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TIBIAL TORSION; DOES IT DIFFER IN CHILDREN WITH CONGENITAL TALIPES EQUINOVARUS (CTEV) COMPARED TO NORMAL ONES?

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ABSTRACT

Background: Congenital talipes equinovarus (CTEV) or clubfoot is one of the commonest congenital orthopaedic conditions requiring intensive treatment. A typical clubfoot consists of a deformed foot in equinus ,varus, adduction. In some cases a cavus component is also there. Tibial torsion is the angle between the transverse axes of the proximal and distal tibial articular surfaces. Controversy exists concerning the presence or absence of excessive medial or internal tibial torsion in CTEV. **Materials & Methods:** A cross sectional study was done of thirty consenting patients with CTEV and thirty children with injuries not involving the tibia or fibula selected by convenience sampling attending the orthopaedic clinic of a tertiary care hospital of Western Maharashtra . We measured the angular difference between the proximal and distal posterior tibial planes as defined by ultrasound scans thus minimising the error introduced by the posterior shifting of lower end fibula in the fibular notch after manipulative correction. The data was entered in excel and appropriate statistic test was applied. **Results:** The mean external torsion of the tibia in children with CTEV was 18 degrees (standard deviation 2.7), which was significantly less than the mean external torsion of tibia in normal children (38.13 degrees; standard deviation 9.194) ($p<0.05$). **Conclusions:** The children with CTEV have a relative tibial intorsion, as compared to normal children.

INTRODUCTION

Congenital talipes equinovarus **(**CTEV) usually represents congenital dysplasia of all musculoskeletal tissues distal to knee. Incidence is 1-2 /1000 live births, more common in Hawaiians and Caucasians compared to orientals, 50% are bilateral, and male to female ratio is 2.5 : 1 .Most of them are idiopathic but occasionally it may be associated with other congenital malformations and syndromes such as Arthrogryposis, myelomeningocoeletc[1,2]. There have been many methods for treatment of CTEV such as Ponseti cast application method, External fixator applications and various osteotomies[3,4,5].Controversy exists concerning the presence or absence of excessive medial or internal tibial torsion. Many studies are supporting the presence of tibial torsion in clubfoot. Many of the observers have linked tibial torsion to recurrence of deformity in treated clubfeet[6,7].The problem of whether tibia has an abnormal torsion in clubfoot can only be solved by measuring the relative alignment of it's proximal and distal articular surfaces ; this has not proved possible in vivo . CT scans and ultrasonography have both been used to produce images of the proximal and distal juxta-articular surfaces of the tibia. These surfaces are thought to relate closely to the plane of the nearby joint and can therefore be used to measure tibial torsion. An ultrasonography involves no ionising radiation and hence can safely be used for this purpose. Different researchers measure tibial torsion with different methods and reference lines, resulting in a huge variation in the reported normal ranges of tibialtorsion[1,2,6,7,8]. Each method has its own advantages and disadvantages and no conventional technique for routine assessment of tibial torsion has gained wide acceptance yet [6,9]. The aim of the present study was to measure tibial torsion with the help of ultrasonography in children having CTEV and to compare it with the tibial torsion in normal children measured similarly.

MATERIALS AND METHODS

Study design: A analytical cross sectional study
Ethical approval: Approval of ethics committee of our college was obtained. The informed consent form from the parents was obtained.
Sample size: Thirty consenting patients with CTEV and thirty patients with normal foot selected by convenience sampling attending the Orthopaedic clinic of a tertiary care hospital of Western Maharashtra over a period of 2 years as per following inclusion criteria:
Inclusion criteria: Patients with diagnosis of CTEV under 12 years of age, patients with no history of fracture

involving the study leg, patients with no history of any bony surgery done over study leg, Patients who were able to co-operate for the examination e.g. ability to lie immobile for the period of examination.

Exclusion criteria: Patients whose parents were not consenting for the investigation, patients who were unable to co-operate for the procedure, Patients above 12 years of age, Patients in whom any bony procedure was done as treatment, patients who sustained any fracture in the study leg in the past.

