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Insertion anatomy of the pectoralis major tendon

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ABSTRACT

Background: Pectoralis major tendon tears are encountered in young active patients.
Methods: In 10 fresh cadaveric shoulders we measured-
1. Proximal to distal insertion width of the pectoralis major tendon.
2. The distance of the superior border of the tendon from the supero-medial tip of the greater tuberosity (GT).
Results: The average insertion width was 46 mm. The average distance between the superior border of the tendon and the tip of the GT was 48.5 mm.
Conclusion: The superior border of the tendon should be repaired with two anchors at a distance of 48.5 mm from the tip of the GT so as to cover a width of 46 mm.

1. Introduction

Pectoralis major tendon tears are an uncommon entity. They are frequently known to occur in young active patients after heavy bench-press, weightlifters and in military personnel.[1] These tears may present acutely or chronically after a prolonged period of time.[2] A complete and acute tear of the tendon can be surgically repaired at the insertion footprint with the help of suture anchors, bone tunnels or cortical buttons.[3–5] A chronic tear may have to be repaired with the help of a tendon allograft. Thus, the knowledge of the insertion anatomy on the humerus is important to restore an accurate footprint. Furthermore, pectoralis major tendon is also used for tendon transfer procedures in chronic subscapularis tendon tear and winging of Scapula due to serratus anterior palsy.[6,7] However, there have been very few reports in the literature about the insertion anatomy of the pectoralis major tendon. Furthermore, there are no reports about the details of the footprint anatomy in the Indian population. The purpose of our study was to describe the dimensions of pectoralis major tendon insertion and its distance from the supero-medial tip of the Greater tuberosity (GT).

2. Material and methods

Ten shoulders in five fresh male cadavers were dissected through the delto-pectoral approach to expose the pectoralis major tendon and its insertion on the humerus. The origin of the cadavers were from the Maharashtra region of India. Their average age was 50 years (range 40–60 years). The cadaveric shoulders had no pathology, scars or injuries on gross examination. The tendon of the pectoralis major was delineated to allow an accurate measurement of its insertion footprint on the humerus. The footprint insertion was measured from proximal to distal with the help of a vernier caliper (Fig. 1). The distance of the superior border of the tendon from the supero-medial tip of the greater tuberosity (GT) was also measured with the help of a vernier caliper.

3. Statistics

The data were reported as mean ± standard deviation (S.D.). The left and right side measurements were compared using students *t*-test and a P value less than 0.05 was considered to be significant. Data was entered in Excel spreadsheet 2011 for statistical analysis.

4. Results

The average proximal to distal width of the pectoralis major tendon was 46 mm (S.D 4.5 mm) (Table 1). The average distance between the superior border of the pectoralis major tendon and the supero-medial tip of the Greater tuberosity was 48.5 mm (S.D. 3.9 mm). The tendon inserted as a narrow strip whose medio-lateral width was too small to be measured accurately.

The left and right shoulders did not show any significant

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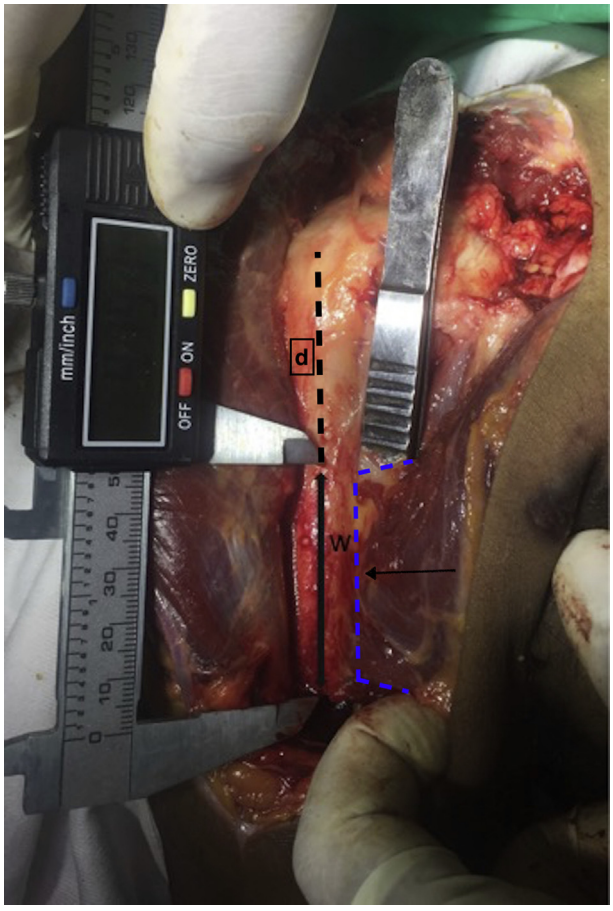

Fig. 1. Proximal to distal width (w) of the pectoralis major tendon and the distance (d) between the tip of the GT and the superior border of the tendon measured by vernier caliper.
Arrow points towards the pectoralis major tendon and dotted blue line delineates the tendon

difference for the insertion width ($p = 0.24$) and for the distance between the pectoralis major tendon to the tip of GT ($p = 0.78$).

