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ENTHESES OF THE LATISSIMUS DORSI TENDON AND PREVALENCE OF THE ARCH OF LANGER: A MORPHOMETRIC ANATOMICAL STUDY OF NIGERIAN CADAVERS

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ABSTRACT
Studies on quantitative morphometry of the Latissimus dorsi muscle and its tendon of insertion in black cadavers are few, and not much is available in the literature concerning its relationship with the arch of langer when this anatomical variant is present. The purpose of this study was to determine the insertion characteristic of the Latissimus dorsi muscle and document incidence of the arch of Langer in Nigeria. Mean width of the latissimus tendon was 2.70cm at its point of insertion, and mean length was 7.32cm. Levene's test for equality of variance and independent sample t-test were done separately to determine significant difference between the width, and the length of right and left specimen position of the cadavers from the two universities. The result indicates that there was no significant difference between the width of the right specimen position [M=2.77, SD = 0.43] and the left specimen position [M = 2.63, SD = 0.58] across the two universities in Nigeria. t[26] = 0.914, p = .366, Hedges' g = 0.253039 [this indicates a small effect size implying that the magnitude of the difference is small]. We observed in all specimens, fascial connections between the latissimus and teres major and 2 insertional patterns of insertion with respect to the tendon of the teres major. No arch of langer was found in our series. Our results will be useful for specialist surgeons considering mastectomy, chest, rotatotor cuff and face reconstruction procedures.

KEYWORDS: Latissimus dorsi tendon, arch of Langer, morphometry, insertion footprint.

INTRODUCTION
The latissimus dorsi is part of the musculoskeletal axis of support for the head and trunk and direct involvement of it's tendon has been linked to activity related enthesopathies.[1-3]

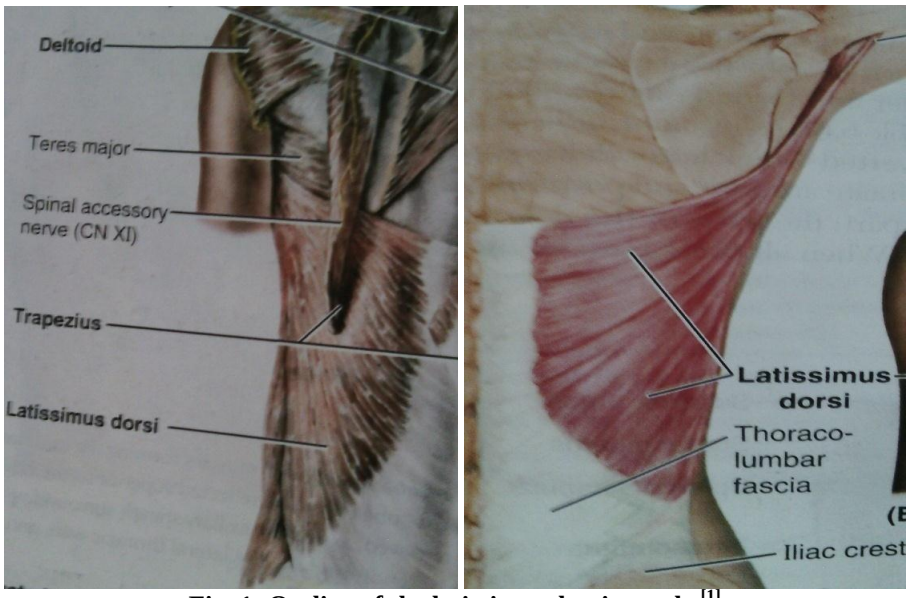

Fig. 1: Outline of the latissimus dorsi muscle.[1]

The muscle is commonly considered the best choice in cosmetic and plastic reconstructive Surgeons.[4] However the muscle, in particular it's foot print of insertion has not been studied in Nigeria.