Study procedure:

Ultrasound study: Ultrasonography was done by using 7.5 MHz probe of a real time ultrasound without any prior preparation required of the patient [6,9].

Scanning technique: The child was asked to lie in prone position on a firm table with the leg supported motionless by a seated assistant.

The 7.5 MHz probe of a real time ultrasound scanner was maintained in a vertical position for proximal & distal measurement. The angular difference between the proximal & distal posterior tibial planes was determined by scans immediately distal to the proximal tibial articular surface & just proximal to the ankle. The articular surface of tibia was seen as a prominent line on the screen. Once the proximal tibial articular surface line was determined, the image was saved. With the patient in same position, the ultrasonography probe was moved to distal articular level of tibia. The distal tibial articular margin was determined similar way. Again the image was saved. All ultrasound settings were maintained same throughout the procedure. With both the images side by side , print was taken. The angle between proximal and distal tibial articular surface was calculated which was the tibial torsion. (fig 1&2)

Fig 1: Determination of proximal tibial plane by ultrasonography

Fig 2: Determination of distal tibial plane by ultrasonography

Statistical analysis: Mann Whitney test was used for data analysis as the values of tibial torsion in normal as well as in children with congenital talipes equinovarus were showing skewed distribution.

RESULTS

Thirty patients with CTEV deformity were studied for tibial torsion with the help of ultrasonography by the method described earlier. All patients were of the age below twelve years. Thirty more children with normal feet were studied for tibial torsion with the help of ultrasonography as control group.

In normal children the distal posterior tibial plane was found to be externally rotated in relation to the proximal posterior tibial plane. Combining readings from right and left legs, the mean external torsion was 38.13 degrees(standard deviation 9.194 degrees) . There was no significant difference in the mean angle at different ages ($p< 0.05$).

Children with CTEV had the mean external torsion of the tibia in the affected leg or legs of 18 degrees (standard deviation 2.7), which was significantly less than 38.13degrees; the mean angle of control legs ($p< 0.05$).

We used Mann Whitney test to compare the results of the study and control group. The p value came out to be less than 0.05.

Thus we conclude that children with CTEV had less external torsion in tibia, as compared to normal children.

Table 1: values of mean external rotation in study and comparison groups

	GROUP	N	Meanexternal torsion in degrees	Mean Rank	Sum of Ranks
Tibial torsion	Study	30	18±2.7	16.02	480.5
	Comparison	30	38.13±9.19	44.98	1349.5
Mann-Whitney U			15.500		
p value			< 0.05*		

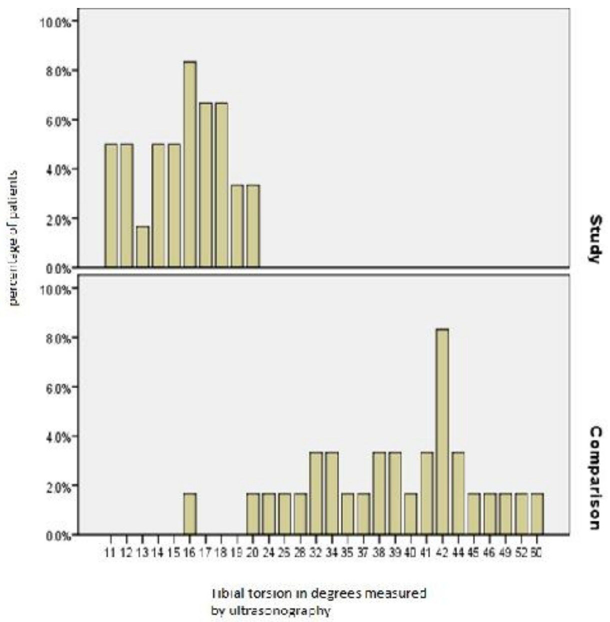

Fig 3 : Graphical presentation of the tibial torsion values in study and comparison groups