5. Discussion

Tears of the pectoralis major tendon mostly occur at the footprint insertion during high velocity injuries or at the myotendinous junction during low velocity injuries.[2] Acute tears from the insertion site do not leave any identifiable cuff of tissue at the footprint. Chronic tears pose significant challenge as the tendon gets retracted and the footprint is not recognized easily. Although they can be treated conservatively, the preferred mode of treatment in athletic individuals and in patients with high demand activity is a surgical repair of the tear.[3–5] We wanted to study and measure the width of the pectoralis major tendon and its distance from the tip of the GT. We found that the average proximal to distal width of the tendon was 46 mm. We also found that the distance between the superior border of the tendon and the tip of the GT was 48.5 mm. This insertion anatomy should be borne in mind while repairing the tendon at its insertion footprint. An accurate reproduction of the insertion anatomy is desirable when the repair is done with bone tunnels or bone anchors. The distance from the tip of the greater tuberosity can be used as a landmark to restore the footprint of the pectoralis major tendon. Since its medio-lateral width is small, it can be accurately repaired with two suture anchors placed along the long axis of humerus within a distance of 46 mm. The proximal bone anchor should be placed such that the superior border of the tendon is at least 48.5 mm away from the greater tuberosity. Our study underscores two important factors in the pectoralis major anatomy in the Indian population. The insertion width in our study was found to be narrower as compared to the western population which can be explained by the smaller built up of the Indian population.[8] However the distance of the tendon from the tip of the GT was found to be similar.

Only three other published studies have described the pectoralis major footprint anatomy.[8–10] Carey et al. in their study in six cadavers, found that the proximal to distal footprint measurement was 72.3 mm (±12.3)[9]. This measurement was more than what we found in our study population. They also found a distance of 42.3 mm of the superior border of the tendon from the supero-medial tip of the greater tuberosity. We found this distance to be approximately similar to what we found in our study (48.5 mm). Figueiredo et al. found the average proximal to distal distance was 80.8 mm and medio-lateral width was 6.1 mm[8]. Their average distance from the top of humerus head to the superior border of pectoralis tendon was 59 mm. We studied the distance of the tendon from the tip of the GT. Since the top of the humeral head is covered with the rotator cuff tendons, we felt that the tip of the GT will be an easier and more accessible landmark intraoperatively. Fung et al. reported that there were two layers (anterior and posterior) of the pectoralis major tendon insertion (66 and 77 mm respectively).[10] Similar to Carey et al., we found that the delineation of two separate layers of the tendon was not possible.

Some authors have reported that the pectoralis major tendon twists on itself so that the most inferior fibers of the sternal head insert superiorly on the humerus.[11] However this has been not been agreed upon by other authors.[10] Superior insertion of the pectoralis major tendon is also a reliable landmark to locate and protect the anterior axillary nerve as it can be located under the deltoid muscle within a centimeter distal to the pectoralis major tendon insertion.[12]

Pectoralis major tendon insertion anatomy has to be borne in mind while harvesting the tendon for tendon transfer procedures in irreparable subscapularis tears and serratus anterior palsy.[6,7] A recent technique of pectoralis major tendon tear repair described the use of cortical endobuttons.[13] A knowledge of the insertion anatomy will avoid any complications such as posterior axillary nerve injury because a recent study described that the nerve is at risk and at close proximity when the drill is passed at the superior border of the tendon.[14] Pectoralis major tendon insertion has also been found to be an important factor in deciding the height of the

Table 1
Proximal to distal width of the pectoralis major tendon and its distance from the supero-medial tip of the GT.

s.no	width of pec major (left)in mm	width of pec major (right) in mm	distance from tip of GT (left) in mm	distance from tip of GT (right)in mm
1	46	46	48	46
2	42	42	53	55
3	42	42	49	48
4	46	48	50	50
5	50	56	43	43

humeral head prosthesis in 4-part proximal humerus fractures. Various studies have found that the distance between the top of the humeral head and the superior border of the pectoralis major is between 56 and 59 mm[15,16]. This distance has been found to be consistent and should be recreated intraoperatively during hemi-replacement of the shoulder in proximal humerus fractures. However, this was not the objective of our study. Thus we studied the distance between the tip of the GT and pectoralis major tendon, since this landmark can help us in deciding the level of the repair of the tendon.

The main limitation of our study is the low number of cadavers due to the limited availability of fresh cadavers.

6. Conclusion

The proximal to distal width of the pectoralis major tendon is 46 mm and the medio-lateral is too small to be measured. In tears of the pectoralis major tendon, the superior border of the tendon should be repaired at 48.6 mm from the tip of the GT.

Conflicts of interest

The authors report no conflict of interest.

Disclosures

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