Original Research Paper

VOLUME-6 | ISSUE-1 | JANUARY-2017 • ISSN No 2277 - 8179 | IF : 3.508 | IC Value : 78.46

A STUDY OF ANGLE OF FEMORAL TORSION IN MEDICAL COLLEGE JABALPUR

Medical Science

KEYWORDS:

JAIN P. C	Associate Professor, NSCB MEDICAL COLLEGE JABALPR, M.P.
GUHA B. K	Associate Professor, NSCB MEDICAL COLLEGE JABALPR, M.P.
TIWARI AMRISH	Assistant Professor, NSCB MEDICAL COLLEGE JABALPR, M.P.

Introduction: Orthopaedists and Anatomists have long been interested in knowing the angle of anteversion of femoral neck. Excessive anteversion is thought to be particularly important in congenital dislocation of the hip, Perthe's disease, cerebral palsies and in toeing gait. The knowledge of the angle of femoral torsion is also of value in the treatment of malunited fracture of the femur. An abnormal angle can also cause disabilities. The knowledge of this angle can also be advantageously utilized for Smith Peterson Nailing which is used for treatment of Fracture neck of femur.

Definition: The angle of inclination of femoral neck is the angle formed by the axis of the femoral neck with the axis of the femoral shaft. The torsion of the femur is the inclination of axis of the femoral neck with references to the condylar plane of the distal end of the femur. If the axis of the neck inclines forward the angle of torsion is called anteversion, anterotat ion, anterior twist or positive angle. If it points backwards it is called retroversion or retrotorsion or posterior twist or negative angle. Generally it is assumed that at birth the anteversion is about 32 degrees, gradually decreasing and in adult on an average it is about 8 degrees.

The angle of femoral torsion is also defined as the angle which the transverse axis of the head of femur makes with the transverse axis of the lower end of femur. When viewed from above, with the limb in vertical position, the neck of femur makes an angle with the axis of knee joint, this is the angle of femoral torsion. This angle is also described by some authors (Dunn, 1952) as the angle of anteversion of the neck of femur. Roberts Walter H. (1962) defines it as the angle of torsion of femur, also called the angle of declination. He defined it as the angle formed by the intersection of lines drawn through the main transverse axis of the upper end and that of the lower end.

Evolutionary aspect- To achieve the present human form, man has undergone a constant change for millions of years which constitute evolution. During this period there had been a change in the structure. This change is affected by various factors like environment and functional needs which make the animal adaptable to the circumstances and thus, the life can be continued, and species born. During the phase of evolution, changes have taken place in various parts of the body. In lower animals all the four limbs were used for locomotion. With the adaptation of the erect posture a number of changes have occurred in the limbs. In reptiles and quadruped animals the limbs are still used for locomotion only. But in primitive tetrapoed, as in urodales, turtle and lizards even today, the limbs are wider, sprawled out from the sides of the body, with necessary expenditure of much energy in keeping the body off the ground. Improvements on this situation have been made by numerous tetraped. In the ancestral ruling reptiles there was a strong trend towards bipedalism, with powerful hind limb turns forward beneath the body giving not merely a long stride but direct support of the body on the vertically placed limb. In primitive forms femur projected nearly straight out laterally from the acetabulum, and the articular surface for the girdle lay, in consequence, directly on the head of the bone. But in some reptiles, and in all mammals where the limb is rotated to a forward position parallel to the main axis of the body, the head is of necessity turned inward at more or less a right angle to the shaft, but with the adaptation of arboreal habit the forelimbs were chiefly used for prehension and grasping and with presumption of erect posture the pelvic girdle has undergone rotation and consequently the lower limb has also rotated inward. The fore limbs became free not only for prehension and grasping but various other activities and the hind limbs were only used for the purpose of locomotion. Due to the various changes in the form of body which have taken place and are especially well marked in the lower limbs, which now have to bear the body weight and have to perform the function of locomotion. Among the various changes, the shifting of muscular attachments to provide adequate leverage for balancing the body in the new posture and for working efficiently upon the limbs in its movements, the attachments of the muscles that elevate or flex the thigh must be anterior to or in front of their insertion in the femur. In order to obtain a good purchase upon the thigh the extensor muscle attachments must be on the back. These requirements necessitated an antero-posterior extension of the pelvis. Since the axis of the lower limb is now parallel to spine instead of being perpendicular to it, in a similar way the specialization of the lower limb for the support of locomotion the legs became very much longer and stronger. This will lead to further changes in pelvis and spine and like this the structure is conditioned by function. Though the cost of it is paid in the form of resulting weakness, which may lead to diseases like hernia.

