*Available online at http://www.journalcra.com*

*International Journal of Current Research*
*Vol. 5, Issue, 12, pp. 3763-3766, December, 2013*

**INTERNATIONAL JOURNAL OF CURRENT RESEARCH**

**ISSN: 0975-833X**

**CASE STUDY**

# MUSCULAR VARIATIONS IN AXILLA, INCIDENCE, EMBRYOLOGICAL AND SURGICAL SIGNIFICANCE

***Venkatesh G. Kamath, Radhakrishna Shetty K., Muhammed Asif and Ramakrishna Avadhani**

Department of Anatomy, Yenepoya Medical College, Mangalore, India

**ARTICLE INFO**

***Article History:***
Received 08th September, 2013
Received in revised form
15th October, 2013
Accepted 27th November, 2013
Published online 02nd December, 2013

***Key words:***
Axillary dissection,
Langers axillary arch,
Latissimus dorsi, Pectoralis major.

**ABSTRACT**

Hundred axillary dissections were conducted by the first author over four years. A muscular slip was observed during such a routine axillary dissection in a cadaver extending from the lower border of Latissimus dorsi muscle to the trilaminar tendinous insertion of pectoralis major muscle. The arch was identified as the "Axillary arch of Langer". This attribute's its incidence to 1% in south Indian population. The paramount importance of the arch to the surgeons operating in the axilla has been discussed. The article aims at describing the various reported muscular variations in the axilla, their embryological basis and surgical significance as their knowledge is vital due to their relevance in hyper abduction syndromes, post mastectomy breast reconstruction using latissimus dorsi myocutaneous flaps, lymphoedema, differential diagnosis of axillary swellings and thoracic outlet syndrome.



## INTRODUCTION

The axillary arch, also described as chondro-epitrochlearis muscle by some authors is a common variation encountered during surgeries involving the axillo-pectoral region (Landry, 1958). The most common arch is the 'Axillary arch of Langer', (Langer'ser Achselbogen), first described in 1846, extending from anterior axillary portion of latissimus dorsi to the trilaminar tendon of pectoralis major muscle extending across the neurovascular bundle of upper limb (Langer, 1991). The article aims to highlight the importance of this atavistic anomaly and other muscular variations acknowledging their proximity to brachial plexus, vital lateral lymphatics and the axillary vein that drain the upper extremities. The possible role of these variations in post mastectomy lymphoedema, axillary vein thrombosis and neurological deficits is discussed.

## MATERIALS AND METHODS

Hundred axillary dissections were conducted by the first author over three years. During each dissection the skin was reflected followed by division of the clavipectoral fascia. The neurovascular bundle of axillary vessels and the brachial plexus was then exposed carefully with the objective of noting any possible muscular variation in the region. Data was collected from various sources regarding various muscular variations reported over the years so as to understand the average incidence rates in different populations and to know the most common variation. Data was also collected regarding various embryological theories for such variations and all such theories have been discussed. Finally data regarding the various surgical complications due these arches was collected.

***Corresponding author: Venkatesh G. Kamath,***
*Department of Anatomy, Yenepoya Medical College, Mangalore, India.*

## RESULTS AND DISCUSSION

During such a routine dissection in a cadaver of a 50 year old man, a musculo-tendinous arch was found extending from the lower border of latissimus dorsi to the posterior aspect of trilaminar tendon of pectoralis major muscle close to its insertion. The arch measured 8.5 cm in length and 10mm in breadth and was fusiform in shape. The arch extended across the neurovascular bundle of the upper limb as shown in Figure 1. It was identified as Langer's arch. No separate nerve was seen supplying the arch. Only one such variation was noted over four years in 100 axillary dissections attributing its incidence to 1% in south Indian population.

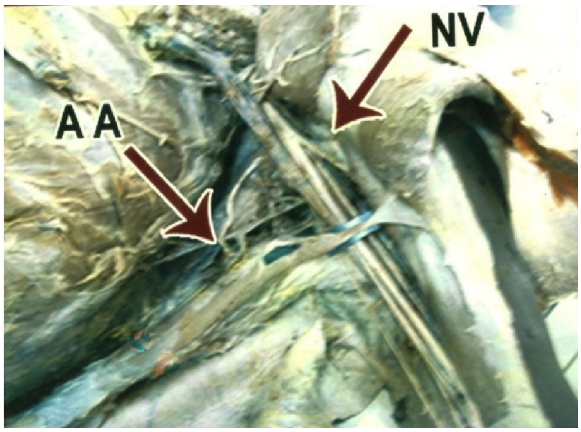


**Fig. 1. AA= axillary arch. NV=Neurovascular bundle of axillary vein and artery**

Anatomists and Surgeons have noted several variations in this region and the incidence of such arches is reported to vary

