

# Review on axillary arch and its surgical implications

## Abstract

Axillary arch commonly known as ‘Axillary arch of Langer’ is a muscular or musculo-tendinous arch that extends from the lower border of latissimus dorsi muscle to the tendinous insertion of pectoralis major muscle. There are a few variations of the arch reported in the past such as the chondroepitrochlearis extending from pectoralis major to medial epicondyle and some from pectoralis major to the coracoid process. The arch stretches across the axillary vessels and branches of brachial plexus, compressing on these structures resulting in several clinical manifestations that are reviewed in the article. The article also reviews the embryological basis of the arch. The incidence of the arch varies between 0.25 to 7% in diverse ethnic groups. The knowledge of its possible existence in the axillary region is essential in several surgical procedures involving the axilla in order to avoid neurovascular damage and post-surgical complications. The significance of the arch in hyper abduction syndromes, differential diagnosis of axillary swellings, post mastectomy breast reconstruction using latissimus dorsi myocutaneous flaps and several other clinical conditions is discussed.

**Keywords:** axillary arch, chondro-epitrochlearis, lymph edema, neuro-vascular bundle, surgical significance

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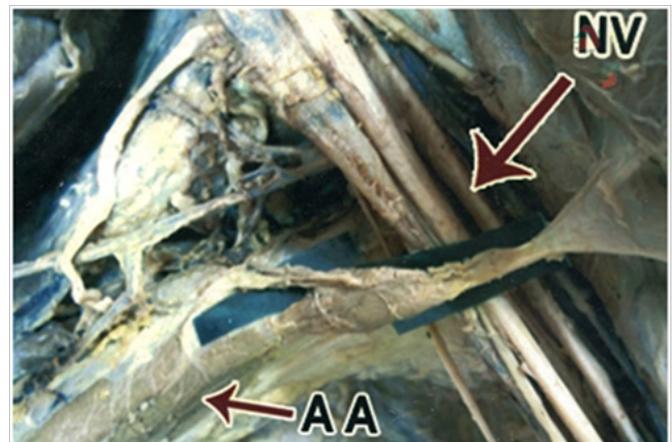
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## Introduction

The axillary arch, commonly known as the ‘axillary arch of Langer’, was first described in 1846 by Langer’ser Achselbogen as a muscular or musculo-tendinous arch from the anterior axillary portion of latissimus dorsi muscle extending across the neurovascular bundle of the axilla to the trilaminar tendon of pectoralis major muscle.<sup>1</sup> This arch is an atavistic anomaly in the axillary region and is also described by few authors as chondro-epitrochlearis when it extends from the pectoralis major muscle to the medial epicondyle.<sup>2</sup> In either case the arch is always found to exist over the axillary vessels and nerves and therefore it assumes profound surgical significance. The proximity of the arch to brachial plexus, axillary vessels and the lateral lymphatics of the axilla needs to be acknowledged as compression of these structures can result in axillary vein thrombosis, neurological deficits and lymphoedema.<sup>3</sup> The arch is usually fusiform in shape and is believed to be a remnant of panniculus carnosus muscle which a subcutaneous muscular sheet well developed in lower mammals such as cats.<sup>4</sup> The surgical implications of the arch are due to its position in the axilla which often becomes a hindrance to a surgeon operating in the vicinity. A surgeon operating a case of breast cancer can face difficulty in clearing lateral axillary lymph nodes due to the presence of the arch and inadequate clearance can lead to cancer recurrence and post surgical lymphoedema.<sup>5</sup> A muscular arch extending from the lower border of latissimus dorsi muscle to the trilaminar tendon of pectoralis major muscle is shown in Figure 1. The figure clearly depicts the arch compressing on the neuro-vascular bundle of the upper limb.<sup>6</sup> This article is a review that describes the variations of the axillary arch, their embryological basis and surgical implications.



**Figure 1** Depicts an axillary arch from lower border of latissimus dorsi to pectoralis major tendon.<sup>6</sup>

## Discussion

It is essential to be familiar with the surgical anatomy of the axilla before understanding the surgical implications of the arch.