Materials and Methods:

One hundred femurs from the department of Anatomy, Medical College, Jabalpur, Madhyapradesh, India, were taken for the present study. Out of these 56 belonged to left side and 44 were those of right side. The angle of femoral torsion was measured on an osteometric board by keeping the femur in such a way that the posterior surface of the condyles and greater trochanter touched the surface of the ostemetric board.

The mechanical axis of the neck was taken as a line joining the two points mainly the centre of the head where the thickness was maximum and the centre of the neck where antero-posterior thickness was least when viewed from above. A pin was stucked with plastic in along the line of these two points. The femur was then placed against the vertical wall of the osteometric board with a paper pinned to the wall. Corresponding to the pin the neck axis line was drawn on the paper. The lower edge of the paper remaining parallel to the surface of the board. Therefore it corresponded with the axis of the knee. The angle so formed by the line of the pin and the lower edge of the paper give the angle of femoral torsion which was measured by a protractor (Figure 5).

When the angle was negative, the plotting of the axis of the neck along the pin instead of remaining above the base-line which represent the axis of the lower end went below it in the reverse fashion as shown in Figure 6.

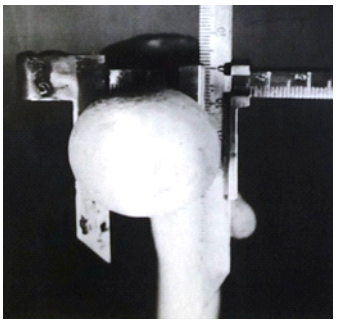


Fig. 1 Showing method of measuring centre of the head

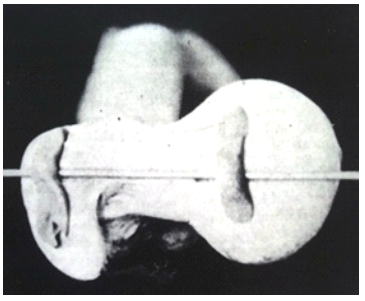
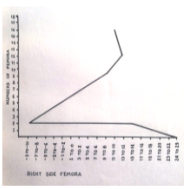


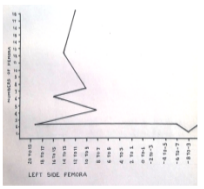
Fig. 2 Showing pin stuck with plasticin along the long axis of the neck

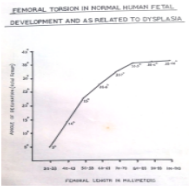
Observations: After measuring the angle in all the femora, the right side and left side were separately charted out as shown in tables. Mean, standard error of mean (S.E.M.), range of variation (R.V.) and standard deviation (S.D.) calculated.

	No.of femora showing the +ve angle.	Mean	S.E.M.	Range of variation	S.D.
Rt	40	11.27°	± 0.44	8 - 25°	2.81°
Lt	51	12.37°	± 0.39	7 - 20°	2.77°

	No.of femora showing the -ve angle.	Mean	S.E.M.	Range of variation	S.D.
Rt	4	- 12.75°	± 2.24	- 9 to -20°	4.49°
Lt	5	- 8.6°	± 0.72	- 7 to -11°	1.62°







Discussion:

The earliest work in this connection was of Mikulicz J.(1878), Soutter R. and Bradford E.G. (1903) studied twist in normal and congenital dislocated femora. Le-Damany also studied the torsion in the same year. Parson F.G. (1914) studied the character of femur in English people. Durham. H.A. (1915) studied anteversion of femoral neck in normal femora. Since that time number of workers had been interested in femoral torsion. There may be various factors responsible for the degree of torsion. One of the important factors is the racial factor. Therefore the angle of femoral torsion in different races will be different and the data of one particular race may not be true for another race. Keeping this in mind Kate and others studied the angle of femoral torsion in Indian subjects. The angle is about 15 degree as stated in Gray's Anatomy. This is based on the work mostly in European's. Kate in his studies finds this angle to be 11.48 degree which is quite lower than the figure mentioned in Gray's Anatomy. Leonard Ruby et al (1979) studied anteversion of femoral neck. They studied by three methods in living subjects. The methods were Roger's fluoroscopic method, Ryder's Crane biplanner method and Dunn's axial technique. Every patient was examined by 2 or 3 methods and the average of 3 observations in each instance was recorded. The range of error in Roger's method was -4 to +7 degree, in Ryder' Crane's method the range of error was -5 to +8 degree and Dunn's method +3 to 9 degree. The mean errors were 1.4, 2.7 and 4.7 degree respectively. When Roger and Ryder Crane's methods were used, the results of measurements agreed with in a range of +8 to -15 degree in normal limbs. The anteversion in normal subjects shows a range of 8 to 50 degree and the differences between right and left ranged from 0 to 20 degree in normal subjects. The total numbers studied by them was 64 hips. However in the present study the above mentioned method were not used.

