

Corrective Anterior Bowing Tibial Orthosis

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Abstract: Tibial bowing specifically refers to bowing of the diaphysis of the tibia with the apex of the deformity directed anterolaterally, anteromedially, or posteromedially. The congenital anterolateral bowing of tibia and fibula is accompanied by shortening, a common denominator of "congenital pseudoarthrosis of the tibia" was first suggested by Nicoll in 1969s. Understanding the nature of the deformity and establishing the correct diagnosis are very important. The aim of this project is to design and develop a modified orthosis for correction of anterior bowing of tibia. It was found that Anterior directed torsional force creates sufficient anterior translation of upper part of tibia with deflecting couple and such administration will result in gradual reduction of bone bowing reference tubercular. Continuous & periodical changing in bending moment results in appreciable reduction in bowing.

Keywords: Anterior tibial bowing, corrective orthosis

1. Introduction

Tibial bowing specifically refers to bowing of the diaphysis of the tibia with the apex of the deformity directed anterolaterally, anteromedially, or posteromedially. The congenital anterolateral bowing of tibia and fibula is accompanied by shortening, a common denominator of "congenital pseudoarthrosis of the tibia" was first suggested by Nicoll in 1969s. The reported incidence of Congenital pseudoarthrosis of the tibia (CPT) varies between 1: 140, 000 and 1: 250, 000 and bilateral forms are extremely rare. The tibia shows area of segmental dysplasia resulting in anterolateral bowing of the bone. The osseous dysplasia leads to a tibial nonunion and, because of tibial bowing and reduced growth in the distal tibial epiphysis, shortening of

the limb usually occurs. The disease becomes evident within a child's first year of life.

Classification

- Anterolateral bowing is associated with pseudoarthrosis of the tibia and neurofibromatosis.
- Posteromedial bowing is associated with fibular hemimelia.
- Congenital anterolateral bowing of the tibia is a rare deformity that may lead to pseudoarthrosis and risk of fracture.
- It is found in 50 - 55% of patients with posteromedial bowing.
- Only 6 - 10% of patients with neurofibromatosis will have anterolateral tibial bowing.



Aim and Objective

Aim

The aim of this project is to design and develop a modified orthosis for correction of anterior bowing of tibia.

Objectives:

As it is a structural developmental progressive disease it can be corrected through orthotic approach.

2. Literature Review

R Mohanty* and P. Kumari (2012) had done study on posteromedial tibial bowing by use of AFO. The innovative design of AFO used in this study was effective in controlling the progression of the deformity, preventing other complications etc. The use of orthosis with therapeutic effect can markedly improve the rate of resolution of deformity. A good follow up of the patient can give marked correction of the deformity with improved gait.

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3. Materials & Methods

Case Study

A 4 year old female child presented to P&O department of SVNIRTAR, with B/L anterolateral tibial bowing presented since birth, dimple in the skin post to apex of the bowing. The AP radiograph revealed lateral bowing and lateral radiograph revealed anterior tibial bowing at distal 1/3rd of leg B/L. the child was able to walk.



Design Concept

Each treatment aims to obtain a long term bony union of tibia and fibula, to prevent limb - length discrepancy, to avoid mechanical axis deviation, soft tissues lesions, nearby joint stiffness, and pathological fractures. The principle of orthotic management is alteration of abnormal compressive forces on posterior aspect as well as abnormal tensile force on anterior aspect so that normal growth will resume with the correction of deformity. The patient was fitted with an custom moulded dynamic AFO with turnbuckle mechanism. The design feature includes two posterior shell (foot&calf) with attachment of turnbuckle and laterally a attachment bar. Pressure pad at the apex of curve, which was encircle on the bar.

Component

- Calf shell.
- Foot and ankle enclosure.
- Turnbuckle.
- Lateral bar with adjustable plate.
- Corrective pad with straps.





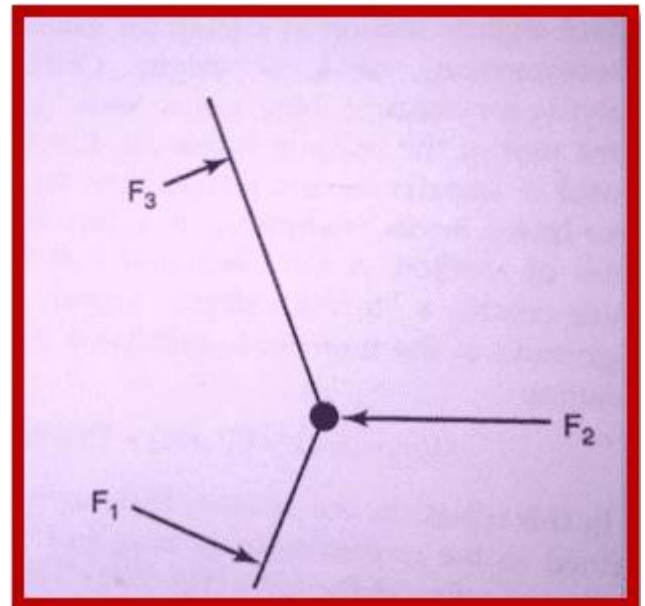
Posterior frame work with proximal anterior directed force in consultation with rotational effect is a demand for a correction. The requirements is being conceptualized through a bipart AFO system with posterior upper section swiveling against angular adjustment device and stabilization. Once the distal segment is contact with foot and stabilized through a strap the upper swiveling part can rotate in a clockwise manner to create adequate anterior directed force for straightening of the anterior bowing of tibia. Corrective pad with straps was attached on the apex of the bowing. The strap was fixed on the rod of the turnbuckle mechanism passes anteriorly with fastened corrective pads on apex of curve, encircles the leg and fastened on d - ring which is fixed on turnbuckle rod posteriorly. This will give medial directed force for correction of lateral bowing of tibia.

Biomechanics

This innovative orthosis is based on principle of:

- 1) Transverse load by 3 point force system
- 2) Static progressive prolonged stretch.





The said corrective orthosis is a two base system:

- 1) The stationary proximal elongated foot shell.
- 2) restricted movable proximal calf shell capable of formation of bending moment.
- 3) The bending moment governed through a posterior turnbuckle twister.

Operative Mechanism

The foot and the distal end of tibia is fixed under the shell, whereas the upper part is moving in clockwise way to reduce anterior bowing through bending moment component. The bending moment is concentrated through posterior support. Required bending moment also actuated through posterior turnbuckle.





4. Result

Anterior directed torsional force creates sufficient anterior translation of upper part of tibia with deflecting couple and such administration will resulting gradual reduction of bone bowing reference tubercular. Continuous & periodical changing in bending moment results appreciable reduction in bowing.



5. Conclusion

The device is very simple in design light in weight & acceptable to pediatric group. But it is customized under individual patients requirement. Anterior bowing of tibia is a progressive mal structure phenomena. The mal structure growth from epiphysis can be corrected through proper

support and corrective device. The continuous use of the device will minimise the bowing gradually through periodical alignment; s

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