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KEY WORDS: THIRD TROCHANTER, CONTIGUOUS MUSCLE ACTIVITY.

# INCIDENCE OF THIRD TROCHANTER IN DRY HUMAN FEMUR IN INDIAN POPULATION RAJASTHAN.

**Puneet Joshi*** Ph.D Scholar, Department of Anatomy, S.M.S. Medical College, Jaipur. *Corresponding Author

**Dr. Nand Lal** Senior Professor, Department of Anatomy, S.M.S. Medical College, Jaipur.

**Sakshi Mathur** Ph.D Scholar, Department of Anatomy, S.M.S. Medical College, Jaipur.

**ABSTRACT**

- Femur is the longest and strongest bone in the human body. Its length is associated with a striding gait, it's strength with weight and muscular forces.
- Third trochanter is described as an oval tubercle at the superior end of the gluteal tuberosity. It is also referred to as the trochanter tertius.
- This skeletal variant, when present, occur as an oblong, rounded or conical, roughened or smooth elevation which may be continue with the gluteal ridge and is manifested as a distinct femoral entity.

**Summary:** The study was carried out on a collection of 200 dried adult femora of unknown age & sex available at departments of anatomy from different medical colleges of Rajasthan. Out of total 200 femora studied, the presence of third trochanter was noticed in 16 (8.0%) femora. Out of which 7 (3.5%) was in right side(R) and 9 (4.5%) in left side. Third trochanter was predominantly observed higher in left side. In orthopedic surgery, trochanteric region is an important as it's an entry point, usually lateral side of the great trochanter, although anterior and posterior approaches have variable interest for implants such as plates and DHS (Dynamic Hip Screw), lateral approach is standard.

## INTRODUCTION:

- Bone is a highly vascular mineralized connective tissue, consisting of cells and an intercellular matrix in which the great majority of its cells are embedded.
- Bones vary not only in their primary shape but also on lesser surface details, or secondary markings which appear mainly in post-natal life. Most of the bones display features such as elevations and depressions, smooth areas and rough ridges, rounded projection in a tuberosity or tubercle, occasionally trochanter.
- Third trochanter is described as an oval tubercle at the superior end of the gluteal tuberosity. It is also referred to as the trochanter tertius.
- This skeletal variant, when present, occur as an oblong, rounded or conical, roughened or smooth elevation which may be continue with the gluteal ridge and is manifested as a distinct femoral entity.
- The presence of bony crests, ridges and tuberosities are directly correlated to the function of contiguous muscle activity.
- The third trochanter function to provide an attachment area for the ascending tendon of the gluteal maximus. It may perhaps serve to increase attachment surface area for the gluteal musculature thereby providing greater efficiency of contraction.
- The gluteus maximus function may exert a mechanical loading on third trochanter thereby altering surface morphology.
- The third trochanter may function to provide increase skeletal mass as a reinforcement mechanism for proximal diaphysis in response to increase ground reaction force.[7]
- A relationship between third trochanter incidence and a specific femoral morphology implies that this discrete trait shares a common development basis with size and/or shape components of femoral development and growth. By extension the third trochanter would thus appear to posse high information content with respect to underlying hereditary factors among human populations.[8]
- Factors governing the etiology and expression of the third trochanter as well as other post cranial non-metric skeletal traits are not well delineated.
- The phenotypic development and expression of dis-continue skeletal traits were considered to be controlled largely by genetic factors.[4] however, Gruneberg recognized that the expression of non- metric skeletal variants was partially dependent on generalized or local size variation.[4]
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- The gluteus maximus function may exert a mechanical loading on third trochanter thereby altering surface morphology.
- The third trochanter may function to provide increase skeletal mass as a reinforcement mechanism for proximal diaphysis in response to increase ground reaction force.[7]
- Factors governing the etiology and expression of the third trochanter as well as other post cranial non-metric skeletal traits are not well delineated.
- Recent studies indicate the significance of various biological and enviourmental factors such as age, sex, nutritional status or side dependence influencing the manifestation of certain non-metric traits in both experimental non-human samples and human populations.
- In orthopedic surgery, trochanteric region is an important as it's an entry point, usually lateral side of the great trochanter, although anterior and posterior approaches have variable interest for implants such as plates and DHS (Dynamic Hip Screw), lateral approach is standard.

