The third osseous ambiguous tubercle - A study on Indian population

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Abstract

Background & Aim: Bony prominences on the medial side of the lower end of femur include the adductor tubercle and the medial epicondyle. A third osseous ambiguous tubercle or the Gastrocnemius tubercle is often noted about which there is not much mention in standard textbooks of Anatomy. This tubercle gives attachment to the medial head of gastrocnemius muscle. Its clinical relevance cannot be under estimated particularly in cases of treatment of rupture of medial head of gastrocnemius [Tennis leg] and while raising of Gastrocnemius flaps.

Materials and Methods: This study was conducted in 150 dry femora and in 10 dissected knee joints [Total femora 160 : 150 dry bones + 10 cadaveric femora] gross specimens. The presence of gastrocnemius tubercle, supracondylar tubercle, the distances between gastrocnemius tubercle and adductor tubercle, medial epicondyle and condylar margin were measured. Results: The incidence of gastrocnemius tubercle was 55% and was predominantly noted on the right side [63%]. The average distance between the gastrocnemius tubercle and the adductor tubercle was 6 mm, and the average distance between the gastrocnemius tubercle and medial epicondyle was 15 mm. The incidence of supracondylar tubercle was 71% and in 95% of the bones it was noted above the medial condylar margin. Conclusion: The awareness of the presence of gastrocnemius tubercle and supracondylar bony prominences in the medial side of lower end of femur will be of much use to the Orthopaedic surgeons and Plastic surgeons

Keywords: gastrocnemius tubercle, supracondylar tubercle, tennis leg, femur

Introduction

Gastrocnemius tubercle is situated below and behind the adductor tubercle nearer to a fossa where the medial head of gastrocnemius muscle is attached. In an Indian study, the gastrocnemius tubercle was observed in 36% of cases. Review of literature showed that there is more mention only about two osseous prominences, medial epicondyle and adductor tubercle. Medial epicondyle is convex, palpable and lies antero inferior to the adductor tubercle. It is more of a facet rather than a projection. It receives the insertion of tendinous hamstring part of adductor magnus. Medial head of gastrocnemius is attached to a fossa at the upper and posterior part of the medial condyle behind the adductor tubercle and to a slightly raised area on the popliteal surface of the femur just above the medial condyle.

Stopford observed [99%] constant supracondylar tubercles are seen in the popliteal surface of the femur just proximal to the medial condyle corresponding to the site of attachment of the gastrocnemius muscle. Tubercles were nodular with a wide base larger than adductor tubercle in 80%, slightly developed in 11.7%, larger projections extending upto 1 inch into the diaphysis in 8% and simultaneous lateral supracondylar projections seen above lateral condyle in 8.7%. He dissected 40 specimens and confirmed that gastrocnemius muscular part arises from the diaphyseal part of the femur and tendinous part arises posterior to the adductor tubercle. He reported the absence of supracondylar tubercle in 0.35% of his sample. There was no mention of the gastrocnemius tubercle. Injuries to the medial side of the knee are most common affecting the superficial, deep part of the tibial collateral ligament and posterior oblique ligament. Rupture of the medial head of gastrocnemius tendon [Tennis leg] is a common traumatic injury of the calf. Gastrocnemius flaps are used currently as a treatment for skin necrosis in post total knee arthroplasty.
Curiosity about the ambiguity of gastrocnemius tubercle, its reference in recent studies and no mention about the same in standard text books, stimulated us to undertake the present study.

Materials and Methods

This present study was conducted in 160 bones of which 150 were dry femur bones and 10 were dissected gross specimens of the knee joint. Bone collections in the department of anatomy of Annapoorana Medical College [100 femora], Salem and Velammal Medical College [50 femora], Madurai were used for the study. 10 gross specimens of knee joint [lower limb] kept for routine dissections were utilized from the department of anatomy in Annapoorana Medical College, Salem. Total of 160 bones, 78 right and 82 left sides were studied. Duration of the study was from June - Dec 2016.

Bone study: 78 right and 82 left sided femur bones were studied for the i] Presence or absence of the gastrocnemius tubercle, ii] Size of gastrocnemius tubercle in comparison with the adductor tubercle, iii] Distance between gastrocnemius tubercle and adductor tubercle, iv] Distance between gastrocnemius tubercle and medial epicondyle, v] Vertical distance between gastrocnemius tubercle and inferior condylar margin and vi] Presence or absence of supracondylar tubercle and its location from condylar margin was measured.

