

Case Report

# Effectiveness of Modified Patella Tendon Bearing Orthosis for Distal Tibial Fracture - A Case Report

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## ABSTRACT

**Background:** According to the AO/OTA classification, the term ‘distal tibial fracture’ includes a heterogeneous group of fractures that involve the distal part of both tibia and fibula. The modified patellar tendon bearing orthosis may be a good option for patients who would functionally deteriorate. This brace was introduced 60 years ago; however, it is under-utilized clinically and underrepresented in the literature.

**Case Description and Methods:** A 19-year-old boy with multiple deformities (distal tibial fracture of left leg, leg length discrepancy, equines contracture and ankle instability) resulting in an unstable ankle, who through the use of modified patellar tendon bearing orthosis, was able to walk at a supervision level without additional assistive devices. After the fitment of orthosis the subject was assessed and the gait parameters were taken on 6 meter walking way.

**Result:** After the fitment of orthosis with initial gait training, he was able to walk independently without any crutches.

**Conclusion:** Modified PTB orthosis can be considered as a very excellent orthosis for the orthotic management of distal tibial fracture. As this orthosis fulfils all the desired function with some additions like light weight, good cosmesis and better weight transmission.

**Key words:** Modified patella tendon bearing orthosis, multiple deformities, distal tibial fracture, non-weight-bearing, Gait parameters.

## INTRODUCTION

A fracture is dissolution of bony continuity with or without displacement of the fragments. It is always accompanied by soft tissue damage of varying degrees; there are torn vessels, bruised muscles, lacerated periosteum, and contused nerves. Sometimes there are injured internal organs and lacerated skin. The trauma to soft tissue must always be taken into consideration and is often vitally more important than the fracture itself. <sup>[1]</sup> Extensive tissue and muscle loss around the weight-bearing joints of the lower limbs, such as the foot-

ankle complex, can lead to immobility in patients with distal tibial fracture.

To mitigate this challenge, the modified patella tendon bearing orthosis was designed to offload the foot ankle joint and to shift weight-bearing onto the knee joint.

We describe here the case of a patient who was unable to bear weight through the foot-ankle complex due to distal tibial fracture resulting from a severe road traffic accident, but who could ambulate successfully with the use of modified PTB

orthosis and make progress in his daily rehabilitative programme.

The aim of the study was to design & fabricate a light weight effective modified patella tendon bearing orthosis for the management of distal tibial fracture and the main objective was to know the effectiveness of the orthosis in the distal tibial fracture patient by using the spatio-temporal parameters of gait and energy expenditure.

## MATERIALS AND METHODS

### Subjects

A sample convenience of one patient (age 19 years) with multiple deformities mostly distal tibial fracture took part in this study. The patient was recruited from Chennai, India. The age, gender and other anthropometric data were collected from the patient. A detailed explanation of the study was given to patient, after he signed on an informed consent form.

### CASE REPORT

We treated a 19-year-old boy who sustained multiple deformities when he came into contact with a road traffic

accident. Prior to injury the patient had normal independent functional levels. Physical examination revealed the distal tibial fracture of left leg, leg length discrepancy, equines contracture and ankle instability.

Initially, the patient was at a dependent level functionally, requiring an overhead lift for transfers out of bed and 2-person assistance for mobility in bed. The patient was limited to walking 5 feet. Orthopaedic surgery made the patient non-weight bearing through the left ankle 1 month after hospitalization and it was decided that the ankle would need to be surgically fused. The patient's functional status slowly improved throughout his hospitalization.

At this time it was determined to initiate the modified PTB orthosis. (Fig 2 and 3) The modified PTB orthosis was custom-made with Polypropylene molded. A "Z" cut was made to allow easy passage of the limb and two straps were fastened to hold it securely. During fitment time we found patient was able to walk nicely with some minor gait deviations.