## MATERIAL & METHODS:

The study has been conducted on 200 adult dry human cleaned femora of unknown age & sex.

All the bones were examined carefully for any variations by visual inspection, appropriate measurements were taken & specimen were photographed.

Bones which have gross pathological deformities, broken & non dried specimens were excluded from study.

For this study the third trochanter (Fig.2) is defined as the osseous oval tubercle in the superior part of gluteal tuberosity. It is localized in the majority of cases laterally to the line connecting the top of the greater trochanter with the superior bifurcation of the linea aspera (a). The term tubercles refer to certain measurable features of the structure: the length/width ratio of the tubercles does not exceed 5.0

(the structure is oval-shaped, but not linear) (b) and the minimum height/width ratio of the tubercle is 0.05 (the mean declination of the transverse slope is not less than 10%) (c).

To include any femur to the group with the third trochanter its gluteal tuberosity prominence has to refer simultaneously to all three conditions, (a), (b) and (c).

The osteometric measurements & their symbols (P1-P10) as well as the definition of the femoral indices were taken directly and without alteration from the standard anthropometry handbook.

The length and width of third trochanter wherever found have been taken by using a digital Vernier caliper (Fig.1). Photographs have been taken by a Casio digital camera (12 mega pixels).

Total length of femur was measured with INOX digital Vernier caliper in point to 2/3 additive stages. [Fig.3A].

Each femur has been measured for the followings (Fig.3):-

1. Total femoral length (P1, k-m).
2. Mid shaft circumference (P2, n).
3. Transverse mid shaft circumference (P3, g).
4. Anterior to posterior mid shaft width (P4, j).
5. Transverse proximal diaphyseal width (P5, d-e).
6. Anterior to posterior proximal diaphyseal width (P6, h-i).
7. Distance from the lesser trochanter to the most superior point of greater trochanter (P7, e-a).
8. Distance from lesser trochanter to the most inferior point along the superior border of femoral neck (P8, e-b).
9. Distance from the lesser trochanter to the most medial point of femoral head (P9, e-c).
10. Distance from most medial point of femoral head to most lateral point on the greater trochanter (P10, f-c).

The following indices were studied/calculated to obtain data.

1. Femoral massiveness index (FMI)
   FMI = (P2/P1) X 100%
2. Shaft massiveness index (SMI)
   SMI = (P2/P1) X 100%
3. Shaft pilastry index (SPI)
   SPI = (P5/P3) X 100%
4. Diaphysis platymetry index (DPI)
   DPI = (P1/P5) X 100%

The osteometric measurements were carried out according to standard definitions and using procedures, precision and equipment as described else-where.

According to the SPI, the level of "Pilastry" (the development of the linea aspera) was divided into 4 groups: absent, weak, medium and high. The level of "Platymetry" (flattening of superior femoral diaphysis) was divided into 4 groups in relation to the DPI: hyperplatymetry, platymery eurymetry and stenometry. (Table 1 & 2)

**Table 1: Shaft pilastry index (SPI).**

| Development of linea aspara (Pilastry) | SPI Range (min-max) |
|---|---|
| No pilastry | Less than 100.0 |
| Weak pilastry | 100.0 – 109.9 |
| Medium pilastry | 110.0 – 119.9 |
| High pilastry | 120.0 and more |