Dissection method: 10 knee joint gross specimens [5 right limb and 5 left limb] dissected routinely were used for our study. The structures [tendons of sartorius, gracilis and semitendinosus] on the medial side of knee were detached from its insertion and lifted above. The capsule of the knee joint was defined. Distal attachment of hamstring part of adductor magnus was identified and adductor tubercle was palpated. Medial head of gastrocnemius [tendinous and muscular part] was detached from its origin and gastrocnemius tubercle was identified. Tibial collateral ligament and its attachment to medial epicondyle were dissected. Presence or absence of gastrocnemius tubercle and supracondylar tubercle was noted. Distance between the three bony prominences was measured using vernier caliper.

Results:

I] Presence of Gastrocnemius tubercle: the gastrocnemius tubercle was observed as a tubercular prominence posterior to the adductor prominence just above the facet in 88 [55 %] bones, out of which 56 [63.63 %] were right sided femur and 32 [36.36 %] were left sided. In 72 bones [45%] tubercular prominence was not seen and a shallow depression was present posterior to the adductor tubercle.

II] Size of Gastrocnemius tubercle in comparison with adductor tubercle: Gastrocnemius tubercle was prominent and larger in size than the adductor tubercle in 10 [11.36 %] bones. In 30 femora [34.09%] the gastrocnemius tubercles were similar in size as the adductor tubercle of the corresponding bone. In 48 bones [54.54%] they were smaller in size when compared to the size of the adductor tubercle.

III] Distance between Gastrocnemius tubercle and Adductor tubercle: The average distance between the gastrocnemius tubercle and the adductor tubercle was 6mm [Range 5 - 10 mm].

IV] Distance between Gastrocnemius tubercle and Medial Epicondyle: The average distance between gastrocnemius tubercle and medial epicondyle was 15 mm [Range12 - 22 mm].

V] Distance between Gastrocnemius tubercle and Inferior Condylar margin: The average vertical distance between the gastrocnemius tubercle and the inferior medial condylar margin was 32 mm [Range 28-36 mm].

VI] Presence or Absence of supracondylar tubercles: [Figno: 3]

Supracondylar prominences were observed in 115 bones [71.87%]. In 110 [95.65%] femora, supracondylar tubercles were present at an average distance of 25 mm from the posterior part of the medial condylar margin. Out of which 95 [86%] were larger than the size of the adductor tubercle. In 15 [13.6%] the femora, supracondylar tubercles were slightly smaller in size compared to the adductor tubercle. Paired supracondylar tubercles, one above medial condyle and
Fig: 1 : Right knee pointer is attached at the gastrocnemius tubercle.

Fig: 2: Right Knee Tendinous Head of Gastrocnemius Attached to Gastrocnemius Tubercle

Fig: 3: Lower End of Left Femur

Abbreviations: AD - Adductor Tubercle; AM - Tendinous Head Of Adductor Magnus; MC - Medial Condyle; MG - Medial Head Of Gastrocnemius; Gastrocnemius Tubercle With Attachment; SCT - Supracondylar Tubercle Above Medial Condyle; GT - Gastrocnemius Tubercle; FC - Facet

one above the lateral condyle at an average distance of 25 mm and 17 mm were noted in 10 [8.6%] bones. Isolated supracondylar tubercles, smaller in size were observed in 5 [4.34%] femurs above the lateral condyle at a distance of 17.2 mm.

VII) Gross dissection of 10 knee joint specimens: [Fig.: 1, 2]

Gastrocnemius tubercle with an attachment of tendinous part of the medial head of gastrocnemius muscle was observed and differentiated from the adductor tubercle. Gastrocnemius tubercle was palpable, prominent and located posterior to the adductor tubercle at an average distance of 6mm. In all 10 gross specimens the presence of gastrocnemius tubercle was confirmed by its location posterior to the adductor tubercle, palpation and attachment with a
tendinous head of medial head of gastrocnemius. Supracondylar tubercles [5 above medial condyle, 1 above lateral condyle] were observed on the popliteal surface of the femur at an average distance of 25 mm from the medial condylar margin and 17 mm from the lateral condylar margin. The fleshy part of the medial head of gastrocnemius was found to be attached to the medial prominence. Few fibres of plantaris tendon were closer to the lateral prominence.

