
RESEARCH ARTICLE

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COMPARATIVE STUDY OF THE FEMURS OF *HOMO ERECTUS* AND OF RECENT MALE THAIS

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Summary

The subject of this study is a plaster cast of a left femur belonging to Homo erectus or Pithecanthropus, discovered by Dubois in the Trinil bed of Solo River, Central Java, Indonesia.

The cast has similar characters to the recent male Thai femurs used for comparison, except for an area of exostosis on the medial side, extending from the lesser trochanter for a distance of about 9.9 cm. In addition to this pathological abnormality, another important characteristic of the Homo erectus femur is that when placed in the normal anatomical position with the two condyles in the same horizontal plane, it makes a very small angle with the vertical plane as compared to the bigger angle made by a recent male Thai femur.

Seventeen measurements were made on lengths, breadths and circumferences and three on angles. Four indices were calculated. It can be concluded that nearly all the diameters and indices of the Homo erectus femur lie in the higher part of the range of variation while a few are greater than the range. The head and lower end were relatively large, as compared to the overall length. This indicates that Homo erectus was no taller than a rather tall modern Thai but had bigger and stronger legs.

The main difference is that there is no angle of obliquity or condylo-diaphyseal angle as compared to the 5°-12° observed in recent male Thai femurs. This indicates that Homo erectus could not stand erect with his knees touching each other.

Introduction

The Museum of Prehistory had in her possession a plaster cast of a femur of *Homo erectus* made from a cast belonging to the Dept. of Biology, Chulalongkorn Univ. The original specimen from which the casts were made was discovered by Dr. Dubois in 1892 in the Trinil bed of Solo River, Central Java, Indonesia and is believed to be about 500,000 years old. The original cast was extremely well done and is a

TABLE 1: MEASUREMENTS OF THE FEMUR OF HOMO ERECTUS COMPARED TO THOSE OF THE FEMURS OF 68 RECENT MALE THAIS.

	Recent Male Thais		Homo Erectus (mm)
	Average (mm)	Range (mm)	
Length			
Total length	424 ± 21	379-463	453
Oblique length	421 ± 21	379-458	454
Trochanteric length	421 ± 20	363-439	433
Subtrochanteric region			
Antero-posterior diameter	22.3 ± 1.5	20-26	31
Transverse diameter	27.6 ± 4.2	20-23	N.D.
Circumference	80.7 ± 5.5	69-93	N.D.
Platymeric index	80.9 ± 9.2	66-115	N.D.
Middle region			
Antero-posterior diameter	25.9 ± 2.2	21-31	32
Transverse diameter	25.1 ± 2.6	20-33	31
Circumference	80.9 ± 6.2	72-94	103
Pilastric index	104 ± 8.3	80-119	103
Shaft robusticity index	12.1 ± 0.8	10.8-14.0	13.9
Supracondylar region			
Antero-posterior diameter	26.9 ± 2.6	19-32	34
Transverse diameter	36.1 ± 4.0	28-43	39
Popliteal index	74.9 ± 6.8	65.0-92.4	87.2
Head region			
Vertical diameter	43.7 ± 2.6	38-49	48
Horizontal diameter	43.7 ± 2.6	38-49	47
Circumference	139 ± 7.5	122-155	152
Femoral head index	10.4 ± 0.5	9.3-11.3	10.6
Neck region			
Vertical diameter	29.6 ± 2.5	25-36	33
Horizontal diameter	23.5 ± 1.6	20-27	31
Circumference	90.7 ± 5.7	81-105	100
Lower end			
Transverse condylar breadth	69.3 ± 4.1	60-76	90
Condylar breadth index	16.5 ± 0.6	15.4-18.1	19.7
Angles			
Collo-diaphyseal angle	127° ± 4.8	115-138°	130.5°
Condylar-diaphyseal angle	8.5° ± 2.1	5-12°	0°
Angle of torsion	18.2° ± 8.2	1-43°	11°

N.D. = not determined since measurements could not be made due to growth in this region