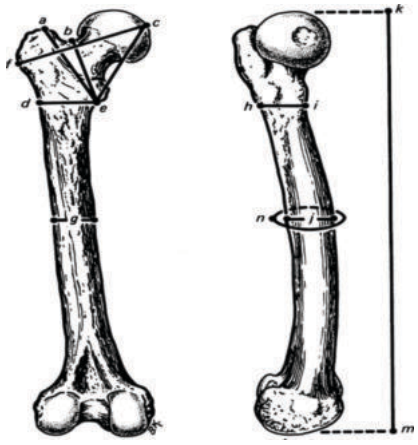
**Table 2: Diaphysis platymetry index (DPI).**

| Flattening of superior Femoral diaphysis | DPI Range(min-max) |
|---|---|
| Hyperplatymetry | Less than 75.0 |
| Platymetry | 75.0 – 84.9 |
| Eurymetry | 85.0 – 99.0 |
| Stenometry (transverse platymetry) | 100.0 and more |

A numbers of femora with the third trochanter and without were included in the study for the osteometric measurements referred to.

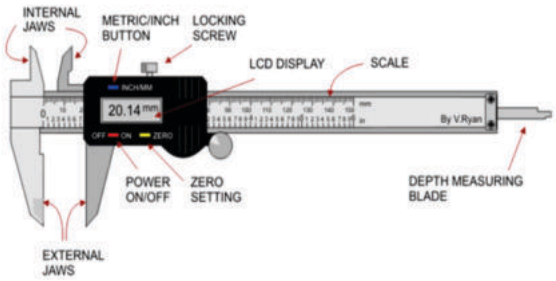
The bones without the third trochanter were chosen randomly to equal in number those with the trochanter. The random assignment applied also to the ratio of right and left bones.

This procedure enabled a comparative group to be made up identical to the previous one in the term of origin and body side.




**Data Analysis:**

the observed data were expressed as means and standard deviations for continuous variables and percentage for categorical variables by using SPSS [statistical package for the social sciences – Inc.]




**(Fig. 1. Digital Vernier Caliper)**

**(Fig. 2 Third Trochanter Right Femur)**

**(Fig. 2A Third Trochanter left Femur)**

## RESULTS:

In present study the followings results were obtained –
The study was carried out on a collection of 200 dried adult femora of unknown age & sex available at departments of anatomy from different medical colleges of Rajasthan.

Out of total 200 femora studied, the presence of third trochanter was noticed in 16 (8.0%) femora. Out of which 7 (3.5%) was in right side(R) and 9 (4.5%) in left side.

Third trochanter was predominantly observed higher in left side.

The length of third trochanter was in right side(R) ranging between 6.52 – 13.04mm and in left side(L) between 5.87 – 15.42mm. So length of third trochanter was ranging between 5.87 – 15.42mm (R+L).

Maximum length & width of third trochanter was in left side that is 15.42mm & 7.82mm respectively.

**Table1: Counts and proportion of third trochanter**

| Third trochanter | n = 16 | In % |
|---|---|---|
| Right | 7 | 3.5% |
| Left | 9 | 4.5% |
| Combine | 16 | 8.0% |

## DISCUSSION:

The findings recorded from the present study were compared with previous studies and the following results were noted:
The incidence of the third trochanter in present study is found to be 8% similar to other studies conducted on polish population (6.6%) by Bolanowski[3], by Ghos[7] et al in general Indian population (6.6%).

The incidence was lower than the studies conducted on Northern Tamil Nadu (13.72%) [Aziz N], on Pakistan population (13.9%) and study by Rajad R[5] (13%).

The third trochanter is present in other mammals special like whales, rats, and rabbits as well. It was also found in the Neanderthals but not in the other species of anthropoids.

The expression of the third trochanter is mainly influenced by physical activity and can provide information about enviourmental stimuli exerted by that particular population.[8]

Present study also did not report any significant gender variations but S. Ghos[7] et al demonstrated a gender variation being higher in males while another study in Negros and Whites reported that third trochanter is more common in females.

Clinical relevance of this study is in fracture treatment. The findings can be useful in intramedullary nailing and reaming of proximal femur. Attachments of muscles and ligaments act as reinforcing elements to bone. When there are no such attachments and bone is covered with periosteum only it offers a little resistance for onset of fractures.

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