ARCH OF LANGER

Langer's axillary arch when present is usually unilateral, without a side preference, and is rarely bilateral. It arises as a musculotendinous slip, varying in size from from 7-10 cm in length and 0.5–1.5 cm in width, extending from the anterior border of the latissimus dorsi muscle, both from the muscle and the tendon, has been observed to be more frequent in females and with significant differences in the prevalence of neurovascular compression symptoms from 1.7% (Turkish population) to 43.8% (Chinese population).[4]

A secondary purpose of this study was to document the occurence rate of the arch of langer among Nigerians and explore it's relationship with the latissimus dorsi muscle and the radial nerve. It is believed that many of the symptoms associated with this anomaly when present can be relieved by division of the muscle. However, there is paucity of information in Anatomy and Medical journals regarding this anatomical variant.

MATERIALS AND METHOD

We performed a careful anatomical dissection of the upper scapulo axillary region on 48 specimina from 24 embalmed cadavers at the University of Portharcourt in Rivers State and the Niger Delta University in Bayelsa State. Dissections were performed as outlined in Cunningham's manual of practical anatomy.[6-8]

After obtaining institutional approval, we dissected the pecto axillary region following standard laboratory dissection protocols and measured the width and length of the latissimus dorsi tendon of insertion using an electronic vernier caliper, with a precision= 0.1mm. We also carried out a thorough search for the anatomical Arch of Langer.

Presence or absence of ipsilateral tendinous or fascial connections between the latissimus dorsi and other muscles around the shoulder region were noted.

RESULTS

Mean width of the latissimus dorsi tendon at its point of insertion was 2.7cm and its mean length was 7.32cm (Table 1). Fascial connections were seen between the muscle bellies of the latissimus dorsi and teres major in all specimens (Figure 1).

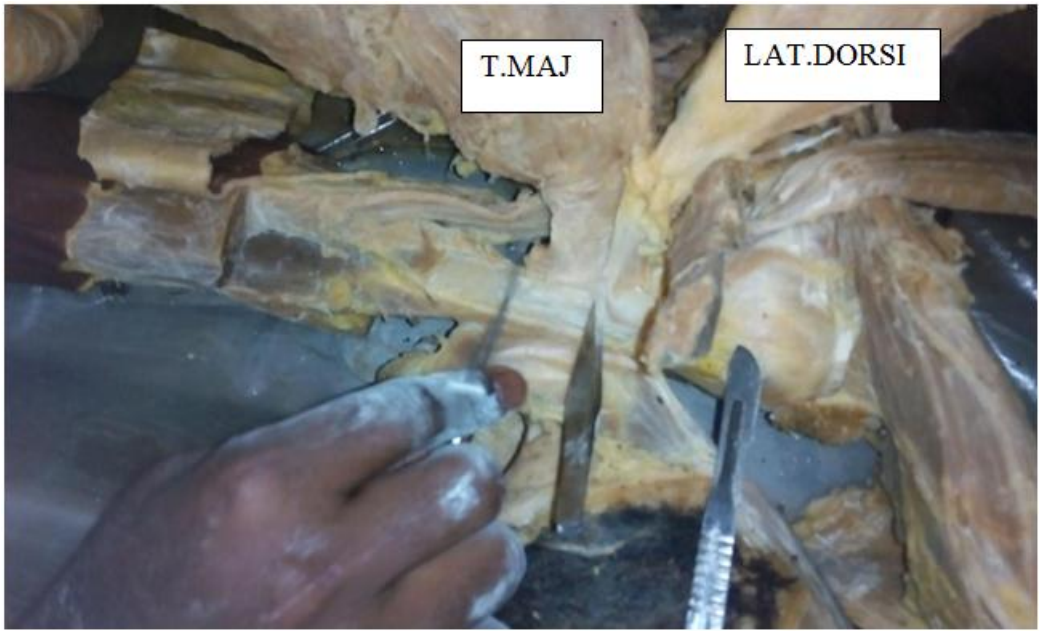

Fig. 2: Dissection showing very close fascial connection between latissimus dorsi and teres major muscle.

Table 1: Measurement of Latissimus Dorsi Tendon.

