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Osborne's ligament: a cadaveric study and literature review

Abstract

First described in 1957 by Dr Geoffrey Osborne, the Osborne ligament is defined as a band of tissue that connects the two heads of the flexor carpi ulnaris, which forms the roof of the cubital tunnel, between the medial epicondyle and the olecranon. We retrieved data from 16 elbows of 8 cadavers, measuring the length of the Osborne's ligament in both maximum extension and in 90º flexion. Using this data, we managed to compare the differences between the left and right arm and also between male and female specimens.

Our goal was to find statistically significant differences between the variables: males vs females; right vs left elbow; flexion vs extension. To our knowledge, no prior study has compared the length of this ligament between both elbows.

Keywords: female specimens, 8 cadavers, maximum extension, maximum extension, maximum extension

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Introduction

The ulnar nerve can be compressed in many zones of its trajectory, resulting in a neuropathy commonly known as Cubital Tunnel Syndrome, which is the second most common compression neuropathy in the upper extremity.[1]

Dr Geoffrey V. Osborne described a band of fibrous tissue spanning the ulnar and humeral heads of the flexor carpi ulnaris (FCU) muscle, below which was the cubital tunnel. The other limits of this tunnel are the medial collateral ligament, olecranon, and the capsule of the joint.[2–4]

The Osborne's ligament is one of the main causes of CTS, related to the narrowing of the cubital tunnel upon flexion of the elbow, with the resultant increase in cubital tunnel pressure.[1,5,6]

In a paper O'Driscoll et al.[5] described the roof of the tunnel as the cubital tunnel retinaculum (CTR), which was then classified in four types: 0 – Absent CTR; Dislocated ulnar nerve. Ia – Thin CTR; Taut in full flexion; No compression. Ib – Pathologically thick CTR; Taut between 90º - 120º flexion; Dynamic compression. II – CTR replaced by anconeus epitrochlearis; Static compression. These authors also correlated this types of CTR with clinical disease.

Review of literature suggests that males and the left side are more affected and that the pathology is bilateral in 18.6-38.8% of the cases.[7] To explore this particularity in the incidence, we decided to compare the length of the ligament in extension and flexion on both male and female cadavers and in both elbows of the same specimen.

Materials and methods

A total of 16 elbows from 8 cadavers (4 male and 4 female) were used. All of them were for anatomy studying in the Faculdade de Medicina da Universidade do Porto (Table 1). The ages ranged from 58 to 85 years (mean age (SD) of 72,1 (9,7) years old).

The cadavers were chosen after dissection by medical residents in a dissection course in December 2017. The medial side of the elbow was dissected with identification of both origins of FCU, the most prominent point of the medial epicondyle and the Osborne ligament, which, was then classified by the O'Driscoll classification. The anterior/medial margin of the ulnar attachment, and the posterior/lateral margin of the humeral attachment of the FCU muscle were marked by a 0.5x16mm needle (Figure 1 & 2), and the distance between the two needles was measured using a milimetric ruled provided by the anatomists in both maximum extension and 90º flexion. Since we used a milimetric ruler, we decided to round down the in-between results.

Figure 1 The anterior margin of the ulnar attachment.

Statistical analysis was performed using SPSS 26.0®. Normality of variables was assessed through histogram evaluation and Kolmogorov-Smirnov test. Mean comparisons were performed using paired samples t-test, independent-samples t-test when normality was observed; Statistical significance was considered for p-values <0,05. All discriminated measures are shown in Table 1–4.

Figure 2 The medial margin of the ulnar attachment.

Results

Based on O'Driscoll's classification, we identified one ligament as type 0, ten as type Ia, four as type Ib and none as type II (Table 1). The male group had average superior values of length than the female group: Average +1.375mm in the extension measures and 2.75mm in the flexion measures. There was also a variance when we compared the right arms with the left ones, with the right member having a 2 mm average difference in flexion and a 0.875mm superiority in extension.

We did find an increase of the length of the ligament from extension to flexion, as expected. The mean increase of the length from extension to flexion in the left elbows was 6.25 mm and on the right elbows of 7.375mm. When comparing male with females, the first group showed an average increase of 7.5 mm, in contrast with the 6.125mm increase observed in the female group. The percentage of increase from flexion to extension was also calculated, with the females presenting a 34.03% increase in the ligament's length from extension to flexion; the males a 38.71% increase in the same parameters. When comparing sides, the right elbows showed a 38.56% increase in length, in contrast with the 34.25% of the left members.

Table 1 O'Driscoll's classification of ligaments

Cadaver number	Sex	Age (y.o.)	Length (mm)				O'Driscoll classification	
			Left		Right		Left	Right
			Flexion	Extension	Flexion	Extension		
43	M	71	25	19	28	18	Ia	Ia
49	F	63	19	12	23	15	Ia	Ia
13	F	84	29	21	24	20	0	0
30	M	72	25	18	27	17	Ia	Ib
21	M	85	21	19	31	21	Ib	Ia
22	M	78	31	22	27	21	Ib	Ia
26	F	66	23	15	28	22	Ia	Ib
48	F	58	23	20	24	19	Ia	Ia
Average		72.125	24.5	18.25	26.5	19.125		
Standard deviation			3.7081	3.072	2.5	2.356602		

Table 2 Showing the standard deviation of female

Females	Length			
	Left		Right	
	Flexion	Extension	Flexion	Extension
49	19	12	23	15
13	29	21	24	20
26	23	15	28	22
48	23	20	24	19
Average	23.5	17	24.75	19
Standard deviation	3.5707	3.6742	1.9202	2.9439