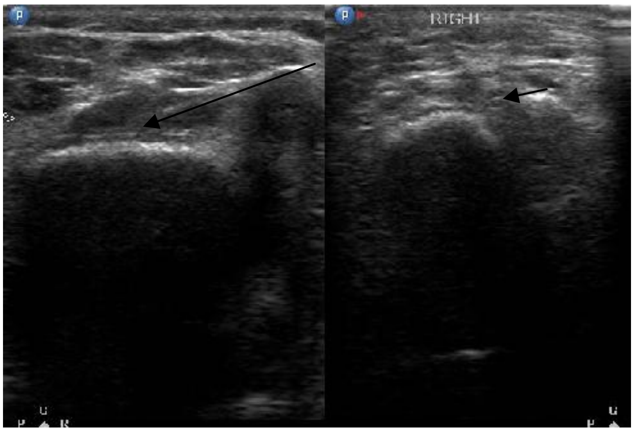

Fig 4: Left half of image showing ultrasonographic representation of proximal tibial plane with long black arrow and right half showing the distal tibial plane with a short black arrow.

DISCUSSION

Clubfoot deformity was first described by Hippocrates around 300 B.C. Since then many people have done research on clubfoot and it's management. Descriptions of pathological anatomy in clubfoot can be found in some of the earliest orthopaedics writings and continue to be essentially correct today, even as we have more sophisticated methods of imaging to quantitate that deformity.

Several authors have called attention to the internal-rotation deformity within the long axis of the tibia, which not infrequently accompanies congenital club-foot. Thus every one interested in the treatment of club feet recognizes this concomitant deformity, but opinion is divided with regard to its correction. Campbell[10] in his recent book stated that, with rare exception, the internal-rotation deformity of the tibia may be disregarded from a surgical viewpoint. In an endeavor to clarify his own position, he reviewed a series of sixty-two consecutive cases of congenital club feet that had been followed for periods varying from two to five years, and the conclusion was reached that not only does tibial torsion accompany club-foot in a higher percentage of cases than was formerly believed, but it also occurs in sufficient degree to warrant surgical correction.

It was during the follow-up period on some cases of bilateral club-foot that attention became focused upon tibial torsion as a factor in recurrence of the deformity. Previously it was noted that adduction was the chief deformity recurring in those feet which relapse, and closer observation has now- revealed that in over 90 percent of these cases tibial torsion was present in the leg which showed recurrence and absent in the others which had maintained its correction.

Before the equinovarus deformity has been corrected it is often difficult to determine whether internal rotation of the tibia is present, or if present to what degree. However, after the equinovarus has been corrected and the Child is walking, it is easy to detect tibial torsion, since the child invariably ‘'toes in "on the affected side. A line dropped from the anterior superior spine of the ilium, bisecting the patella, will fall to the lateral border of the foot. Outside the little toe, instead of between the great and second toes as is normal. With the patella pointing straight forward, palpation of the malleoli at the ankle will show the external malleolus to be anterior to the medial malleolus instead of parallel to it as is normal. Thus, when the child is walking, the weight-bearing thrust falls obliquely across the long axis of the foot and drives the navicular around to the medial side of the head of the talus with recreation of the adduction deformity of the forefoot. If this same vicious force is allowed to continue, varus of the heel and inversion of the foot will follow the adduction deformity. These undesirable sequelae to correction of clubfoot can be obviated if a rotation osteotomy of the tibia is done when tibial torsion is present.

For that matter, we require a method to measure tibia l torsion, which is simple, less time consuming, easily available, with no health hazards to patients, and as accurate as possible.

There are several publications on precise methods for measuring tibial torsion.

The method described by Tohno at the 12th congress of SICOT in 1973, using axial tomography, is perhaps the most precise, but is also the most complicated, costly and time consuming. On the other hand our method is simple, cost effective, less time consuming and as precise as the method described by Tohno.