S/N	SCHOOL	SPECIMEN POSITION	WIDTH (CM)	LENGTH (CM)
1	UNIPORT	RIGHT	2.27	8.30
2	UNIPORT	LEFT	3.05	8.13
3	UNIPORT	RIGHT	2.55	8.17
4	UNIPORT	LEFT	2.47	8.30
5	UNIPORT	RIGHT	2.93	8.55
6	UNIPORT	LEFT	3.34	7.74
7	UNIPORT	RIGHT	3.44	3.13
8	UNIPORT	LEFT	3.63	7.97

9	UNIPORT	RIGHT	2.77	5.68
10	UNIPORT	LEFT	3.21	8.14
11	UNIPORT	RIGHT	3.75	7.26
12	UNIPORT	LEFT	3.50	7.34
13	UNIPORT	RIGHT	2.94	8.23
14	UNIPORT	LEFT	2.14	7.82
15	UNIPORT	RIGHT	2.38	5.84
16	UNIPORT	LEFT	3.80	7.66
17	UNIPORT	RIGHT	3.51	6.47
18	UNIPORT	LEFT	2.87	8.05
19	UNIPORT	RIGHT	3.17	6.99
20	UNIPORT	LEFT	2.94	8.22
21	N.D.U	RIGHT	2.88	6.45
22	N.D.U	LEFT	2.14	7.42
23	N.D.U	RIGHT	2.53	5.71
24	N.D.U	LEFT	2.08	8.83
25	N.D.U	RIGHT	1.88	6.36
26	N.D.U	LEFT	1.86	7.99
27	N.D.U	RIGHT	2.57	7.37
28	N.D.U	LEFT	2.59	7.77
29	N.D.U	RIGHT	2.54	6.94
30	N.D.U	LEFT	2.27	8.56
31	N.D.U	RIGHT	2.40	7.45
32	N.D.U	LEFT	2.60	7.86
33	N.D.U	RIGHT	2.71	6.08
34	N.D.U	LEFT	2.11	8.13
35	N.D.U	RIGHT	2.21	6.04
36	N.D.U	LEFT	1.97	8.41
37	N.D.U	RIGHT	2.38	6.41
38	N.D.U	LEFT	2.00	7.71
39	N.D.U	RIGHT	2.63	6.43
40	N.D.U	LEFT	2.07	7.57
41	N.D.U	RIGHT	3.01	5.25
42	N.D.U	LEFT	3.11	7.87
43	N.D.U	RIGHT	2.66	6.31
44	N.D.U	LEFT	2.74	8.35
45	N.D.U	RIGHT	3.08	7.36
46	N.D.U	LEFT	3.05	7.60
47	N.D.U	RIGHT	2.83	7.16
48	N.D.U	LEFT	2.13	7.98

Table 2: Measurement of the latissimus dorsi tenddon in the intertubercular groove.

S/N	RIGHT	LEFT
1	12.50	12.23
2	12.19	12.52
3	13.37	11.73
4	4.88	6.01
5	7.28	13.14
6	11.80	11.94
7	12.52	11.82
8	7.09	11.47
9	9.79	12.09
10	9.86	12.42
11	9.77	11.49
12	8.65	13.21
13	8.76	11.13
14	9.28	10.14
15	11.02	12.88

16	11.08	11.60
17	8.25	11.44
18	9.02	12.70
19	9.70	11.65
20	9.62	11.36
21	7.48	10.98
22	9.44	12.31
23	11.07	11.33
24	10.68	11.99

Sample Characteristics and analysis

Width

A Shapiro Wilk's test, [p > .05] and visual inspection of their histograms, Normal Q-Q plots and boxplots showed that the width were approximately normally distributed for both left and right, with a skewness of 0.398 [SE = 0.481] and kurtosis of 0.390 [SE =0.935] for the right and skewness of 0,467 [SE= 0.464] and kurtosis of -1.007 [SE =0.902] for the left.

Tests of Normality

	Specimen position	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	Df	Sig.	Statistic	df	Sig.
Width	LEFT	.177	25	.041	.924	25	.064
	RIGHT	.096	23	.200*	.976	23	.836
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

An independent sample t-test was conducted to examine the specimen position differences in width across the cadavers from the two universities. Levene's test for Equality of variance shows unequal variance between the left and right, p=0.041. The result indicates that there is no significant difference between the width of the right specimen position [M=2.77, SD = 0.43] and the left specimen position [M = 2.63, SD = 0.58] across the two universities in Nigeria. t[26] = 0.914, p = .366, Hedges' g = 0.253039 [this indicates a small effect size implying that the magnitude of the difference is small].