### A brief review of surgical anatomy of the axilla

Axilla is a pyramidal tent shaped portal for structures that enter the upper limb from the thorax or leave the upper limb to enter the thorax. The anterior wall of the axilla is formed by pectoralis major muscle, the posterior wall by subscapularis and latissimus dorsi muscles, the

medial wall by serratus anterior muscle and the lateral wall by the upper part of shaft of humerus. The floor is formed by the axillary fascia. The contents include the nerves and vessels that enter and leave the upper limb, the axillary lymph nodes and the axillary fat. The axillary artery, axillary, median, ulnar and radial nerves enter the upper limb while the axillary lymphatics and the axillary vein leave the upper limb to enter the thorax. The axillary artery and the nerves are enclosed in an axillary sheath which is an extension of the pre-vertebral layer of deep cervical fascia of the neck while the axillary vein lies outside the sheath. The axillary lymph nodes are arranged in groups which include the anterior, posterior, central, lateral and apical groups.<sup>7</sup> An axillary arch when present passes across the neurovascular bundle thus compressing these structures resulting in axillary vein thrombosis, nerve compression, arterial occlusion and edema of lymphatics.

### The variations of the axillary arch

Several variations of the arch have been reported by surgeons during axillary surgeries and the anatomists during cadaver dissections. The incidence of the arch varies from 0.25-7% in diverse ethnic groups. The classical variety of the arch is the one that is called the 'Axillary arch of Langer', where a muscular or musculo-tendinous slip is noted from the lower border of latissimus dorsi to the trilaminar tendinous insertion of pectoralis major muscle.<sup>8</sup> The next most common variant is the Chondro-epitrochlearis, a musculo-tendinous arch that extends from pectoralis major to medial epicondyle. This variation was described by Dovernoy.<sup>9</sup> A chondro-epitrochlearis muscle that bifurcates into an upper and lower slip with the upper slip inserted into the capsule of the shoulder joint close to the origin of long head of biceps and the lower slip into the medial epicondyle is also described.<sup>2</sup> An axillary arch which is unusually medial extending from the lower border of latissimus dorsi muscle to the coracoid process of the scapula is also described by Dharap.<sup>10</sup> In the case described by Dharap in 1993 in addition to this slip several accessory slips were also observed which included three fibrous strands extending from the arch to the pectoralis minor, short head of biceps and coracobrachialis and two muscular slips to the deep surface of teres major muscle. Innumerable accessory muscular slips arising from the ribs and costal cartilages in addition to the ones arising from the pectoralis major and latissimus dorsi muscle have been described by Dharap.<sup>10</sup> An interesting case of bilateral chondro-epitrochlearis muscle with contracture was reported in a seventeen year old Chinese boy. The contracture restricted the abduction of arm and this interfered with playing and exercise. The condition was present since birth and was later corrected surgically.<sup>11</sup> A unique case was reported where both the 'Axillary arch of Langer' and the 'chondroepitrochlearis' were observed in the same axilla. The 'Axillary arch of Langer' originated from the latissimus dorsi muscle, while the 'chondroepitrochlearis' originated from the pectoralis major muscle and both the muscular slips crossed over the axillary neurovascular bundle and had a common insertion into the lateral lip of inter-tubercular sulcus of the humerus and the fascia covering the biceps brachii muscle.<sup>12</sup>

### Embryological basis

The classical variety of the arch is the 'Axillary arch of Langer' where a single slip is observed from the latissimus dorsi muscle to pectoralis major muscle and this is believed to be a remnant of panniculus carnosus muscle which is a subcutaneous muscular sheet well developed in lower mammals.<sup>4</sup> In case of chondro-epitrochlearis muscle, Perrin<sup>13</sup> believed that it is homologous with 'extensor plicae alaris' of birds.<sup>13</sup> However it was then observed that these muscles in birds being extensors were innervated by the posterior division of brachial plexus,<sup>14</sup> while the chondro-epitrochlearis belonging to flexor