**Discussion**

Gastrocnemius tubercle was first reported and confirmed by Laprade in 2007 by his systematic study using dry bones, gross dissection and electromagnetic tracking sensor system. Our study facilitated in identification, location and differentiation of the three osseous prominences and coincided with the findings of Laprade as shown in Table -1. He had noted the incidence of gastrocnemius tubercle in all the specimens whereas, in our study we noted only in 55 % of the bones. The incidence of gastrocnemius tubercle in the present study is lesser when compared to the study by Laprade. The reason for this could be the lesser sample size in the present study.

In another Indian study by Shilpa the incidence of this tubercle was 52.5% which is close to our observation. However, in both the studies [Laparde and Shilpa], right sided predominance of the gastrocnemius tubercle was observed which was noted in our study too. The size of the gastrocnemius tubercles was also found to be smaller than that of the adductor tubercle as shown in Table -1. They differed only in the distance between gastrocnemius tubercle and the adductor tubercle. These facts can be explained by the theory that prominences are usually found in a bone where a tendon or muscle is attached to it and also because of continued incorporation of collagen into the bone from the muscle.

<table>
<thead>
<tr>
<th>Name of study &amp; year</th>
<th>Gastrocnemius tubercle</th>
<th>Size of gastrocnemius tubercle compared with adductor tubercle in %</th>
<th>Average distance of the gastrocnemius tubercle from</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Presence</td>
<td>Absence</td>
<td>Larger</td>
</tr>
<tr>
<td>Side</td>
<td>Both</td>
<td>Right</td>
<td>Left</td>
</tr>
<tr>
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<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Shilpa '2015</td>
<td>52.57</td>
<td>27.5</td>
<td>24.7</td>
</tr>
<tr>
<td>Present study 2016</td>
<td>55</td>
<td>63</td>
<td>36</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name of Study &amp; Year</th>
<th>Supracondylar tubercles</th>
<th>Absence</th>
<th>Larger than adductor Tubercle</th>
<th>Smaller or Slightly developed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Above medial condylar margin</td>
<td>Above lateral condylar margin</td>
<td>Above both the condylar margin</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>Average Distance mm</td>
<td>%</td>
<td>Average Distance mm</td>
</tr>
<tr>
<td>Stopford '2016</td>
<td>99</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Present study 2016</td>
<td>95.65</td>
<td>25</td>
<td>4.34</td>
<td>17.2</td>
</tr>
</tbody>
</table>
They tend to aggregate, corresponding to the form and pattern of the tendinous fibres and are always elevated above the general surface. Prominences are related to the power of the muscle involved and they increase with advancing years\(^{1}\).

Incidence of supracondylar tubercles observed in this study coincided with the findings of Stopford\(^3\). Dissection method confirmed the origin of fleshy fibres of the medial head of gastrocnemius. Predominance of supracondylar tubercles above the medial condylar margin could be due to a good lifestyle with active muscular activity.

The prominences of supracondylar and gastrocnemius tubercles observed by previous authors\(^{1,6}\) were different by its location [Table I&2]. Former is found at an average distance of 25 mm above the medial condylar margin in the diaphysis of the popliteal surface of the femur. Gastrocnemius tubercles are found at an average of 6mm posterior and lateral to the adductor tubercle, closer to the epiphysis of the posterior condylar margin. Both prominences are due to the medial head of gastrocnemius tendon, but the supracondylar tubercle is caused by fleshy fibres of the muscle whereas gastrocnemius tubercles are caused by tendinous fibres of the same muscle.

Aging in the absence of physical activity leads to significant decrease in lower limb lean mass\(^{12}\) and this could be the reasons for the absence of supracondylar prominences and gastrocnemius tubercle in rest of the bone collection.

**Conclusion**

The third osseous tubercle or the gastrocnemius tubercle is not an often noted or mentioned entity. The incidence of the same has been variably reported. The data presented here would be useful to the Orthopaedic surgeons and Plastic surgeons. The authors intend to conduct the study in future with more sample size in live patients using advanced imaging modalities.

**Conflicts of Interest:** None

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**References**


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