Table 3 Showing the standard deviation of male

Males	Length			
	Left		Right	
	Flexion	Extension	Flexion	Extension
43	25	19	28	18
30	25	18	27	17
21	21	19	31	21
22	31	22	27	21
Average	25.5	19.5	28.25	19.25
Standard deviation	3.5707	1.7321	1.6394	2.0616

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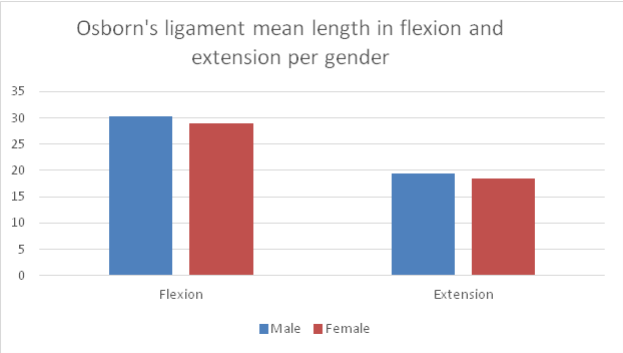
Table 4 Difference in standard deviation between male & female

	Female	Male	Right	Left
Average in Flexion	24.125	26.875	26.5	24.5
Average in Extension	18	19.375	19.125	18.25
E-F Difference	6.125	7.5	7.375	6.25
Increase E-F Percentage (%)	34.03	38.71	38.56	34.25

Osborn's ligament mean length (SD) was 29,6 (3,5) in flexion and 18,9 (3,0) in extension (paired samples t-test p<0,001); no significant differences were found between male and female (independent samples t-test p=0,405 in flexion, p=0,526 in extension). Also, no significant differences were found between left and right elbows (independent samples t-test p=0,262 in flexion, p=0,750 in extension) (Graph 1).



Graph 1 Osborn's ligament mean length in flexion and extension per gender.

Discussion

Cubital tunnel syndrome is a frequent entrapment pathology, only matched in frequency by the carpal tunnel syndrome. The name given to the roof of this tunnel has varied throughout literature, with the most commonly used being Osborne's ligament.[8,9]

There has been documented the innumerous factors contributing to this disease, as the ligament morphology, the stretching of the ligament and the narrowing of the tunnel when the elbow is flexed.[5–7,9,10] The flexion of the elbow causes the tightening of the ligament, allowing the capsule to protrude into the tunnel thus increasing the internal pressure of the tunnel.[5,9,10]

Many previous studies explored the correlation between elbow flexion and the changes in ligament length. Vanderpool et al.[11] examined 18 limbs from cadavers, describing a 5mm increase of length by every 45º of flexion and a 40% lengthening from extension to full flexion.

Apfelberg et al.[12] reported an increase in the distance between the two ends of the ligament (medial epicondyle – olecranon) of approximately 10mm when the elbow was flexed. Schuind et al.[13] described an increase of 45% of the ligament's length from extension to full flexion. Kei Yamada et al.[6] examined the change in length of the ligament with elbow flexion at different angles, coming to the conclusion that the length increased by 52.3% at elbow flexion angles from 20º to 140º and that the ligament's elongation increased more gradually after 90º flexion than before.6 Also in accordance with this last point was a study from Macnicol et al.[14] which reported a higher increase in the internal pressure of the tunnel at flexion angles above 90º than with lesser degrees of flexion.

The epidemiology of the disease and complaints[7] was our main driving force in this study, by comparing female with male gender, and the right and left elbows. One point we wished to correlate with the measures was the hand dominance, unfortunately the faculty had no records of such particularities. We did find larger ligaments and increases in males, but the same does not apply to the left elbows we observed.

The clinical importance of the Osborne's ligament is well documented, particularly in the ulnar nerve palsy.[1–3,5,7,9,11,15,16] A 2015 study aimed to introduce the "Scratch Collapse Test" as a diagnostic tool to evaluate patients with cubital tunnel syndrome by evaluating five sites of ulnar nerve compression: Arcade of Struthers, cubital tunnel retinaculum, Osborne's ligament, volar antebrachial fascia and the edge of the hypothenar muscles.[15] The surgical release of the ulnar nerve in the elbow, more specifically, the excision of the Osborne ligament to decompress the ulnar nerve is widely performed.[16]

Our study had limitations: the attachment sites of the ligament were hard to identify and were susceptible to interobserver bias; different preservation conditions on the different specimens; dissection of the different specimens was performed by different individuals, and thus the degrees of dissection were different; possible different angles of maximum extension due to cadaveric rigidity; limited clinical application.

Conclusion

We dissected a total of 16 elbows, 8 female and 8 male, and measured the length of the Osborne's ligament in 90º flexion and on full extension. We compared the results between males and females and also from left and right arms. As expected males had average superior ligament's length when compared with females, but the percentage of increase wasn't statistically relevant (34.03% vs 38.71%). The side's comparison showed similar discrepancies, as the lengths were superior in the right arms, and more relevant than that, was the percentage of ligament's length increase in the right members when compared to the left side (38.56% vs 34.25%). The relationship between length of the ligament and tension on the canal is well established. Our study results matched the epidemiology in the comparison between male and female, but did not confirm the left side predominance.

Cadaveric studies are particularly important as they alert surgeons for the variability and exceptions that we might find in our daily practice. There would be interest in finding a correlation between the hand dominance and the length/elongation of the Osborne's ligament.

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Conflicts of interest

The authors declare there are no conflicts of interest.

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