group was innervated by the anterior division of brachial plexus.<sup>15</sup> The most appropriate embryological explanation was provided by Steinbach who ascribed chondro-epitrochlearis to be an atavistic anomaly representing distal insertion of pectoralis major in quadruped mammals.<sup>16</sup> In mammals the pectoralis major muscle is inserted lower down the humerus to the medial epicondyle while the minor is attached to its upper end. During evolution, as a hominid assumes a standing posture, this insertion of pectoralis major muscle shifts upwards to the lateral lip of inter-tubercular sulcus and the pectoralis minor muscle shifts to the coracoid process. During this shift the lower fibres of pectoralis major get twisted.<sup>17</sup> Steinbach explained that the chondro-epitrochlearis muscle represents the preserved distal fibres of pectoralis major muscle that have failed to shift during embryogenesis. This view is further strengthened by Landry<sup>2</sup> who noted that twisting of pectoralis major was absent in those clinical cases associated with presence of chondro-epitrochlearis muscle.<sup>2</sup> In most of the cases of axillary arch it is observed that the arches are supplied by medial pectoral nerve which ascribes their origin to pectoral group of muscles.<sup>18</sup> The axillary arch of Langer and the chondro-epitrochlearis were found to have a common nerve supply in most of the cases.<sup>19</sup> In some cases like the case reported by Dharap<sup>10</sup> in 1993 several accessory muscular slips and fibrous strands were observed. This is believed to be due to events occurring in phase 3 and phase 4 of ontogenesis of muscles in the axilla. During embryogenesis several muscle primordia fuse to form a single muscular sheet which then undergoes apoptosis. Sometimes complete apoptosis at some places fails to occur resulting in persistence of some muscles in that region that fuse with connective tissue formed in phase 4 resulting in multiple musculo-tendinous arches.<sup>20</sup>

### Surgical implications of axillary arch

The presence of an axillary arch can result in hyper abduction syndrome characterized by compression of axillary artery, vein and the nerves. Axilla is a region of hyper dynamic blood flow and muscular or fibrous slips in the region compressing on the blood vessels can lead to stasis of blood flow favoring thrombosis and subsequent thromboembolism.<sup>3</sup> An axillary arch can compress upon the lateral axillary lymphatics and restrict their removal during axillary surgeries for breast cancer thus increasing the risk of recurrence of carcinoma.<sup>5</sup> Breast reconstruction surgeries involve the use of latissimus dorsi myocutaneous flaps and once the flap is raised the pedicle is rotated and presence of a musculo-tendinous arch in such cases can result in axillary vein entrapment syndromes resulting in postoperative lymphoedema of the upper limb. The anterior margin of latissimus dorsi muscle constitutes the lateral margin of dissection in axillary surgeries and in the presence of a musculo-tendinous arch the surgeon can get confused regarding the placement of the incision. This can lead the surgeon to a level above the axillary vein which increases the chances of damage to the axillary sheath as a level below the vein is usually more favorable. Management of a case of axillary arch essentially consists of surgical division of the muscular slip and other accessory slips and fibrous strands. During the surgery the incision is placed along the anterior margin of latissimus dorsi and this is followed by division of the clavipectoral fascia. The axillary contents are then accessed from a level below the axillary vein to prevent damage to the axillary sheath followed by division of the arch.<sup>8</sup> In cases of axillary contractures due to the arch early surgical excision of the arch is suggested followed by physiotherapy to prevent scarring.<sup>11</sup> The presence of an axillary arch needs to be considered in differential diagnosis of axillary swellings such as lipomas, ectopic breast tissue, inflammatory axillary lymph nodes, infundibular follicular cyst, nodular fibromatosis and metastatic deposits in the axillary lymph nodes.<sup>21</sup>

## Conclusion

Axillary arch is a musculo-tendinous slip observed in the axilla stretching across the axillary vessels and branches of brachial plexus. 'Axillary arch of Langer' extending from the latissimus dorsi to pectoralis major and chondro-epitrochlearis muscle extending from pectoralis major to medial epicondyle are the two most common variants described. The arch is usually supplied by the medial pectoral nerve. The Langer's arch is a remnant of panniculus carnosus muscle as described by Ruge<sup>4</sup> and the chondro-epitrochlearis is an atavistic remnant of pectoralis major muscle as described by Steinbach. The incidence of the arch varies from 0.25 to 7% in different demographic profiles. The arch has several surgical implications owing to its proximity to brachial plexus, axillary vein and axillary artery. A surgeon operating in the axillary region must be aware of this variation as it is associated with several clinical complications such as hyper abduction syndrome, contracture of the arch muscle and subsequent neuro-vascular compression, axillary vein thrombosis, lymph edema of upper limb and improper surgical clearance of axillary lymph nodes. The treatment of axillary arch involves surgical division of the arch without damaging the axillary sheath and its contents.

