Original Communication

GASTROCNEMIUS TUBERCLE IN INDIAN POPULATION: A NEW ANATOMICAL ENTITY?

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RESUMEN

Los libros de texto comunes de anatomía describen dos protuberancias óseas presentes en el cóndilo medial del fémur. A parte del tubérculo aductor (TA) y del epicóndilo medial (EPM) del fémur también se ha observado una tercera protuberancia ósea en muchos huesos. En la literatura publicada previamente se lo denomina tubérculo gastrocnemio. La cabeza medial del músculo gastrocnemio y el ligamento oblicuo posterior están adheridos al mismo. Hemos observado 396 (derecha-204 e izquierda-192) fémures secos de pacientes indios. Se observó la presencia en el cóndilo medial de la tercera protuberancia ósea, es decir, el tubérculo gastrocnemio (TGC) junto con el tubérculo aductor y el epicóndilo medial. Se advirtió la presencia o ausencia de TGC. Se comparó el tamaño del TGC y del TA. Se midió la distancia entre TA y TGC y se midió asimismo la distancia entre TGC y EPM utilizando un calibre vernier digital con un grado de precisión de hasta 0,01 mm. Para la elaboración de datos se calculó el porcentaje, la distancia media, el rango y la desviación estándar. Se comprobó la presencia de TGC en 207 huesos, es decir 52,27% (derecha-109 e izquierda-98). En la mayoría de los fémures (80,7%) el TA es de tamaño mayor que el TGC. La distancia media entre TGC y TA en el lado derecho es 10,8 ± 2,4 mm y en el lado izquierdo es 10,9 ± 2,3. Se observó una distancia entre TGC y EPM de 14,8 ± 0,5 mm en el lado derecho y de 14,9 ± 2.9 mm en el lado izquierdo. Las diferencias bilaterales no son significativas en términos estadísticos. Es importante para los clínicos identificar el TGC para evitar la reparación no anatómica de lesiones del ligamento medial de la rodilla.

***Palabras clave**: tubérculo gastrocnemio, fémur, cóndilo medial.*

ABSTRACT

The standard textbooks of anatomy describe two bony prominences on the medial condyle of femur. In addition to adductor tubercle (AT) and medial epicondyle (MEP) of femur a third bony prominence was also observed in many bones. In previously published literature it was named as gastrocnemius tubercle. The medial head of gastrocnemius muscle and posterior oblique ligament were attached close to it. We observed three hundred and ninety six (right-204 and left-192) dry femora belonging to Indian population. The medial condyle was observed for the presence of third bony prominence - gastrocnemius tubercle (GCT) along with adductor tubercle and medial epicondyle. The presence or absence of GCT was noted. The size of GCT and AT was compared. The distance between the most prominent point on AT and GCT and between GCT and MEP was measured using digital Vernier caliper accurate up to 0.01 mm. The percentage, mean, range and standard deviation was calculated for the data. Presence of GCT was noted in 207 bones (52.27%) (right-109 and left-98). In majority (80.7%) of the femora AT was larger than GCT. Mean distance between GCT and AT on right side was 10.8 ± 2.4 mm and on left side it was 10.9 ± 2.3. Distance between GCT and MEP on right side was observed as 14.8 ± 0.5 mm and on left side 14.9 ± 2.9. The bilateral differences were not significant statistically. It is important for clinicians to identify GCT to avoid non-anatomical repair of medial knee injuries.

***Key words**: Gastrocnemius tubercle, femur, medial condyle*

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INTRODUCTION

The medial surface of medial condyle of femur presents a large blunt eminence at its centre, named the medial epicondyle (MEP) for the attachment of the medial collateral ligament of the knee joint. Posteriorly, where the medial supracondylar line joins the medial condyle, the adductor tubercle (AT) is situated (Jones et al, 1953). Textbooks of Anatomy describe only two bony prominences (AT and MEP) on the medial condyle of femur (Romanes, 1887; Basmajian and Slonecker, 1989; McMinn, 1990; Standring, 2008). Presence of AT and MEP is also mentioned by Snell (2008) and Moore et al (2010). However LaPrade et al (2007) observed presence of three separate osseous prominences over the medial aspect of the femur. This third bony prominence was consistently present in the bones observed by LaPrade et al (2007) and was located at slightly distal and posterior to the adductor tubercle (AT). As the medial head of gastrocnemius tendon was attached close to the third osseous prominence, they proposed its name as gastrocnemius tubercle (GCT). They also found that the posterior oblique ligament of knee joint attachment was closer to the gastrocnemius tubercle than to AT (LaPrade et al, 2007).