Some of the simpler clinical methods as reported by Dupuis[11] in 1951 or Weissman[12]in 1954 use the patella as a point of reference, so that the resultant values obtained are a combination of rotation at the knee and torsion of the leg itself. Thus they are less accurate. The X-ray measurement described by Rosen & Sandick[13] (1955) is relatively costly, with some radiation hazards and time consuming as compared to the simpler clinical methods and is no more precise. With the tropometer and the caliper--the main practical difficulty was exact location of the medial malleolus in severely deformed feet of small children. This accounted for the difference in values as reported by two observers. The caliper appeared, however, to give more reproducible results. It is generally agreed that clinical methods for measuring tibiofibular torsion are subject to a wide range of inter-observer error (Luchini and Stevens [14] 1983). They all use the bimalleolar plane as the distal line of reference ; the malleoli are not easily defined, and the fibula is potentially mobile within the fibular notch (Khermosh, Lior and Weissman 1971).This is not a problem with our method as we depend on articular margin of tibia which can be objectively localized by ultrasonography. Joseph [15]et al 1987 reported the results of many of the previous studies of tibiofibular torsion. Methods using a torsionometer applied to the malleoli produced mean values in normal children of less than 20 degrees (Wynne-Davies l964; Turner and Smillie 1981). These results were confirmed by Hutchins et al (1986) who used computerised tomography (CT). Measurements of torsion in which the posterior tibial surfaces are defined by CT scans or ultrasound, are more accurate (Butler-Manuel, Guy and Heatley 1990).

Thus, in the normal child, the bimalleolar plane is externally rotated. Hutchins[16] et al (1986) found that the bimalleolar plane became more externally rotated during growth, the torsion being only about 10 degrees in the neonate, confirming reports of others who have used the malleoli as the distal reference plane (Ritter, De Rosa and

Babcock 1976; Staheli et al 1985). According to Lloyd Roberts et al.[17] (1974) and Swan et al (1969), the hind foot and ankle mortise of incompletely corrected clubfeet are laterally rotated on a tibia which itself has no rotational deformity. Such a rotation is a complication of previous treatment.

Our study shows that ultrasonography can be effectively used to measure tibial torsion. It is safe, simple, quick and very precise .Also ultrasonography is available at most of the places.

Our results show that external torsion is diminished in the affected legs of patients with CTEV.

The mean external torsion was 38.13degrees (standard deviation 9.194 degrees), in children with CTEV compared to 18 degrees (standard deviation 2.7) in normal children. We found no limitation to our study.

As the values of tibial torsion in normal as well as in children with CTEV were showing skewed distribution, Mann Whitney test was applied for statistical analysis. The difference found was statistically significant ($p< 0.05$) .Thus children with CTEV have a relative internal tibial torsion, despite treatment involving repeated dorsiflexion and eversion. We believe such manipulation may be responsible for the clinical observation of posterior displacement of the distal fibula (Swann et al 1969). Wynne-Davies (1964a) reported such displacement as seen on lateral radiographs of the feet of patients with CTEV. However, for such views the radiographer places the plate parallel with the forefoot, and any residual forefoot adduction may lead to an apparent posterior displacement of the fibula (Simmons 1978).

If manipulation leads to fibular displacement it may also be responsible for the late stiffness found in the feet of children with CTEV. We hope in the future to define fibular position at various stages during therapy using ultrasound or CT scans in the transverse plane. External tibial osteotomy seems only appropriate in these rare instances of marked internal torsion which are not associated with posterior fibular dislocation. One hesitates to draw a hard and fast limit to the degree of deformity which requires attention, since correction means an open operation on a young child. Many of the surgeons feel, however, that no tibial torsion of 15 degrees or more should be disregarded. There is an advantage in derotating the tibia as soon as the foot is corrected, because the child is already accustomed to the plaster casts.

We look forward to find out the relation between the abnormal tibial torsion and recurrence of deformity or under correction of deformity in children with CTEV in our future study so that these problems can be anticipated and addressed early.

CONCLUSION

Our results show that external torsion is diminished in the affected legs of patients with congenital talipes equinovarus. Thus they have a relative internal tibial torsion, despite treatment involving repeated dorsiflexion and eversion. Hence we propose that ultrasonogtraphy is an inexpensive, readily available, less hazardous and effective tool to find out the proximal and distal tibial planes and to calculate the angle between them i.e. the tibial torsion.

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Conflict of Interest: We had no conflicts of interest

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