fascia of the thigh, following removal of the entire deep fascia, the sartorius and adductor longus tendon were found in the medial side, establishing the limits of a triangular depression in the top one-third of the thigh known as the femoral triangle. The contents of the femoral triangle and the femoral nerve was studied.

The rectus femoris, vastus lateralis, vastus medialis, and vastus intermedius tendons of the anterior compartment of the thigh, collectively known as the quadriceps femoris, were investigated. The femoral nerve supplies all of the muscles of the anterior compartment. Iliacus and psoas major tendon were also traced in the thigh due to their insertion on lesser trochanter. Made a curving incision from the spine of the second sacral vertebrae, gluteus maximus muscle is exposed. After cutting the gluteal muscles the tendinous insertion of Piriformis, Gemellus Superior, Gemellus Inferior, Obturator Internus and Externus were envisioned and studied.

After reflecting the adductor longus, aponeurotic origin of gracilis, were identified in the medial compartment of the thigh. The adductor brevis was located deep within the adductor longus and pectineus muscles. After dividing the adductor brevis near its origin in the deepest plane of muscles, the adductor magnus and obturator externus were investigated. The hamstring muscles, which includes the long head of biceps femoris, semitendinosus, semimembranosus, and ischial section of the adductor magnus and its tendinous insertion has been studied.

Knee Region

Removed the superfecial structures around the knee joint, leaving only the fibrous capsule, ligaments, and muscle/tendon attachments. Examined the articular surfaces, capsule, medial and lateral collateral ligaments, oblique popliteal ligament, and arcuate popliteal ligament.

Cut the quadriceps femoris tendon right above the knee joint. Extended the incision on either side of the patella, with the ligamentum patellae fixed to the tibial tuberosity. Reflected the patella downwards to see into the knee joint cavity and the large infrapatellar synovial fold and fat pad in it. Removed the fat and posterior section of the fibrous capsule to reveal the cruciate ligaments, meniscofemoral ligaments and transverse ligament.

The Tendinous insertions of Sartorius, Gracilis and Semitendinosus is observed medially in the knee. Posteromedially and posterolaterally it is related to tendinous origin of Medial head of Gastrocnemius and Lateral head of Gastrocnemius respectively. Laterally it is in relation with the tendinous origin of Popliteus and tendinous insertion of Biceps femoris.

Leg Region

After reflecting the skin, superficial veins and cutaneous nerves were revealed. The four anterior compartment muscles, tibialis anterior, extensor digitorum longus, extensor hallucis longus, and peroneus tertius, which were close together on the lateral surface of the tibia, interosseous membrane, and medial surface of the fibula, were studied and their tendons were traced from below the extensor retinacula on the dorsum of the foot to their insertion.

The lateral flap of skin was mirrored more laterally, revealing the peroneal muscles of the lateral compartment. The deep fascia that covered the peroneal muscles was separated to reveal the peroneus longus and peroneus brevis muscles. Their tendons were traced and investigated under the peroneal retinacula, near their insertion.

The tendons of medial and lateral heads of the gastrocnemius were identified by incising the deep fascia of the back of the leg vertically and reflecting them. The tendon of popliteus is spotted below the lateral head of gastrocnemius. Plantaris was identified and analysed based on its longest tendon. The strong soleus muscle was deep within the gastrocnemius. Deep to it, the tendinous origin of Extensor Hallucis Longus, Extensor digitorum longus, Tibialis Posterior were studied. The Tendinous insertion of Sartorius, Gracilis and Semitendinosus is observed medially.

After removing the muscles surrounding the proximal tibiofibular joint, identified the tendon of the popliteus muscle on its posterior surface. The joint is opened and the anterior, posterior ligament along with the fibrous capsule is studied. After removing the muscles from the anterior and posterior surfaces of leg, interosseous membrane is exposed.

Following the removal of muscles of the distal tibiofibular joint, attachments of anterior and posterior tibiofibular ligaments, including the fibrous capsule and the strong interosseous tibiofibular ligament were identified.