between 0.25-7percent in various populations. Jonathan W. Serpell and Michael Baum reported Langer's axillary arch during a routine axillary dissection. In the author's joint experience only 5 cases were encountered in 2000 axillary dissections attributing the incidence to 0.25% (Serpell and Baum, 1991). The author's have described its relevance in differential diagnosis of axillary swellings and thoracic outlet syndromes, hyperabduction syndrome and latissimus dorsi myocutaneous flaps for breast reconstruction. An arch similar to the one described in this article from lateral edge of latissimus dorsi to pectoralis major muscle was noted by I.R. Daniels and G. Querci della Rovere, 2000, during a surgery for breast carcinoma in the axilla (Daniels and Querci della Rovere 2000). The senior author reports 17 cases in 2000 axillary dissections ascribing the incidence to 0.8%.The surgeons described the difficulty in clearing the lateral axillary lymphatic because of this arch and its role in post operative lymphoedema and recurrence of carcinoma due to inadequate lymphatic clearance. The incidence observed by the authors over four years is quite similar these reports. On analysing the data regarding the various reported axillary muscular variations this is found to be the most common variation.

## REVIEW OF SURGICAL ANATOMY OF THE AXILLA

Axilla, a pyramidal tent shaped bridge, connecting the thorax to the upper limb, is a fat filled space that is a portal for vital vessels, nerves and lymphatics into and out of the upper limb. The anterior wall is formed by pectoralis major muscle, the medial wall by serratus anterior muscle, the posterior wall by subscapularis and latissimus dorsi and laterally by the upper part of the humeral shaft. The floor is formed by the axillary fascia that stretches across to the arm. The axillary vein, axillary artery and the axillary nerve are arranged from medial to lateral side. The axillary artery is present within the axillary sheath which is an extention of the prevertebral layer of deep cervical fascia. The most important structures in this region are the axillary lymph nodes which are arranged in three levels in relation to the pectoralis minor muscle. The axillary arch stretches across these vital structures and can compress them resulting in complications like axillary vein thrombosis, arterial occlusion, brachial plexus compression and lymphoedema as shown in Figure 2. The most common tendinous arch is the axillary arch of Langer' extending from anterior axillary portion of latissimus dorsi to the trilaminar tendon of pectoralis major muscle extending across the axillary vessels. The Langer's arch is believed to be an embryological remnant of a subcutaneous muscle sheet called panniculus carnosus which is well developed in some lower mammalian species like cats (Ruge, 1914). Another variant is Chondro-epitrochliaris, a musculo-tendinous arch extending across the medial aspect of the arm from pectoralis major to medial epicondyle. This variation was ascribed by Testut (1884) to Wood (1868) and Wood himself attributed the name to Dovernoy (1855). Stuart O. Landry Jr. reported a chondro-epitrochlearis muscle that bifurcates into a upper and a lower slip. The upper slip is inserted into the capsule of shoulder joint close to origin of long head of biceps and the lower slip into the medial epicondyle. Landry (1958) Perrin (1871) and Testut (1884) believed that chondro-epitrochliaris is homologous with 'extensor plicae alaris' of birds that serve to tighten the patagium, the fold of skin at the leading edge of the wing (Perrin 1871).