SHOWING RANGE OF VARIATION OF ANGLE OF FEMORAL TORSION BY OTHER WORKERS

Name of worker	Number of bones	Range in degrees
Mikulicz (1878)[30]	120	37 to -25
Broca[2]	-	38 to 2
Le-Damany (1903)[25]	30	-
Soutter & Bradford (1903)[43]	150	50 to 0
Parsons (1914)[34]	266	40 to -17
Durham (1915)[9]	200	35 to 0
Pick et al (1941)[38]	152	41 to -18
Kingsley & Olmsted (1948)[22]	630	38 to -20
Kate & Robert (1963)[21]	104	30 to -17
Patil,Kate & Dybey (1966)[35]	213	51 to -12

S.No.	Workers	Year	No.of femora studied.	Mean torsion angle.	Remarks
1.	Mikulicz	(1878)[30]	120	11.67°	
2.	Le Damany	(1903)[25]	30	11.30°(R) 14.07°(L)	
3.	Parsons	(1914)[34]	266	Male - 13.00°(R) 13.00°(L) Female- 18.00°(R) 16.00°(L)	
4.	Pearson & Bell	(1919)[37]	..	11.63°(R) 14.71°(L)	On 17th century bones.
5.	Altmann	(1924)[1]	..	17 mm.embryo 0.10° 3rd month- 00.0° At birth-Higher than Adult ranging from 30° to 50° First 2 years-Detorsion till adult average of 12° is reached.	
6.	Ingalls	(1924)[19]	100	12.60°(R) 10.35°(L)	
7.	Elftman	(1945)[10]	..	11.86°	
8.	Kingsley	(1948)[22]	630(Adult) 30(Infant) 34(Children 2-15 yrs)	8.54°(R) 7.47°(L) 24.40° 17.90°(R) 16.40°(L)	7.94°(Male) 8.11°(Female) 22.60°(Male) 26.20°(Female)

Summary and Conclusion:

The angle of femoral torsion was studied in 100 femora in the department of Anatomy, Medical College Jabalpur. 91 femora showed positive angle, the mean being 11.89 degree. 9 femora showed negative angle, the mean being negative 10.44 degree. The average mean was 11.76 degree. The mean of the right side was 11.27 degree and that of left side was 12.37 degree. In negative angles the mean of right side was negative 12.75 degree and that of left negative 8.6 degree. This study indicates that the average angle of femoral torsion in Jabalpur region of India is 11.76 degree. The right side angle is less than that of left side. The left side angle is mostly confirming with the study of Kate but right side angle is greater in present study. However, a study in larger number will help to draw definitive conclusions.

VOLUME-6 | ISSUE-1 | JANUARY-2017 • ISSN No 2277 - 8179 | IF : 3.508 | IC Value : 78.46

1. Altmann,F. (1924) : Untersuchungon Uber die Torsia Femoris, Zeit.Anat., Entwick, 75: 82-126, cited by Elftman, 1945.

2. Broca : Cited by Elftman, 1945.

3. Browne,D.(1934) : Talipes equinovarus. Lancet, 227: 969-974.

4. Bryce,T.H.(1915) : Quain's Elements of Anatomy. Eleventh Ed.Part.I. Longmans, Green and Co.London, pp. 284-285.

5. Crane,L.(1959) : Femoral torsion and its relation to tesing-in and teseing-out. J. Bone Jt.Surgery, 41-A: 421-428.

6. Drachman,D.B. and B.Q.Banker (1961) : Arthrocryposis multiplex Congenita, Arch. Neurol, 5,89-93.

7. Dunn,D.M. (1952) : Anteversion of neck of femur. J.Bone Ind.Jr.Surg. 34 B, 181-186.

8. Durham,H.A.(1915) : Anteversion of the femoral neck in the normal femur. J.Amer. Med.Ass. 65: 223-224.

9. Durham,H.A.(1915) : Anteversion of femural neck in normal femur. Am.J.Anat., 94: 1-44.

10. Elftman,H.(1945) : Torsion of lower extremity. Am.J.Phys.Anthrop.N.S. 3:255-265.

11. Fairbank,H.A.T.(1938) : Congenital dislocation of the hips with special reference to anatomy. Br.J.Surg. 17: 388-416.

