

# Effectiveness of Modified Dual Axis Knee Brace in Case of Genu Recurvatum - A Case Report

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## ABSTRACT

**Background:** Genu Recurvatum is a deformity of knee joint that tends to push it backwards by excessive extension in tibiofemoral joints. This poses a significant challenge because of technical difficulties and a high incidence of recurrence. Knee braces are used to improve genu recurvatum, but evidence is limited concerning their effectiveness. Therefore, the aim of this study was to investigate the effect of changing the Hyperextension angle and pain of Modified Dual Axis Knee Brace on genu recurvatum patient.

**Case Description and Methods:** A 19-years-old boy diagnosed with right side genu recurvatum was fitted with a modified dual axis knee brace to reduce the knee hyperextension angle and to reduce the knee pain. The medio-lateral radiographs were analysed for measuring the knee hyperextension angle. After the fitment of orthosis for 2 months the subject was assessed and the knee hyperextension angle was

check with the help of goniometer and the pain with the help of numeric rating scale.

**Result:** After the fitment of Modified Dual Axis Knee Brace for person with knee hyperextension may help in reducing the hyperextension angle of knee and pain, whereas increasing the walking ability.

**Conclusion:** Modified Dual Axis Knee Brace is an effective knee brace for treatment of Genu Recurvatum. However, a further analysis including a greater number of patients and revision follow-up is necessary for generalizing this study.

**Key Words:** Genu recurvatum, modified dual axis knee brace, NRS-11, pain.

## INTRODUCTION

Genu recurvatum is a deformity in the knee joint, so that the knee bends backwards. In this deformity, excessive extension occurs in the tibiofemoral joint. Genu recurvatum is also called knee hyperextension and back knee. This deformity is more common in women and people with familial ligamentous laxity. <sup>(1)</sup> Hyperextension of the knee may be mild, moderate or severe. Genu Recurvatum can be caused by several causes. These include muscle weakness, especially of the muscles in the top of the thigh (quadriceps), it can be due to injury, or it can occur due to the

shape of one's bones at their knee. Genu recurvatum is hyperextension of the knee of more than 5°, in which the ground reaction force line is anterior to the knee axis. <sup>(2)</sup>

Depending on the aetiology of Genu recurvatum, treatments include physical therapy, functional methods of electrical stimulation or electro goniometric feedback, <sup>(3, 4)</sup> botulinum toxin A injection in cases in which Genu recurvatum is due to spasticity, <sup>(5, 6)</sup> orthoses, such as ankle foot orthoses (AFOs), <sup>(7,8)</sup> knee-ankle-foot orthoses (KAFOs), <sup>(2)</sup> knee orthoses (Swedish knee cages) <sup>(9)</sup> or hinged soft knee orthoses, <sup>(10)</sup> orthopaedic surgery, <sup>(11)</sup> or selective tibial

neurotomy. <sup>(12)</sup> Making clinical decisions in Genu recurvatum is difficult because of the wide range of aetiologies. Step-by-step analysis can be useful to define the main cause of Genu recurvatum and choose the best treatment. <sup>(13)</sup> Studies on orthotic devices for Genu recurvatum have been conducted on AFO and KAFO users, <sup>(2)</sup> the use of knee orthoses (Swedish knee cages) has been assessed, <sup>(14)</sup> and the effectiveness of AFOs vs KAFOs has been compared. <sup>(15, 16)</sup> To assess the effectiveness of KAFO treatment, some authors have analysed the improvement in gait parameters, <sup>(15-19)</sup> while others have studied energy savings. <sup>(7, 20-23)</sup>

A modified dual axis knee brace is a new idea with dual axis knee mechanism. The orthosis fits to the contour of the thigh and leg this dual axis joint allow each other from extension to flexion There is no chance of slippage. This also protect knee from varus and valgus force. It is light in weight and comfortable to be because its flexibility the design is simple and cost effective.

The Aim of the study was to design and fabricate the new design modified dual axis knee brace for the correction of genu recurvatum. Objective was to know the effectiveness of modified dual axis knee brace in case of Genu recurvatum in terms of reduction of knee hyper extension angle, and Pain.