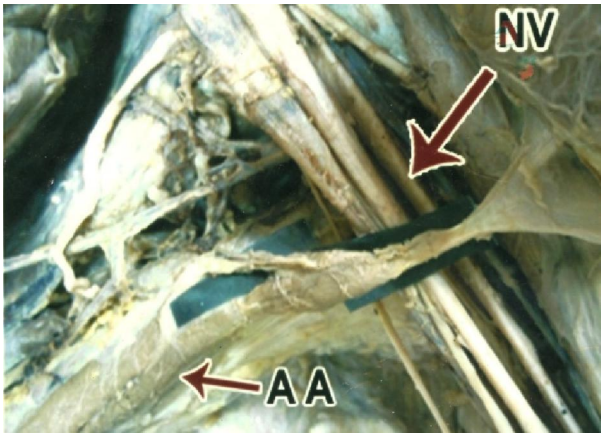


**Fig. 2. AA= axillary arch. NV=Neurovascular bundle of axillary vein and artery**

However these muscles are innervated by the posterior division of of brachial plexus and are extensor muscles (Fisher 1946) whereas the chondro-epitrochlearis is innervated by anterior division of brachial plexus and belongs to flexor muscle group (Bryce, 1899) Ruge (1914) attributed its embryological origin to panniculus carnosus (Ruge 1914) This explanation cannot be denied, however it doesn't explain the shift of its insertion from skin to medial epicondyle. The most appropriate explanation appears to be that given by Steinbach in 1922 who believed that the chondro-epitrochlearis is an atavistic anomaly and represents the distal insertion of pectoralis major in most quadruped mammals (Steinbach 1922). In Quadrupeds the pectoralis major is inserted lower down the humerus and insertion to medial epicondyle and deep fascia of the forearm has been noted and the pectoralis minor is inserted to the upper end of the humerus. During evolution, as a homosapean takes up a standing posture this insertion shifts upwards and the minor moves to the coracoid process while the major shifts to the upper end of humerus earlier occupied by minor and during this process the lower fibres get twisted. (Harris, 1939) Steinbach explains that the chondro-epitrochlearis is merely the preserved distal caudal fibres of pectoralis major and this view is further supported by Stuart O. Landry Jr. who observed that that presence of chondro-epitrochlearis was associated with absence of twisting of pectoralis major which is produced by its caudal fibres (Perrin, 1871). Hollinshead describes that these arches are frequently supplied by medial pectoral nerve thus ascribing their origin to pectoral group of muscles (Hollinshed, 1982). Chiba *et al*. demonstrated a common nerve supply for axillary arch muscle and chondroepitrochlearis. They agreed with Ruge who also suggested that these two muscles have a common genetic origin (Chiba Shoji, *et al.,* 1983). Several accessory muscle slips are described in the axilla arising from latissimus dorsi and pectoralis major or from ribs and coastal cartilages by authors such as (Shafer *et al*., 1923; Davies and Davies, 1962; Gardner *et al*., 1975, Hollinshead, 1982; Bergman *et al*., 1984) (Dharap, 1994). Chih Lin, 1988 has reported an interesting clinical case of a 17 year old Chinese boy, with bilateral contracture of chondro-epitrochlearis muscle, resulting in restricted abduction of the arm and forward flexed postural abnormality in the shoulder. The condition though present since birth was reported when the boy complained of difficulties in military training exercise and playing basket ball and baseball. The condition was surgically corrected. The bilateral involvement and the long history of

progression appeared to suggest a congenital aetiology (Chih Lin, 1988) An unusually medial axillary arch muscle was described by Amol, 1993 extending from the lower border of latissimus dorsi to the coracoid process of scapula. A similar case was described by Testut (1892), Eisler (1912) and Vare and Indurkar (1965). In the case described by Amol, in addition to the above slip, three short fibrous strands radiated from the arch to the surrounding muscles like pectoralis minor, short head of biceps and coracobrachialis and two thin slips to the deep surface of teres major (Dharap, 1994). The author ascribes the anomaly to the phase 3 and phase 4 of ontogenesis of muscles in the axilla. Muscle primordia from several muscle layers fuse into a single muscle sheet followed by apoptosis of several muscles. (Grim, 1972) Failure of complete apoptosis and persistence of the some muscles in the region which later on fuse with the connective tissue elements formed during phase 4 is believed to produce several such musculo-tendinous arches (Cihak, 1972).

The arch has several surgical implications during axillary surgeries following the division of clavipectoral fascia, as the presence of the arch restricts the access to axillary contents. Moreover during the surgeries the anterior margin of latissimus dorsi forms the lateral margin of dissection and the presence of the arch can confuse the surgeon and lead him to a level above the axillary vein leading to increased risk of lymphoedema as dissection at a level below the vein is usually more favourable. The presence of the arch can compress the lateral axillary lymphatics and restrict their removal during axillary surgeries increasing the risk of recurrence (Serpell and Baum, 1991). In breast reconstruction surgeries using latissimus dorsi myocutaneous flap, after raising the flap the pedicle is rotated anteriorly or posteriorly through varied degrees and if the arch is present it may lead to axillary vein entrapment syndrome and precipitate lymphoedema (Serpell and Baum, 1991). The axillary arch has to be considered in differential diagnosis of axillary swellings like axillary lymphadenitis due to tuberculosis, metastasis, rheumatoid inflammation, benign lymphadenitis, infundibular follicular cyst, nodular fibromatosis, ectopic breast and lipoma (de Andrade, 1996). The management in most cases consists of surgical division of the arch. During the surgery following an incision along the anterior margin of latissimus dorsi, the clavipectoral fascia is divided. The contents of the axilla are approached though a level below the axillary vein to prevent damage to the axillary sheath which reduces the risk of postoperative lymphoedema and the arch is then divided (Serpell and Baum, 1991). In cases of axillary contractures as reported above, the whole muscle is to be excised at the earliest, followed by physiotherapy to prevent scarring of the ends (Chih Lin, 1988).