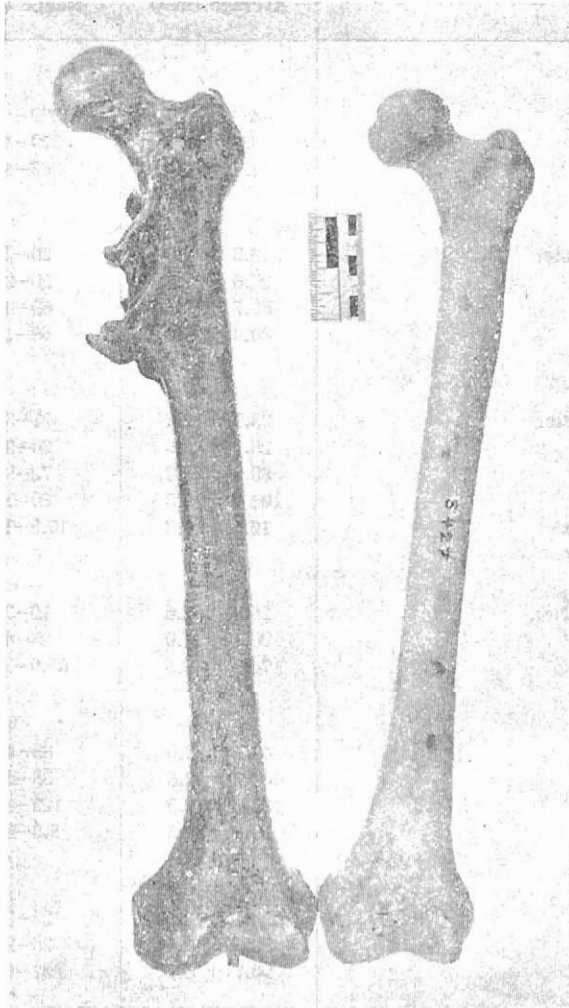


Fig. 1. The cast of a *Homo erectus* femur (left) compared to the femur of a recent Thai male (right). The femurs are aligned so that the condyles of the lower ends of the two specimens are in the same horizontal plane i.e. placed in the normal anatomical position.

very good likeness of the illustrations, made from the original specimen, which appear in text-books on human evolution.

The specimen is a left femur and shows no differences in appearance from recent male Thai femurs except on the medial side of the cast (Fig. 1). On that side there is a pathological growth of bone extending from the lesser trochanter downwards along the shaft for a distance of about 9.9 cm with a width of 2.6 cm. The surface of the growth is rough and unevenly studded with nodules of different sizes, which have heights of 2.1 to 3.2 cm. Major¹ has called it an exostosis or osteosis, while Moodie² has considered it to be the oldest pathological change found in man.

It is still not known how this growth appeared. Professor Hoijer who visited Thailand in 1970 suggested that such a growth might occur by the rubbing of the thighs of a rider against the flanks of a horse. Unfortunately only one femur was discovered and there have been no reports of any horse skeletons of the same period in that region. Wells³ has suggested that some injury might have occurred in the muscles of that part of the body, resulting in an extravasation of blood into the muscle which might cause a pathological change leading to abnormal bone growth. This explanation is quite reasonable because pathological changes can be found in recent man resulting from a frequent rubbing of the region for a long time (Karsner⁴).

In this paper, we describe the detailed measurements of this cast of *Homo erectus* femur, including the dimensions of several regions and also same angles.

Methods

Measurements were made following the techniques described by Wilder⁵. The results obtained for the *Homo erectus* femur were compared to those of recent male Thai femurs studied using the same techniques by Miss Chaipackdee⁶ for her Master's thesis in the Department of Anatomy.

Results and Discussion

The results of our measurements on the femur of *Homo erectus* are shown in Table 1, compared to average values and the extents of variation observed in 68 recent male Thai femurs. These data show that the femur of *Homo erectus* is larger than recent male Thai femurs in nearly all the diameters, and although some of measurements are in the range of variations presently observed they are in the higher figures of the range.

In the subtrochanteric region the *Homo erectus* femur has an antero-posterior diameter 5 mm larger than the highest figure of the range. Other diameters can not be measured because of the growth in that region.

In the middle part of the cast, the antero-posterior diameter is 1 mm more than the highest figure of the range. This causes the circumference to be 9 mm higher than the highest figure of the range. The pilastric index falls within the normal range which indicates that the size of the *Homo erectus* femur does not differ from that of other femurs and that the bone is not thicker or larger toward one side. The shaft robusticity index falls within the range which shows that it is of suitable size and no larger than normal.