## MATERIAL AND METHOD

A sample convenience of one patient (age 19 years) with right side genu recurvatum 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. The aetiology of knee hyperextension was congenital. The patient bears pain before the study. The patient was instructed to wear the orthosis as much as possible at the time of walking or about 12hours/day. The knee brace was taken off every 1 to 2 hours for strengthening exercises of lower extremities. The subject was assessed and the following parameters were taken for knowing the effectiveness of the knee brace: Knee hyperextension angle and pain.

After using the knee brace for 2 months we had done the data analysis.

### Fabrication procedure of the Modified dual axis knee brace

Casting and rectification of the positive mold was done as per the principle of fabrication of knee braces. Components of the knee brace (Figure 1) were aligned with concept of 3 point force system. Two posteriorly directed forces through anterior thigh and leg shell. One anteriorly directed forces through posterior flexible band. This design prevents hyperextension of knee.

Various straps & D-rings were attached for snug fitment of the knee brace.

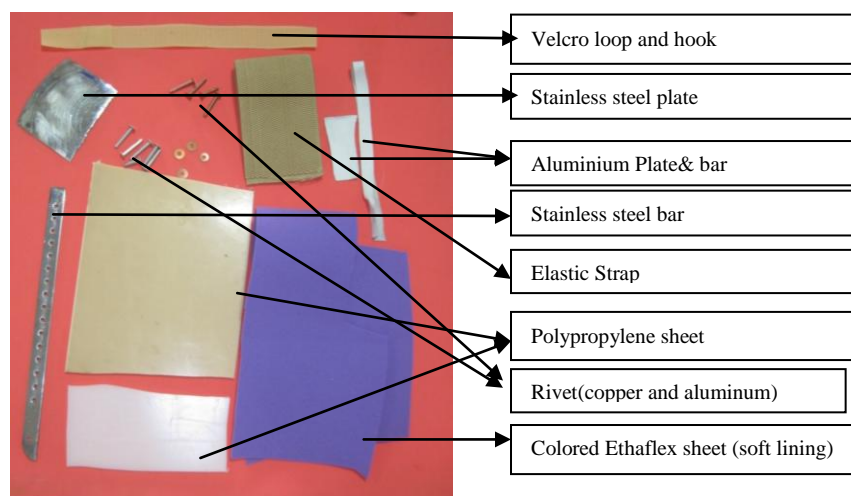


FIGURE 1: Components of the Modified dual axis knee brace

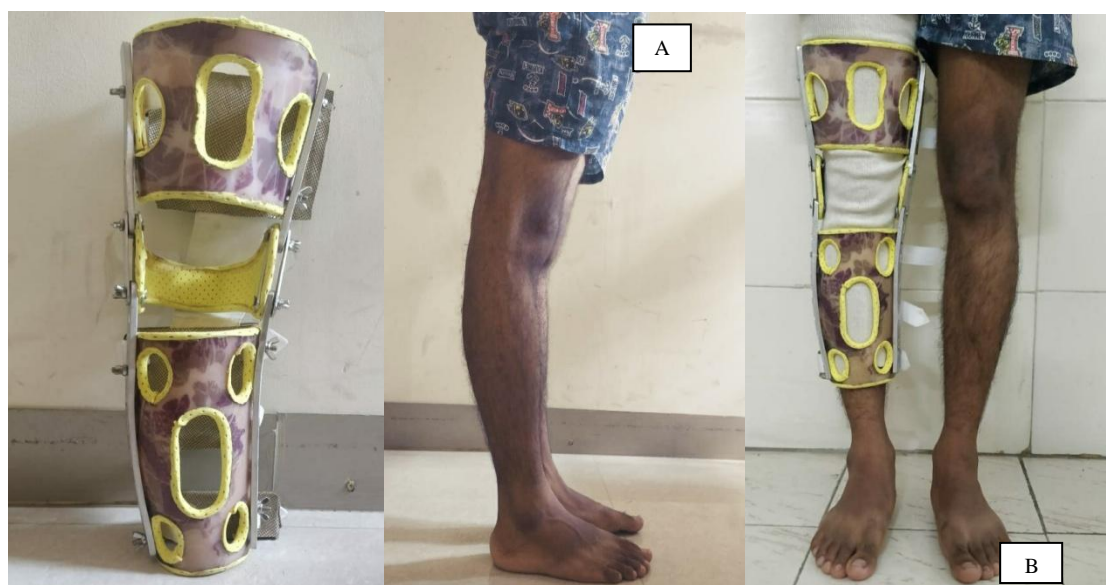


FIGURE 2: Modified dual Patient with right knee Hyperextension degrees Axis knee brace before (A) and after (B) fitment of brace

### Assessment

To calculate the Knee hyperextension angle using Goniometer, we measured the angle formed by lines drawn to bisect the greater trochanter to lateral epicondyle and from epicondyle to lateral malleolus. Knee hyperextension angle was obtained through radiographic measurements before and after the use of modified dual axis knee brace.

### Pain:

The pain felt during walking was recorded by an 11-point numeric rating scale (NRS-11).<sup>(24)</sup> It consists of pain intensities, which

range from 0 to 10, reflecting an increase in pain.

### RESULT

Knee hyperextension measurements were made with traditional goniometer. The knee Hyperextension before orthosis was 30 degrees whereas the post orthosis knee hyperextension was 5 degrees.

Pain assessments were measured with 11-point numeric rating scale (NRS - 11). Pain score 8 was found in pre-test which decreases to 4 after intervention of the knee brace.

Table 1: Summary of clinical data

Subject	Age/Sex	side	Hyperextension Angle of knee		Pain Assessment		Duration of Orthosis
			HAKB	HAKA	PAB	PAA	
1	19/M	Rt. Side	30	5	8	4	2Months