A great deal of confusion is apparent in the previously published literature with regard to the location of the femoral attachments of the medial patella-femoral ligament and the posterior oblique ligament, due to lack of recognition of the gastrocnemius tubercle. In addition, it is important for the clinicians to recognize the presence of this GCT as it would be incorrectly identified as AT on palpation, resulting in non-anatomic repairs or reconstruction of medial knee injuries (LaPrade et al, 2007).

We conducted the study with the aim to find the incidence of gastrocnemius tubercle (LaPrade et al, 2007) in the bones belonging to Indian population and to determine its position with respect to the previously known bony prominences (AT and MEP).

MATERIAL AND METHOD

We observed 396 dry femora (204 of right and 192 of left side) belonging to Indian population, available in the Department of anatomy of four medical colleges in Maharashtra, India. The exact age and sex of the bones was unknown and bones were free from any damage or degenerative changes. The medial condyle was observed for the presence of third bony prominence, gastrocnemius tubercle (GCT) along with adductor tubercle (AT) and medial epicondyle (MEP). The presence or absence of GCT was noted. The size of GCT and AT was compared. The distance between the most prominent point on AT and GCT, also between GCT and MEP was measured using digital Vernier caliper accurate up to 0.01 mm.

The percentage, mean, range and standard deviation was calculated for the data. Chi square and student t test were used to calculate the significance using Stata 13.0 software.

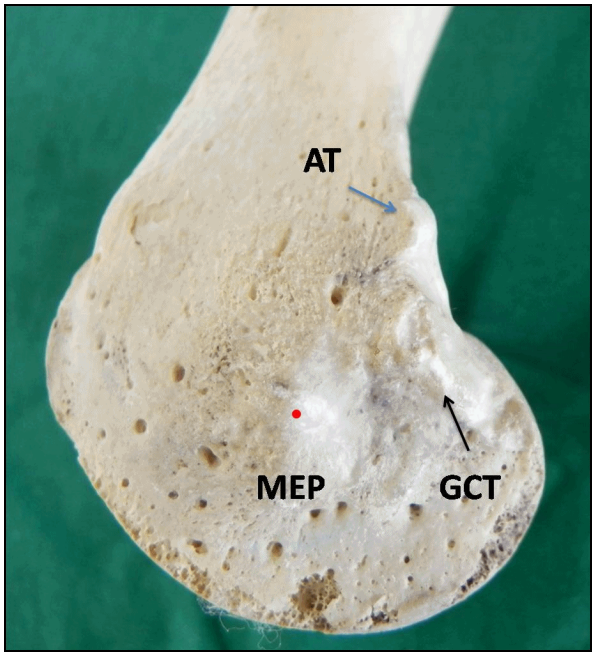

Figure 1: Gastrocnemius tubercle on medial condyle of femur. AT – Adductor tubercle, GCT – Gastrocnemius tubercle, MEP – Medial epicondyle

RESULT

After carefully studying 396 medial condyles of dry femora, we observed the presence of GCT in 207 bones (52.27%) (Fig.1). The tubercle was present in 53.43% (109) of bones of right side and 51.04% (98) of left side; the difference was not significant statistically (chi sq = 0.226, p = 0.634). In majority (80.68%) of the femora where the third bony prominence was present, AT was larger than GCT, in few (7.25%) femora GCT was larger than AT and in remaining (12.07%) both the bony prominences were almost of same size.

Mean distance between GCT and AT on right side was 10.8 ±2.4 mm (range 5.9–19.17 mm) and on left side it was 10.9 ±2.3 (range 6.53–16.31mm; p= 0.471). Distance between GCT and

MEP on right side was observed as 14.8 ± 0.5 mm (range 10.32–23.3 mm) and on left side 14.9 ±2.9 (range 9.18–20.52 mm; p= 0.351). Bilateral differences were not statistically significant.