The lower end of the cast is much broader causing the antero-posterior diameter of the supracondylar region to be 2 mm greater than the highest figure of the range. This difference does not affect the popliteal index, as it is still within the normal range. The transverse diameter of the lower end is 14 mm larger than the highest figure of the range making condylar breadth index to be 1.6 mm greater than the highest figure of the range.

The three diameters of the head of the cast all fall within the range, but the femoral head index is in the lower figure of the range. This indicates that femur of *Homo erectus* has a large head but its length does not conform with the large size of the head. This measurement and index indicate that *Homo erectus* is no taller than the rather tall Thais. Because of the rather large head, some diameters of the neck are also larger, particularly the horizontal diameter, which is 4 mm greater than the highest figure of the range.

Results of measurements of various angles show that the angle of the neck or collo-diaphyseal angle, which is the angle made between the neck and body falls within the higher figure of the range. The Homo Erectus femur has a small degree of torsion, 11°, but it is still within the normal range.

The angle which differs markedly from that of recent male Thai femurs is the angle made between the lower end and the body of the cast—the angle of obliquity or condylo-diaphyseal angle. In the femurs of recent Thai males, a small angle is made, but in *Homo erectus* the condylo-diaphyseal angle is zero. Thus when the cast is placed in the normal anatomical position (Fig. 1.), no obliquity is observed and the body of the cast lies almost in the vertical plane. The presence of such a femur in *Homo erectus* would make him unable to stand erect with both knees touching.

Acknowledgements

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บทคัดย่อ

วัตถุที่ใช้ในการศึกษานี้เป็นชิ้นเหลือชิ้นหนึ่งของกระดูกต้นขาข้างซ้ายของโฮโม อีเรคตัส (*Homo erectus*) หรือปีธเคนโรบัส (*Pithecanthropus*) ที่พบโดยดูบัว (Dubois) ในบริเวณท้องน้ำเก่าทรินิล (Trinil bed) ของแม่น้ำโซโล (Solo) ในตอนกลางของเกาะชวา ประเทศอินโดนีเซีย ชิ้นนี้มีลักษณะคล้ายคลึงกับกระดูกต้นขาของชายไทยซึ่งได้ใช้สำหรับเปรียบเทียบ นอกจากนี้บริเวณของกระดูกอก (exostosis) ทางด้านใกล้กลางจากระดับของโทรแคนเตอร์อันเล็กลงไปเป็นระยะประมาณ 9.9 ซม. นอกจากพยาธิสภาพดังกล่าวแล้ว ยังมีลักษณะของกระดูกต้นขาของโฮโม อีเรคตัสอีกลักษณะหนึ่ง คือเมื่อวางกระดูกลงในตำแหน่งที่ควรจะเป็นในคนมีชีวิต คือวางในท่าที่ให้คอนไดล์ทั้งสองอยู่ในระนาบทางนอนด้วยกัน กระดูกนี้จะทำมุมเล็กมากกับแนวตั้งฉาก ซึ่งเมื่อเปรียบเทียบกับกระดูกต้นขาของชายไทยปัจจุบันแล้ว ผิดกันเพราะทำมุมมากกว่า การวัดได้ทำขึ้น 17 รายการ เช่น ความยาว ความกว้าง ขนาดวัดรอบ และมุมต่าง ๆ อีก 3 รายการ หาค่าของดัชนี 3 รายการ จากผลของการวัดสรุปได้ว่าเกือบทุกขนาดและดัชนีของกระดูกต้นขาของโฮโม อีเรคตัสอยู่ในตอนสูงของขนาดแตกต่าง (range) คงมีบางรายการสูงกว่าขนาดแตกต่างหัวและปลายล่างเปรียบเทียบแล้วใหญ่เมื่อเทียบกับทุกรายการของความยาว ซึ่งบ่งให้เห็นว่าโฮโม อีเรคตัสไม่สูงกว่าชายไทยที่ค่อนข้างสูง แต่โฮโม อีเรคตัสมีขาแข็งแรงกว่า มีข้อแตกต่างที่สำคัญคือไม่มีมุมเอียง (angle of obliquity) หรือมุมระหว่างลำตัวของกระดูกและปลายล่าง (Condylodiaphyseal angle) ซึ่งในกระดูกต้นขาของชายไทยมีค่าจาก 5° - 12° แสดงว่าโฮโม อีเรคตัสขณะมีชีวิตไม่อาจยื่นตรงให้เข้าทั้งสองขิดกันได้