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## Conflict of interest

Author declares that there is no conflict of interest.

## References

1. Langer K. Zur anatomie des musculus latissimus dorsi. *Oester Med Wochenschrift*. 1846;15:16.
2. Landry SO Jr. The phylogenetic significance of the chondroepitrochlearis muscle and its accompanying pectoral abnormalities. *J Anat*. 1958;92(1):57–61.
3. Kamath VG, Shetty KR, Asif M, et al. Muscular variations in axilla, incidence, embryological & surgical significance. *International Journal of current research*. 2013;5(12):3763–3766.
4. Ruge G. Der Hauttrumpfmuskel des Menschen. *Morph Jb*. 1914;47:677–682.
5. Daniels IR, Della Rovere GQ. The axillary arch of Langer-The most common muscular variation in the axilla. *Breast Cancer Res Treat*. 2000;59(1):77–80.
6. Kamath VG, Sharada R, Kumar MRB, et al. *Axillary arch and its associated complications*. 58th National Conference of Anatomical Society of India. India; 2010.
7. Standring S. *Gray's Anatomy: The Anatomical Basis of Clinical Practice*. 39th ed. London: Churchill Livingstone; 2005. p. 1474–1492.
8. Serpell JW, Baum M. Significance of 'Langer's axillary arch' in axillary dissections. *Aust NZJ Surg*. 1991;61(4):310–312.
9. Duvernoy M. Des caracteres anatomiques de grands singes pseudoanthropomorphes anthropomorphes. *Arch Mus Nat Hist Nat Paris*. 1855;8:1–248.
10. Dharap A. An unusually medial axillary arch. *J Anat*. 1994;184(Pt 3):639–641.
11. Lin C. Contracture of the chondroepitrochlearis and the axillary arch muscles. A case report. *J Bone Joint Surg Am*. 1988;70(9):1404–1406.
12. Lama P, Potu BK, Bhat KM. Chondrohumeralis and axillary arch of Langer: a rare combination of variant muscles with unique insertion. *Rom J Morphol Embryol*. 2010;51(2):395–397.
13. Perrin JB. Notes on some variations of the pectoralis major, with its associated muscles. *J Anat Physiol*. 1971;5(Pt 2):233–420.
14. Fisher HI. Adaptations and comparative anatomy of the locomotor apparatus of the new world vultures. *Amer Midl Nat*. 1946;35:545–727.
15. Bryce TH. Note on a group of varieties of the pectoral sheet of muscle. *J Anat Physiol*. 1899;34(Pt 1):75–78.
16. Steinbach K. Uber Varietaten der Unterzungenbein-und Brustmuskulatur. *Anat Anz*. 1923;56:488–506.
17. Harris W. *The morphology of the brachial plexus with a note on the pectoral muscle and its tendon twist*. London: Oxford University Press; 1939;113:19.
18. Hollinshed WH. *Anatomy for Surgeons- The back and the limbs*. 3rd ed. Philadelphia, London: Harper and Row; 1982. 878p.
19. Chiba S, Suzuki T, Kasai T. A rare anomaly of the pectoralis major-the chondroepitrochlearis. *Okajimas. Folia Anat Jpn*. 1983;60(2–3):175–186.
20. Cihak R. Ontogenesis of the skeleton and intrinsic muscles of the human hand and foot. *Ergeb Anat Entwicklungsgesch*. 1972;46(1):5–194.
21. de Andrade JM, Marana HR, Sarmento Filho JM, et al. Differential diagnosis of axillary masses. *Tumori*. 1996;82(6):596–599.