12. Felts,William,J. (1954) : The prenatal development of the human femur.Amer.J.Anat. 94: 1-44.

13. Frazer,J.E.(1948) : The Anatomy of human skeleton, Fourth Ed. J. and A.Churchill Ltd. London, p.119.

14. Freid lander,F.V.(1981) : Uber die Entstehung der angeborenon Hutt uerrenkune.Z. Orthop. Chir; 9: 515-543.

15. Garden,R.S.(1961) : The structure and function of the proximal end of the femur. J.Bone.Jt.Surg. 43B: 576-589.

16. Gray's Anatomy : Edited by Roger Warwick and Peter L.William. Edition No.35 (1973) Page 359.

17. Hass J.(1951) : Congenital dislocation of the hip. Spring field.C.C.Thomas.

18. Illingworth C.F.W. and B.M.Dick(1949) : A textbook of Surg. Pathology. J.and A.Churchill Ltd. London, pp. 134-135.

19. Ingalls,N.W.(1924) : Studied on the femur. Am.J.Phys. Anthrop. O. S.7: 207-255.

20. Joseph R.D. Pollerin and J.C.Job (1958) : Congenital multiple arthrogrypasis semaine hop Paris 34. 525-536.(Abstracted in J.Amer.Med.Ass. 167: 787).

21. Kate B.R. and Roberts S.L.(1963) : The angle of femoral torsion, J.Anat.Soc.India.12: 8-11.

22. Kingsley P. and Olmsted (1948) : A study to determine the angle of anteversion of neck of femur. J.Bone Jt. Surg. 30 A: 745-751.

23. Lanz,T.V. and A.Hennig (1953) : Rollwirkungen dies M. iliopseas and Femurtorsion. Anat. 117: 383-409.

24. Lanz,T.B. and A.Mayet (1953) : Die Gelenkorpen des menschlichen Juftgelenkes in der progredienten Phase ihrer umwegigen Ausformung.Ibid., 117: 317-345.

25. Le Damany,P.(1983) : Les Torsions osseuses. Leur Role dans la Transformation des Membres.J.Anat. 39:126-134 161-165;313-337,426-450, 534-545.

26. Leonard Ruby (1979) : J.of Bone and Jt.Surg. American Vol. 61-A, 46-51.

27. Lofren,L. (1956) : Some anthropometric anatomical measures of the femur of Finns from the view point of Surgery. Acta Chir, Scand. 110: 477-484.

28. Martin,R.(1928) : Lehrbuch der Anthropologie. Gustav Fischer, Jena Vol. 1 pp 328, 410, 1140-1141.

29. Mc Groger,A.L.(1950) : A synopsis of Surgical Anatomy Seventh Ed., The Williams and Wilkins Co., Baltimore, pp. 451-454.

30. Mikulicz,J. (1878) : Uber die individuellen formdifferenzen am femur and an der Tibia des Menschen. Arch. Anat. Physiol. Anat. Abt.1.S. 351-484.

31. Milch,H.(1961) : The measurement of pelvi-femoral motion. Anat.Rec.,148: 135-145.

32. Mollier,S. (1938) : In Plastische. Anatomie Munchen

33. Moss,M.L. and C.R.Noback,(1958) : A longitudinal study of digital epiphyseal fusion in adolescence Ibid,131:19-32.

34. Parson,F.G.(1914) : The characters of the English thigh bones, J.Anat. and Physiol.Lond. 48: 230-267.

35. Patil,T.L. B.R.Kate & P.N.Duber (1966) : The angle of femoral torsion. J.Anat.Soc.India,15:119-131.

36. Paturet,G.(1951) : Traite d. anatomic humaine, Vol.1, Masson and Cie Paris, p. 47.

37. Pearson,K. and Bell,J.(1919) : A study of long bones of the English skeleton. Drapper's Co. Research. Memoirs, Biometric Series X and XI, Part I, Section I, Chap.1-16 and Part II,Section II,Chaps. 7-18 Cambridge U.Press,London.