Struthers' Ligament and Associated Median Nerve 
Variations in a Cadaveric Specimen

Stephen F. Gunther, M.D. a, Doreen DiPasquale, M.D., and 
Robert Martin, M.D.

The Department of Orthopaedic Surgery, Washington Hospital Center 
Washington, DC 
Anatomical Teaching Laboratory of the 
Uniformed Services School of Health Sciences, Bethesda, MD

(Submitted March 22, 1993; sent for revision May 19; received and accepted June 19, 1993)

A Ligament of Struthers has been identified and studied in a cadaveric arm. Its 
relationships to a rudimentary supracondylar process, the pronator teres muscle, 
the median nerve, and the medial epicondyle of the humerus are described. 
Compared to an extensively studied series of normals, the ligament in this case 
was associated with abnormally proximal branching of the median nerve, a 
finding which is surgically significant and not addressed in the literature to date.

In 1849 Struthers [1] described the supracondylar [supracondyloid] process of the 
humerus (Figure 1) as a clinically significant entity, and through ensuing publications 
[2-4], he lent his name to the ligament which usually runs from this process to the medial 
epicondyle. Descriptions of this anomaly subsequent to Struthers' reports are relatively 
few, and most describe associated clinical problems such as compression of the median 
nerve [5-8] or brachial artery, fracture of the supracondylar process [6, 8], or just an 
annoying bump [6, 9, 10]. Very little has been written about the ligament itself from 
observations of cadaveric or surgical specimens, and we can find no detailed descriptions 
of its relationships or of associated variations in median nerve branching. In this paper, 
we report a study of one instance of the Ligament of Struthers and compare the associat-
ed median nerve anatomy to a large series or normals.

MATERIALS AND METHODS

As part of a study of the internal anatomy of the median nerve in the region of the 
elbow, we carefully dissected 38 donated arms, mostly fresh frozen and a few fresh. We 
examined the gross anatomy of the median nerve and its surroundings from 25 cm above 
the elbow to 25 cm below. In twenty arms, we performed internal dissection under magni-
fication within the median nerve in order to map out the fascicular architecture. With 
the IEL a at the elbow as a zero reference, we documented the branching sites of the four 
grossly identifiable branches or branch groups, and then we compared these to the 
branching patterns which were evident after proximal microdissection of the fiber bun-
dles which made up those branches [11]. All data were recorded and sketched, and most 
specimens were photographed. Table 1 and Figure 2 list the four branch groups, the aver-
age (mean) sites at which they exit the median nerve, and their muscular destinations. 
These groups were quite consistent in the order of branching and muscle innervation, 
although there were variations in the number of nerves for each group. Branch I was usu-
ally multiple, averaging 2.2 nerves per specimen. The lower three averaged 1.2, 1.1, and

*To whom correspondence should be addressed. Washington Hospital Center, Department of 
Orthopaedic Surgery, 110 Irving Street N.W., Suite 3B-28, Washington, DC 20010.
bAbbreviations used: IEL, interepicondylar line; AIN, anterior interosseous nerve.
Table 1.

| Branch Group | Destination                  | Point of Origin | Microdissection Distance |
|--------------|------------------------------|-----------------|--------------------------|
| I            | Pronator teres               | +1.5            | 10 cm                    |
| II           | Flexor carpi radialis       | −1.5            | 0                        |
|              | Flexor dig. super. and palmaris longus |               |                          |
| III          | Anterior interosseous N.     | −3.0            | 7.5 cm                   |
| IV           | Flexor dig. super.          | −7.0            | 2 cm                     |

The four branches or branch groups from the median nerve in the region of the elbow. The mean points of branching are listed with reference to the interepicondylar line across the elbow joint. The total distances over which these branches could be dissected proximally within the epineurium of the median nerve are listed as well. There is no figure for the second branch since microdissection has shown that it almost always is comprised of fascicles from the first and third. These findings are consistent with those previous investigators [12, 13].

1.1 nerves, respectively.

In one arm, we found a Struthers' ligament associated with very proximal branching of the AIN of the median nerve. We found proximal branching of the AIN in two other specimens.

ANATOMIC FINDINGS

Specimen # 12 was the fresh frozen and thawed left arm of a sixty-eight year old woman who died of carcinoma of the lung. We were able to contact her physician, and he was confident that she had never had any problems involving the arm, especially any-
thing that could have been attributed to the median nerve. After removing the skin and superficial fascias, we noted a very proximal origin of the pronator teres muscle which was unique among the specimens studied in that the muscle arose from the full length of a well-defined fibrous band of four or five mm thickness running diagonally from a tiny bump on the anteromedial surface of the humerus to the anterior aspect of the medial epicondyle. The epicondylar insertion of the ligament was fan-shaped and distinctly different from the attachment of the medial intermuscular septum which was approximately 1 cm posterior (Figure 3A and B). The bump, a minimal form of supracondylar process, was approximately 5 cm above the IEL and was raised no more than 1 mm from the surface of the bone. Our other dissections showed that the pronator teres muscle usually arises from an aponeurosis which originates on the medial epicondyle and from the aponeurotic covering of the adjacent flexor carpi radialis for at least 12 cm of its length. This held true to Specimen # 12 in addition to the aberrant origin. When we detached the ligament from the supracondylar process and folded it back medially, we could see that the median nerve and brachial artery proceeded on their usual course into the forearm. There was no suggestion of nerve compression.