Ankle, Heel and Foot Region

The ankle joint was dissected after defining the two extensor retinacula, one flexor retinacula, and two peroneal retinacula. The tendons and other structures lying beneath them were identified. Anteriorly, the tendons of extensor hallucis longus, extensor digitorum longus, tibialis anterior, and peroneus tertius, were observed crossing the ankle joint. Laterally, the tendons of peroneus longus and peroneus brevis crossed. Posteromedially it is related to tendon of Tibialis Posterior, tendon of Flexor Digitorum Longus and tendon of Flexor Hallucis Longus.

Removed the remaining extensor and flexor retinacula. Displaced the tendons that are in contact with the joint without eliminating them. A clear picture of the anterior and posterior sections of the fibrous capsule is revealed.

Medially deltoid ligament is laid bare, with three bands superficially namely, tibiocalcanean, tibionavicular and postero - tibiotalar. Deep part of medial ligament i.e; anterior tibiotalar ligament is observed. Laterally the lateral ligament with three bands are identified - anterior talofibular, posterior talofibular, calcaneofibular ligament.

Cut is made longitudinally through the skin and superficial fascia of the sole, from the heel to the middle toe root. The deep fascia (plantar aponeurosis) is uncovered. The four layers of sole is dissected and considered namely the tendons of flexor digitorum brevis, abductor hallucis, abductor digiti minimi, flexor digitorum longus, flexor digitorum accessorius, origin and insertion of four lumbricals, flexor hallucis longus, flexor hallucis brevis, adductor hallucis, flexor digiti minimi brevis, tibialis posterior, origin of plantar Interossei and peroneus longus.

Further the Calcaneo-Cuboid Joint is laid bare where the long plantar ligament, plantar calcaneo cuboid Ligament/ Short Plantar Ligament is noted.

The Calcaneo-Navicular Joint is opened and the plantar calcaneo navicular / Spring Ligament is displayed. Supplemental to it Cuneo-Navicular Joint is dissected and three plantar ligaments is revealed.

Later on, the intercuneiform and cuneo-cuboid Joint is opened and three plantar ligaments is disclosed. Subsequently tarso-metatarsal articulations are unlatched and the plantar ligament is observed.

Down the road the intermetatarsal joint and meatarsophalangeal articulations are opened and the plantar ligaments of both are contemplated.

After unveiling the superior and inferior extensor retinacula in front of the ankle joint on the dorsum of the foot, extensor digitorum brevis, a tiny muscle on the lateral side of the dorsum, was discovered. Its tendons, together with those of the extensor digitorum longus, were traced. The medial most tendon of the extensor digitorum brevis is known as the extensor hallucis brevis.

Tracing the tendons of the anterior compartment of the leg onto the dorsum of the foot, extensor digitorum longus, Tibialis Anterior, Peroneus Tertius and extensor hallucis longus were also found in the mid foot region. Tendinous origin of four Dorsal Interossei was also observed.

To a greater extent the intertarsal joints are anatomized where Talocalcaneal Joint was exposed first with the keen detection of fibrous capsule, medial, interosseous, lateral talocalcaneal ligament and cervical ligament. Further Talocalcaneonavicular joint is opened up and for fibrous capsule and talonavicular ligament.

Later on, in calcaneocuboid joint, fibrous capsule, bifurcate ligament is uncovered. Further Cuneo navicular joint is laid bare and the dorsal ligament is exposed. Farther, Cuboid navicular, Intercuneiform and cuneo cuboid joint is shown along with the dorsal ligament and interosseous ligament each respectively.

Adding on to it tarsometatarsal articulations and Intermetatarsal joints are opened up and the dorsal ligament, interosseous ligament each are thrown light for. In tarsometatarsal articulations three interosseous cuneometatarsal ligament is exposed. More extreme to it the metatarsophalangeal articulations are dissected for exposing the fibrous capsule, four deep transverse metatarsal ligaments, collateral ligaments are seen.