DISCUSSION

We studied 396 medial condyles of femora belonging to Indian population for the presence or absence of GCT, the third bony prominence in addition to AT and MEP. Standard textbooks of Anatomy do not mention presence of this bony prominence.

Campbell (1966) noted that muscles leave marks where they are attached to bones and from such marks we can assess the form and size of the muscle. Liberman (1984) explained that the muscles are essentially “glued” to the bones or cartilages, a greater surface area yields a stronger glue joint. A shallow pit yields a greater surface area than would be the case if it did not exist. Small bumps, nibbling also increases the area of the ‘glue’ joint the principal is similar to that relevant to carpentry, where the surfaces of a joint frequently is roughened to yield a strong joint. (Liberman, 1984)

Standring (2008) describes attachment of medial head of gastrocnemius to a depression at the upper and posterior part of the medial condyle behind the adductor tubercle (but has not mentioned about the bony elevation) and to a slightly raised area on the popliteal surface of the femur just above the medial condyle. LaPrade et al (2007) also found that medial gastrocnemius tendon attachment in a small depression that was proximal and adjacent to the third bony prominence (GCT), located over the postero-medial edge of the medial femoral condyle.

Figure 2: Arrow showing the facet at the attachment of medial head of gastrocnemius muscle with prominent medial border

In their study of twenty femora LaPrade et al (2007) observed presence of GCT in almost all bones and also mentioned that in some bones it was the largest among the three. While in the study of three hundred and ninety six femora we observed presence of GCT in 52.27% of bones. When the sizes of the three bony prominences were compared, AT was larger in majority (80%) and only in few (7.24%) GCT was larger than AT. In 36% of the bones a facet was present at the site described conventionally for the attachment of medial head of gastrocnemius and the GCT was present on the medial border of this facet (Fig 2). In few bones we observed that the entire border of the facet was prominent. Since we have studied the dry bones, we cannot confirm the cause of this prominence as attachment of medial head of gastrocnemius muscle.

LaPrade et al (2007) used this third bony prominence as a useful bony landmark while describing attachment of medial head of gastrocnemius tendon and posterior oblique ligament. They observed that medial gastrocnemius tendon was attached an average of 2.6 mm (range 1.4–4.4 mm) proximal and 3.1 mm (range 2.6–3.6 mm) posterior in a depression adjacent to GCT over the medial aspect of the medial femoral condyle. The GCT and the tendon attachment were 5.3 mm (range 4.0–7.2 mm) distal and 8.1 mm (range 6.1–10.3 mm) posterior to AT. Posterior oblique ligament, on an average, was attached to the femur 7.7 mm (range 6.1–9.8 mm) distal and 6.4 mm (range 4.5–10.6 mm) posterior to the AT and 1.4 mm (range 0.8–2.1mm) distal and 2.9 mm (range 2.1–4.1 mm) anterior to the GCT on the medial part of the knee (LaPrade et al, 2007). Since the present study was carried out on the dry bones, the distance between the bony landmarks and the ligament or muscle attachment could not be measured and compared. We noted that, GCT was present closer to AT (10.9 ±2.3mm) than MEP (14.9 ±2.7 mm).

Fang et al (2010) also have used GCT as a bony landmark (they labeled it as medial gastrocnemius tubercle) in their study of morphology of the medial collateral ligaments of knee joints. Wijdicks et al (2009) in their radiological study have described attachment of Posterior oblique ligament with respect to GCT.

The third bony prominence was present in 52.27% of femora in the study population. It was closer to AT than MEP. We can probably say that the gastrocnemius tubercle can provide extra surface area for the attachment of the medial head of gastrocnemius muscle. Knowledge of presence of GCT is important to describe exact attachment of posterior oblique ligament and for anatomic repair of knee injuries. More such studies can be conducted in different populations to define gastrocnemius tubercle as an Anatomical entity.

Conflict onf Interests

There are no conflicts of interests regarding this article.

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Ethical Approval

The study was approved by the Ethical Committee

Informed consent

Not required.

Contribution

Dr. Shilpa Gosavi contributed in concept, data collection and writing of the manuscript. Dr. Rajendra Garud has helped in writing and editing of the manuscript. Dr. Surekha Jadhav has helped in collection of material and data.

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