## SUMMARY

Several muscular variations are reported in the axilla and hence the surgeon must be aware of these while performing axillary surgeries. Among all the variations reported the most common one is the axillary arch of Langer described in this case extending from latissimus dorsi to tendinous insertion of pectoralis major. The incidence of this anomaly in south Indian population is estimated to be 1%. Though several explanations have been given regarding its embryological basis, the most appropriate appears to be that of Steinbach suggesting chondro-epitrochlearis to be an atavistic remnant of pectoralis major as it also confirms its innervation in most cases by medial pectoral nerve. However the basis suggested by Ruge that it is a remnant of panniculus carnosus cannot be denied. The arch has several clinical implications due to its proximity to vital structures like axillary vein, axillary artery, brachial plexus and lateral axillary lymphatics. The knowledge of the arch and its variations is of paramount importance to surgeons operating for breast carcinoma and other axillary surgeries due to its role in aetiology of hyperabduction syndrome, axillary vein thrombosis, postoperative lymphoedema and latissimus dorsi myocutaneous flap for breast reconstruction and axillary contractures.

## REFERENCES


Bryce T. 1899. Note on a group of varieties of the pectoral sheet of muscle. J. Anat. Lond. 34: 75-83.

Chiba Shoji, Suzuki Takao and Kasai Tatsuo. A rare anomaly of the pectoralis major-the chondroepitrochlearis. Okajimas Folia Anat. Japan. 60: 175-186. 1983.

Chih Lin. Contracture of the chondroepitrochlearis and the axillary arch muscles. The J. Bone Joint Surg. Am. 1405-1406. 1988.

Cihak R. Ontogenesis of the skeleton and intrinsic muscles of the human hand and foot. Adv Anat Embryol Cell Biol. 46: 1-194. 1972.

Daniels I.R. and Querci della Rovere G. The axillary arch of Langer-The most common muscular variation in the axilla. Breast Cancer Res Treat. 59: 77-80, 2000.

de Andrade JM, Marana HR, Sarmento Filho JM, Murta EF, Velludo MA, Bighetti S.

Dharap A. An unusually medial axillary arch. J Anat. 184: 639-641. 1994.

Differential diagnosis of axillary masses. Tumori. 82(6): 596-9.Nov-Dec. 1996.

Dovernoy. M. 1855. Des caracteres anatomiques des grands singes pseudo-anthropomorphes. Arch. Mus. Hist. nat. Ser. 3, 8: 1-248.

Fisher H. 1946. Adapations and comparative anatomy of the locomotor apparatus of the New World vultures. Amer .Midl. Nat. 35: 545-727.

Grim M. Ultrastructure of the ulnar portion of the contrahent muscle layer in the embryonic human hand. Folia Morphologica.(Praha).1972. 20:113-115.

Harris W. 1939. The morphology of the brachial plexus, with a note on the pectoral muscle and its tendon twist. 117pp. London: Oxford University Press.

Hollinshed WH. Anatomy for Surgeons- The back and the limbs. Philadelphia. Harper and Row. pp. 280-281.

Landry S.O. JR. The phylogenetic significance of the chondro-epitrochlearis muscle and its accompanying pectoral abnormalities. J. Anat. 92: 57-61, 1958.

Langer K: Zur anatomie des musculus latissimus dorsi. Oester Med Wochenschrift 15: 16, 1846.

Langer K: Zur anatomie des musculus latissimus dorsi. Oester Med Wochenschrift .1846. 15:16.

Perrin J.B. 1871. Notes on some variations of the pectoralis major with its associated muscle seen during sessions 1868-69, 69-70, at Kings's College, London. J. Anat. Lond. 5: 233-240.

Ruge G. 1914. Der Hautrumpfmuskel des Menschen. Morph. Jb. 47: 677-682.

Serpell JW, Baum M. Significance of 'Langer's axillary arch' in axillary dissections. Aust NZJ Surg 61:310-312, 1991.

Shafer *et al*. in 1923, Davies &Davies in 1962, Gardner *et al*. in 1975, Hollinshed in 1982 and Bergman *et al* in 1984.

Steinbach K. 1922. Uber Varietaten der Unterzungenbein-und Brustmuskulatur. Anat. Anz. 56: 488-506.

Testut L. Les anomalies musculaires chez l'homme expliquees par l'anatomie comparee. leur importance en anthropologie. Paris:Doin.1884.

*******