### Abbreviations:

HAK: Hyperextension Angle of Knee, HAKB: Hyperextension Angle of Knee Before intervention, HAKA: Hyperextension Angle of Knee After intervention, PA: Pain Assessment, PAB: Pain Assessment Before intervention, PAA: Pain Assessment After intervention.

### DISUSSION

This study was set out to evaluate the effect of modified dual axis knee brace on Hyperextension angle and Pain in subjects suffering from Genu Recurvatum. It was hypothesized that there may be a significant effect of Modified Dual Axis Knee Brace on Hyperextension Angle and Pain in case in Genu Recurvatum.

A significant decrease in knee hyperextension (the primary outcome measure) during the stance phase of gait

confirms that the modified dual axis knee brace was indeed effective in controlling excessive genu recurvatum.

The 3-point force system of the orthosis controls hyperextension of knee and maintained the knee in pre flexed position by the anteriorly directed force of posterior cuff shell / flexible band and posteriorly directed by the anterior thigh shell and leg shell.

The Present design is more physiological as it provides opportunity for free swing in gait

cycle and also subjects have demonstrated success in using Dual Axis Orthotic knee and also subjects being stable, secure and comfortable.

This knee brace is weight less (670 gm) as compare to the conventional knee brace (1050 gm). From the result it observed that there was significantly more pain reduced and walking ability improved by using Dual Axis Knee Brace and patient walk in Natural Gait.

Subjective evaluation demonstrated that the orthosis was comfortable, cosmetically highly acceptable, allowing natural swing. The only disadvantage being donning and doffing at first time use, but we found it is comfortable after repeated use within a week.

## CONCLUSION

The Modified Dual Axis Knee Brace is an effective, light weight and low-cost method for treatment of genu recurvatum. Result of the study suggested that there are statistically significant a change is found in Hyperextension Angle and Pain while using Modified Dual Axis Knee Brace. Hence it can be concluded that Modified Dual Axis Knee Brace can be used as an effective knee brace for treatment of Genu Recurvatum. However, a further analysis including a greater number of patients and revision follow-up is necessary for generalizing this study.

## Conflict of Interest

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

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How to cite this article: Behera M, Jacob F. Effectiveness of modified dual axis knee brace in case of genu recurvatum - a case report. *Int J Health Sci Res.* 2020; 10(8):239-243.

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