Dissection revealed that the nerves to the pronator teres and the AIN, usually branches I and III, separated from the median nerve 3.0 cm above the IEL (Figure 3C). The AIN was actually the second branch, not the third, as was the case in most other specimens. Under magnification, the fiber bundles [groups of fascicles] making up the AIN could be dissected intact to 7.0 cm above the IEL, making a total dissection distance of 4.0 cm. The comparable figures for all twenty microdissected specimens were 3.0 cm below the IEL for the gross branching point of the AIN and 7.5 cm for the microdissection distance. There was only one nerve branch to the pronator teres, and this came off 3 cm above the IEL at the same level as the AIN. The median nerve passed under the Ligament of Struthers near its attachment to the supracondylar process.

Specimen # 13 was the right arm of the same woman. There clearly was neither a

Figure 2. Using the IEL across the elbow as zero, the branching points of Specimen # 12 (left) are compared to the means from 37 normals (right). The most remarkable difference is in the branch point of the anterior interosseous nerve.
Figure 3. A. A photograph of Specimen #12. A Ligament of Struthers is seen between the paper arrow and the hemostat. The ruler is marked in 1 cm increments, beginning at the IEL.
B. A sketch which corresponds to Figure 3A.

1. Struthers' Ligament
2. Medial epicondyle of the humerus
3. Median nerve
4. Medial intermuscular septum
5. Normal contour of the pronator teres muscle
6. Pr. T. - pronator teres
7. FCR - flexor carpi radialis

C. The four nerve branches separate from the median nerve more proximally than usual and branches II and III are reversed in order. The branching point of the anterior interosseous nerve is a full 6 centimeters higher than normal (see Table 1 and Figure 2) The relationship of these branches to the Ligament of Struthers is shown.
supracondylar process nor a Struthers' ligament. Like the opposite side, however, the
gross branching point of the AIN was more proximal than normal at 4 cm above the IEL.
It could be further dissected to 8 cm, making the total dissection distance only 4.0 cm
again. There was no abnormality of the pronator teres muscle which took origin from the
medial epicondyle.

There was only one other specimen in which the AIN came off above the IEL. That
was the arm of a forty-two year old man in which the pronator teres muscle originated
from the medial intermuscular septum 2 cm above the medial epicondyle, the nerve to the
pronator [I] came off at + 4.5 cm, and the AIN [III] came off at + 2 cm. As in Specimen
#13, nerve branch II was missing on gross dissection, but microdissection revealed that it
was constituted from branches supplied by I and III.

All other specimens had normal configuration of the pronator teres muscle, lower
origins of the nerve branch I, and considerable lower origins of the AIN.

DISCUSSION

The precise incidence of the supracondylar process and the Ligament of Struthers is
not known, but they probably occur in less than two percent of humans. In 1921, Terry
performed manual examination of one thousand patients in the clinics of Washington
University Hospital in St. Louis, and he found a palpable supracondylar process in 0.7% [14]. He estimated that he could discern a process of 4 mm or more from the surface of
the humerus. However, he was aware from his own observations of skeletons and from
reports of observations from others that smaller bone excrescences existed and that the
true incidence of the anomaly must be over 1%.

It appears that the supracondylar process is usually unilateral as a clinically obvious
entity, but bilateral occurrence is known [4, 5, 10], and the two processes may be of dif-
ferent sizes [4, 15]. The process seems to be a homologue of a bony arch found in the
same location on the humeri of cats, certain monkeys, and some other animals [5, 10, 16],
the arch creating a foramen through which the median nerve and brachial artery pass.
Struthers [3, 4], and even earlier investigators, were aware of this. The supracondylar
process usually is associated with a Struthers' ligament, but not always [7]. The ligament
may be a vestige of the tendon of the latissimo-condyloides, a muscle which extends
from the humeral attachment of the latissimus dorsi to the medial epicondyle in certain
climbing animals [5].