Length

Tests of Normality

	Specimen position	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Lenght	LEFT	.070	25	.200*	.989	25	.992
	RIGHT	.125	23	.200*	.927	23	.095

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

A Shapiro Wilk's test, [p > .05] and visual inspection of their histograms, Normal Q-Q plots and boxplots showed that the length were approximately normally distributed for both left and right, with a skewness of 0.300 [SE = 0.484] and kurtosis of -0.041 [SE =0.902] for the left and skewness of - 0,942 [SE= 0.481] and kurtosis of 2.790 [SE =0.935] for the right.

An independent sample t-test was carried out to determine if there is a difference between the length of right and left specimen position of the cadavers from the two universities. Levene's test for Equality of variance shows unequal variance between the left and right, p=0.001. The result indicates that there is a significant difference between the length of the right specimen position [M=6.59, SD = 1.14] and the left specimen position [M = 8.00, SD = 0.36] across the two universities in Nigeria. t[26] = -5.61, p = .001, Hedges' g = 1.68 which shows a magnitude in the difference in length.

Table 3: Anatomical Variations.

Relationship with other muscles	Insertional patterns	Point of insertion
None	Completely separate	Floor of intertubercular groove
Teres Major	Loosely bound (common tendinous insertion)	Floor of intertubercular groove

Fig. 3: Ddissection showing mapping or zoning of the intertubercular groove.

DISCUSSION

The result of this study showed that no variation occurred at the point of insertion i.e. all (tendons of the latissimus dorsi muscle) inserted at the groove but variations were observed in length and width and also in the pattern of insertion along the intertubercular groove.

The mean width of the tendon of insertion of the latissimus dorsi was 2.70cm and the mean length 7.32. In the current study, there were fascial connections between the muscle bellies of the latissimus dorsi and teres major in all specimens which is related to the work done by Goldberg et al,[9] in their journal titled Surgical Anatomy of Latissimus Dorsi Muscle in Transfers About the Shoulder that showed mean width to be 3.30cm and mean length to 7.30cm.