Toe Region

The skin across the dorsal and plantar aspects of the toes was cleansed to expose the insertions. Extensor digitorum longus, extensor hallucis longus, extensor digitorum brevis, and extensor hallucis brevis on the dorsal surface; and flexor digitorum longus, flexor digitorum brevis, and flexor hallucis longus on the plantar portion of the toes.

The insertion of four lumbricals, four dorsal interossei, three plantar interossei, adductor hallucis, abductor digiti minimi brevis, adductor digiti minimi were identified. There after the interphalangeal articulations are opened up and the fibrous capsule, Collateral Ligament Plantar ligament are revealed.

DISCUSSION

SNAAYU AND ITS PRAKARA AS LIGAMENTS TENDONS APONEUROSIS

The architectural framework of the human body is the product of a highly intricate assembly of multiple components. The structural differences among these components allow for excellent coordination. They are all connected in such a way that they can provide a defined structure and mobility to the body components. Snaayu is among them. Snaayu's anatomy and practical relevance are discussed in Sharira Sthana by Acharya Sushruta.

There are 900 of them in the body where 150 in each shaakaa. Histological study was not possible in ancient times due to a lack of cutting-edge technology to determine the various structures of the organs and muscles; thus, Acharyas presumably mentioned the presence of snaayu based on a variety of other macro factors such as organ structure, and form.

Mainly Snaayus are present in the human body in close proximity to Sandhi. Based on their structural properties, they can be classified into four categories. These are Pratanvati, Pruthula, Vrutta, and Sushira. Acharya Sushruta compares the function of Snaayu as the binding plates of boats, which allow them to float without sinking.

In modern science, the name "Snaayu" can be correlated with ligaments, tendons, aponeuroses, nerves, and fascia based on anatomical structure and clinical indications. There are approximately 900 ligaments and 4000 tendons in a human body.

Tendons are fibrous bands of connective tissue that connect muscles to bones and other structures in the body. Tendons connect muscle to bone. Ligaments are sinewy bands of strong connective tissues that form parallel bundles and are known for their ability to withstand strain. It is one of the primary mechanical forces that hold bones together in a synovial joint. Ligaments connect bone to bone. Aponeurosis is a strong band of thick connective tissue that forms parallel bundles and is designed to withstand strain. Aponeurosis connect muscle to bone. Nerves are the filamentous bands of nervous tissue, which connects nervous system with the other structures.

Hence, taking into account these considerations, snaayu, can be considered as a fibrous structure that binds the mamsa, asthi, medas like tendons, ligaments, aponeurosis, nerves.

Formation of Snaayu

The production of Snaayu in a foetus is as a result of the Kharapaka of Meda dhatu by pitta (Tejas). According to contemporary science tendons, ligaments, aponeurosis are composed of collagen which are packed into fascicles and wrapped by epitenon and endotenon, whereas nerves covered by epineurium, endoneurium. The crucial difference is that ligaments connect bone to bone, whereas tendons & aponeurosis connect muscle to bone. Nerves helpful for the activities of muscles, tendons, aponeurosis etc.

Snaayu Vibhaga

Depending upon the shape and area, Snaayu are classified into four types.

1. Pratanavati Snaayu: Morphologically elongated and present in all Shaakaa and Sandhi where the ligaments and tendons may be taken into a thought.
2. Vrutta Snaayu: These are cord like and are known as Kandara. Agreeing to Acharya Maha Snaayu are called as Kandara. These are shown in Shaakaa and Sandhi. Large nerves and tendons can be taken into consideration in terms of kandara, which are two in each shaakaa.
3. Sushira Snaayu: These are ring like in nature and are found in the ends to Amashaya, Pakvashaya and Basti. Sphincters may be taken into consideration as Sushira snayu.
4. Prthula Snaayu: These are broad in morphology and are present in Parshwa, Uras, Prushtha and Shira. Broad flattened aponeurosis or tendons can be understood as Pruthula snayu.