Very few authors have described the ligament itself, and most texts of anatomy omit
the ligament when describing the supracondylar process. There are several published
observations of the pronator teres muscle taking origin from the ligament, the supra-
condylar process, or both [3–6, 10, 17]. It is the suspicion of the authors that the ligament
always serves as an origin of the muscle. Smith and Fisher [7] reported a case of obvious
compression of a swollen median nerve by a Ligament of Struthers which originated on
the humerus in the absence of any bony process, and they claimed that this was the first
such report since that of Struthers in 1881. It is tempting to conclude that their finding
was similar to ours, but they made no mention of the relationship of the ligament to the
pronator teres muscle. They might well have failed to appreciate a minimal excrescence
of bone representing the supracondylar process, since they did not have the same liberty
of unlimited dissection in their surgical case as we had in our cadaver study. In fact, it
was in his 1854 paper [3] that Struthers described a single example of a well-formed liga-
ment arising from a minimal ridge on the humerus rather than a developed supracondylar
process. The pronator teres originated from the ligament.

We have been unable to find a detailed description, a photograph, or an accurate
sketch of either a cadaver or surgical specimen such as we have presented here. We have
found that the ligament can exist in the absence of a real supracondylar process, that it
originates from the anteromedial humeral surface approximately 5 cm above the IEL of the elbow, that it extends to the anterior part of the medial epicondyle where its fan-like insertion is clearly separate from the more superior and posterior insertion of the medial intermuscular septum, that it can give origin to an anomalous proximal portion of the pronator muscle which can cover the whole length of the ligament, and that the median nerve passes under the most proximal and humeral portion of the ligament close to where a supracondylar process would be. As we have described, this information can be found in bits and pieces in various accounts, but not as a composite description. In addition, we can find no mention in the literature of median nerve branching as it pertains to the Ligament of Struthers.

Within the population of humans who have this anomaly, the incidence of clinical trouble in the way of nerve or artery compression is unknown, but it must be very low. The supracondylar process is most often found inadvertently on x-rays taken for other reasons, and there is no reason to remove it in the absence of clinical signs. Likewise, the Ligament of Struthers must be harmless in the vast majority of instances, and it should not automatically be assumed that it is the cause of symptoms if it is found during exploration of a median nerve which shows signs of neuropathy.

When there is suspected median nerve compression but the site is unknown, surgical exploration above the elbow is usually done retrograde, distal to proximal. The surgeon should be aware that the Ligament of Struthers can exist without a palpable supracondylar process, that the ligament may be covered by a large, anomalous origin of the pronator teres muscle, and that there may be very high branching of the upper three median nerve branch groups, especially the anterior interosseous nerve. The unsuspecting surgeon could damage these branches during dissection.

REFERENCES
1. Struthers, J. On a peculiarity of the humerus and humeral artery. Monthly J. Med. Science 9:260–267, 1849.
2. Struthers, J. On some points in the abnormal anatomy of the arm. Brit. For. M. Chir. Rev. 13:407–415, 1854.
3. Struthers, J. On some points in the abnormal anatomy of the arm. Brit. For. M. Chir. Rev. 14:170–179, 1854.
4. Struthers, J. On the processus supracondyloideus humeri of man. Trans. Int. Med. Congr. London 1:148–151, 1881.
5. Kessel, L. and Rang, M. Supracondylar spur of the humerus. J. Bone Joint Surg. 48-B:765–769, 1966.
6. Barnard, L. and McCoy, S. The supracondyloid process of the humerus. J. Bone Joint Surg. 28:845–850, 1946.
7. Smith, R. and Fisher, R. Struthers' Ligament: A source of median nerve compression above the elbow. J. Neurosurg. 38:778–779, 1973.
8. Newman, A. The supracondylar process and its fracture. Am. J. Roentgenol. 105:844–849, 1969.
9. Mandruzzato, F. Patologia é chirurgia del processo sopra epitrocleare dell’omera. Chir. d’Org. di Movimento 24:123–132, 1938.
10. Witt, C. The supracondyloid process of the humerus. J. Missouri Med. Assn. 47:445–446, 1950.
11. Gunther, S., DiPasquale, D., and Martin, R. The internal anatomy of the median nerve in the region of the elbow. J. Hand Surg. 17:648–656, 1992.
12. Linell, E. The distribution of nerves in the upper limb with reference to variabilities and their clinical significance. J. Anat. London 55:79–112, 1921.
13. Sunderland, S. and Ray, L. Metrical and non-metrical features of the muscular branches of the median nerve. J. Comp. Neuro. 85:191–203, 1946.
14. Terry, R. A study of the supracondylloid process in the living. Am. J. Phys. Anthrop. 4:129–139, 1921.
15. Grant, J. Grant’s Atlas of Anatomy. Fifth Edition, Baltimore, Williams & Wilkins. 1962, 545.
16. Marquis, J., Bruwer, A., and Keith, H. Supracondyloid process of the humerus. Staff Mtg. Mayo Clinic 32:691–697, 1957.
17. Hollinshead, W. Anatomy for Surgeons. Vol. 3, Third Edition. New York, Harper and Row. 1982, 345–346.