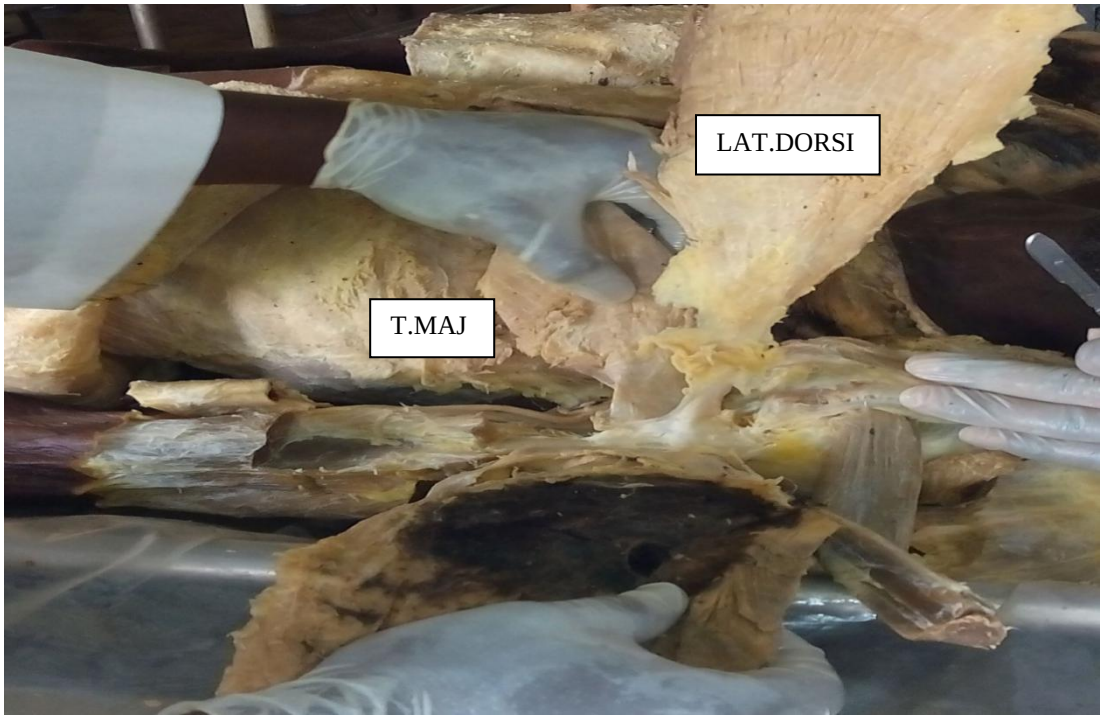

Fig.4: Dissection showing separate tendons of latissimus dorsi and teres major.

The tendons of the latissimus dorsi and teres major near their insertions were found to have two distinct patterns. The first pattern of insertion had the tendons of the two muscles completely separate from each other (Figure 3). These tendons, present in 23 (95.83%) of the specimens and can be easily separated by gentle finger dissection. The second pattern of insertion comprises a common tendinous insertion of the latissimus dorsi and teres

major tendons. This tendon, present in 1 (4.17%) of the specimens and was separated only with sharp division of fibrous connection (Table 3).[9]

We also characterized or mapped the intertubercular groove to determine specific areas were the latissimus dorsi tendon inserts. This was by dividing the groove into three (3) equal parts as shown in Fig. 2.

We measured the groove and observed the pattern of insertion. We observed that most tendons of the latissimus dorsi inserted at the middle 1/3 of the groove which gives 79.17% (about 19 cadaveric specimens) while the remaining 20.83% inserted at the lower 2/3 (about 5 cadaveric specimens) leaving none inserting at the upper 1/3 (0%). Although the latissimus dorsi inserts at the intertubercular groove it has been proven by this study that the tendon does not occupy the entire groove.

We observed a wide area of binding between the latissimus dorsi tendon with that of the teres major as observed also by Goldberg et al,[9] in which both tendons could not be completely separated from each other but were not totally conjoined and could be separated only with sharp division of fibrous connections, this probably as a result of the common relationship in embryological relationship between the two.

There was no connection between the long head of triceps and the latissimus dorsi muscle.

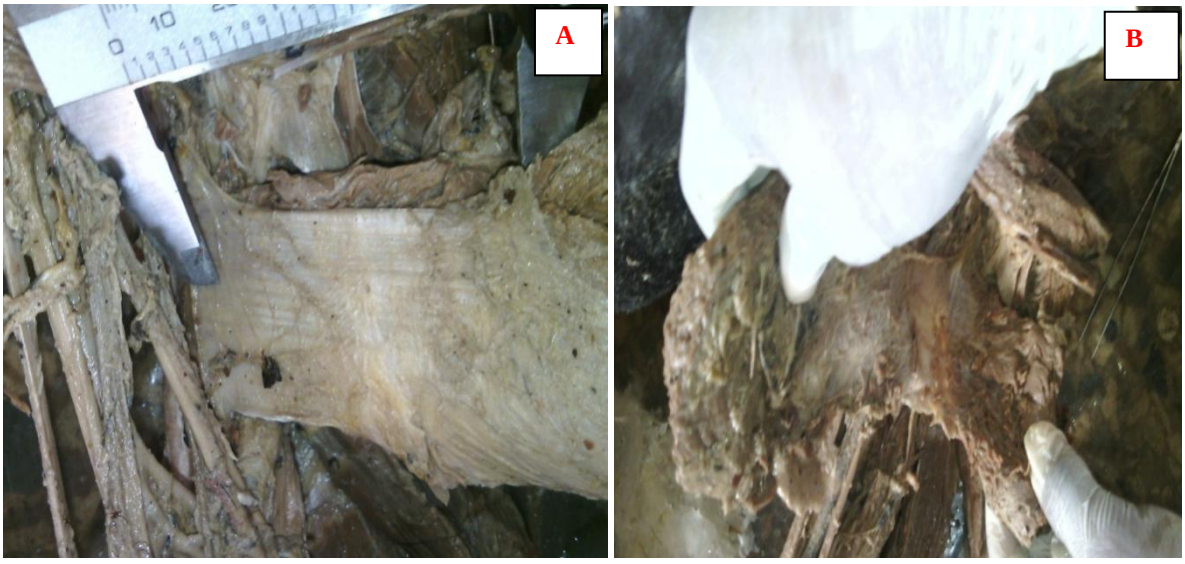

Fig. 5: A= latissimus dorsi tendon, B= bound tendons of latissimus dorsi and teres major.