Karma of Snaayu

The function Snaayu is that it binds the Mamsa, Asthi and Medas of the body together. A tendon aids to move the bone by connecting muscle to bone. A ligament is a fibrous connective tissue that links bone to bone. Aponeurosis is a strong band of thick connective tissue which connect muscle to bone. Nerves are helpful for the activities of muscles, tendons, aponeurosis. It primarily

functions to hold components together and maintain them.

Clinical Importance Snaayu

According to Sushrutha Sharira Sthana injury to the snaayu is more painful when compared to injury to asthi, peshi, sira, sandhi. A sprain is a stretch or tear of a ligament. A strain is analogous to a stretch or tear, aside from it occurs within a muscle or tendon / aponeurosis.

Ligaments can sustain minor, partial rips. They may potentially have a moderate rip (grade 2). Finally, there is a grade 3 tear, which is a full ligament tear. A Grade 3 ligament tear can cause as much pain as a broken bone. Stretch injuries to the nerves can range from mild to severe permanent nerve injury depending on the amount of stretch.

ADHOSHAAKAAGATA SNAAYU AND FIBROUS STRUCTURE OF LOWER LIMB

Total number of snaayu present in each adho shaakaa are 150. These snaayu's are spread in the 6 regions of Adho Shaakaa particularly in vankshana, uru, janu, jangha, Tala -kurcha- gulpha, and anguli pradesha.

Sushrutha outlines sphik as a distinct pratyanga of Madhya Shareera in the fifth chapter of Shareera Sthana. The area situated near Kati is also mentioned in the 18th chapter of Sushruta Sutra Sthana. The area situated near Kati is also mentioned in the 18th chapter of Sushruta Sutra Sthana. Therefore, sphik pradesh snaayu is not included under the Adho Shaakaagata Snaayu.

Discussion on Snaayu of Anguli

Acharya mentions 6 snaayu in each anguli which sums upto 30 on each shaakaa. As per Modern anatomy and dissection total Snaayu in Anguli as per dissection are 53.

Snaayu of Tala-Kurcha-gulpha

Acharya mentions 10 snaayu each in tala-kurcha-gulpha which totally makes 30 on each shaakaa.

Therefore with complete dissection knowledge, the total assortment of snaayu in Tala- Kurcha-Gulpha is 76.

Snaayu of Jangha

Dalhana opines that region between gulpha and janu is called as jangha.[8]

Acharya mentions 30 snaayus are present in jangha pradesha. Hence, total snaayu in jangha as per dissection are 18.

Snaayu of Janu

Acharya mentions 10 snaayus in janu pradesha. In terms of contemporary science, total snaayu in janu as per dissection are 18.

Snaayu of Uru

In Sushruta Samhita, sutra sthana, 35th chapter, the limit of the uru pradesha is defined as the region above the janu up to the vankshana sandhi.[9] This may be regarded as thigh region.

Acharya mentions 40 snaayus in uru pradesha. Modern science encompasses total snaayu in uru as per dissection are 31.

Snaayu of Vankshana

Dalhana believes that vankshana is the moola of uru[10] . According to the Sushruta uttaratantra, vankshana is the sandhi between udara and uru (abdomen and thigh). This is known as the inguinal region of the anterior aspect. The groin fold separates the anterior compartment of the thigh from the abdomen, extending from the anterior superior iliac spine to the pubic tubercle.

Acharya mentions 10 snaayus in vankshana pradesha. Contemporary science concludes total snaayu in vankshana as per dissection are 9.

CONCLUSION

Snaayu is one of the important structure, which plays a vital role in the posture of the human-body. Some of the tendons are considered in multiple regions due to their presence in the particular region, where as tendinous origin and insertion of same muscle and tendons with two heads is considered separately which might not have been considered by Acharyas.

The study concludes total number of snaayu are 205 in Adho shaakaa as per the cadaveric dissection and the literary review.

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