FIGURE 1: Patient limb



FIGURE 2: Modified PTB orthosis



FIGURE 3: Patient with Modified PTB orthosis

Our objective was to know the effectiveness of modified patella tendon bearing orthosis in the distal tibial fracture patient. So we investigated it through gait parameters.

### Methodology

The subject was assessed and the following parameters were taken on 6 meter walking way. Step length, stride length, base of support, cadence and PCI. After using the

orthosis for 15days we had done the data analysis. All measurements are started from ipsilateral side.

### RESULT

Previously the patient was not able to take load over the affected leg resulting which he was unable to walk. So for ambulation purpose he was using axillary

crutches. After the fitment of modified patella bearing orthosis with initial gait training, he was able to walk independently without any crutches. (Table 1)

TABLE 1: The gait parameters of the subject during walking with modified patella tendon bearing orthosis.

Step Length in cm	45 ± 8.507
Stride Length (Rt. Side) in cm	90 ± 7.169
Stride Length (Lt. Side) in cm	91.2 ± 6.369
Cadence	97 Steps/minute
Base of Support in cm	14.775 ± 2.593
Physiological Cost Index	0.26

## DISUSSION

The conventional PTB orthosis was first introduced in 1958, [2] but later it was replaced by light weight polypropylene material. After the original report of Sarmiento [3] the unloading effect of the PTB cast was measured by a number of investigators. [4-6] Using hydraulic measurement Sakurai et al [4] found that a load of 40 kg led to a pressure of 9 kg (22.5%) on the patellar tendon. Svend-Hansen et al [5] measured the unloading effect using a pressure transducer on the sole of the foot and found no difference in the unloading rate between a below-knee cast, a PTB cast and an above-knee cast. Other authors also found that the unloading effect of the PTB cast was disappointing. [4, 6]

This plastic design is good in cosmetic appearance as well as provides good strength for weight bearing. This is a bivalve design, so straps are required to fasten it. Sometimes when these straps are not fastened properly weight bearing by the patient becomes very difficult and the whole concept of PTB fails as it does not provide adequate support. In modified PTB orthosis the above said problems were solved by making the orthosis into a single piece. But a "Z" cut was made to allow easy passage of the limb and two straps were fastened to hold it securely.

During fitment time we found patient was able to walk nicely with some minor gait deviations. He was having a good Cadence and maintaining a good base of support, but his step lengths were not even

may be due to psychological effect of falling.

During patient's ambulation time physiological cost index was found normal. So, patient does not have to expend more energy while walking. This makes the device more energy efficient.

As this design was completely new for the patient with gradual use and gait training the step lengths can be normal. This design also accommodates the leg length discrepancy by providing heel wedge, which could have played a role for uneven step length.

Although satisfactory results were achieved in this case with the modified patella tendon bearing orthosis, further investigation is needed to prove the consistency of the result.

Limitations of the modified PTB orthosis also need to be considered. Skin integrity of the weight-bearing surface (patellar tendon) needs to be closely monitored for tears, abrasions, and irritation. Equines deformity of the involved leg will necessitate more lift or platform to the contralateral leg. Also, some skill is needed to don the modified PTB orthosis, to ensure that the patient is only putting weight through their patellar tendon.

Future research should identify more populations in a variety of health-care systems that may benefit from a modified PTB orthosis.

## CONCLUSION

This case study brought to light a unique orthotic management for distal tibial fracture. Through this study it has been proved that design is very convenient to use, light in weight, good in cosmetics and provides better weight bearing for ambulation. So, it is an appropriate option in choosing the best orthotic treatment for the patients with distal tibial fracture.

## Conflict Of Interest

The author does not have any conflict of interest regarding research, authorship and publication of this article.

**Abbreviations:** AO/OTA - Association for Osteosynthesis/Orthopaedic Trauma Association, PTB - Patella Tendon Bearing, PCI - Physiological Cost Index.

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How to cite this article: Tamizhini N, Behera M. Effectiveness of modified patella tendon bearing orthosis for distal tibial fracture - a case report. Int J Health Sci Res. 2019; 9(3):333-336.

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