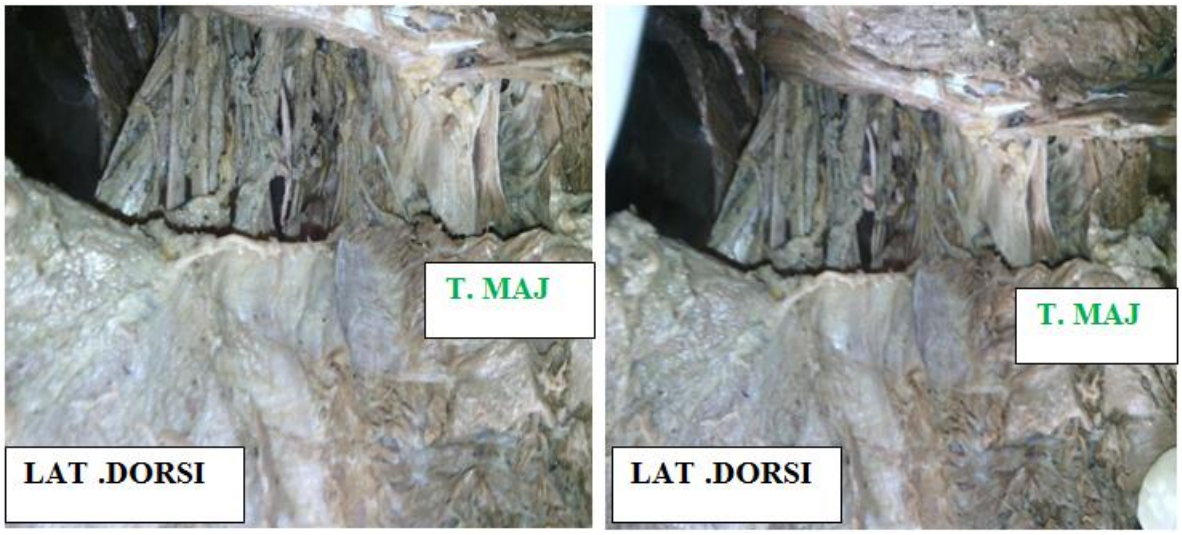

Fig. 6: Dissection showing bound tendons of the latissimus dorsi and teres major muscles.

CONCLUSION

From the results the insertion pattern of the latissimus dorsi muscle is similar to that observed in studies presented in current literature.

There were no significant variations from the common pattern at the point of insertion with regards to the muscle; all the latissimus dorsi dissected inserted at the intertubercular groove and we did not observe significant

bilateral and ipsilateral differences in the width of latissimus dorsi tendons measured.

However there were significant differences in the length of these tendons.

In addition, the latissimus dorsi tendon most frequently inserts at the middle one-third of the intertubercular groove, co-joined with the Teres major muscle. In this this study tendinous connections between the Latissimus dorsi and Long head of triceps were not seen.

The anatomical variant referred to as the arch of Langer does not appear to be a common finding in Nigerian cadavers.

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CONFLICT OF INTEREST
The authors declare that there is no Conflict of interest.

AUTHOR'S CONTRIBUTION
We write to state that both authors contributed significantly, and that all authors are in agreement with the contents of the manuscript. 'Author A' (Oyakhire M.O.) designed the study and protocol, managed the literature search protocol and examined the intellectual content and 'Author B' (Oghenemavwe L.E.) managed the research data, reviewed the design and wrote the first draft of the manuscript. Both Authors read and approved the final manuscript.

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