

Case Report

# Effectiveness of the Static Progressive Knee Orthosis for the Reduction of Knee Flexion Contracture

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## ABSTRACT

**Background:** Post burn knee flexion contractures cause functional limitations of all lower extremity, not allowing the patient to walk normally, creating serious cosmetic defects, and therefore, requiring surgical reconstruction. Treatments of knee flexion contractures have included non-surgical and surgical methods. Traditional methods are of limited benefit in severe and fixed contracture. A static progressive knee orthosis was developed from daily use knee orthosis and is designed to provide low load, and gradual and prolonged stretching. This orthosis may be a good option for patients who would have severe knee flexion contracture.

**Case Description and Methods:** The splint was used in 3 cases of knee flexion contracture. The etiology of contracture was burn scar contracture. All the 3 patients through the use of static progressive knee orthosis were able to reduce knee flexion contracture angle and pain. After the fitment of orthosis for 2 months the subjects were assessed and the knee range of motion angle were checked with the help of goniometer and the pain with the help of numeric rating scale.

**Result:** After the fitment of static progressive knee orthosis for person with knee flexion contracture may help in reducing the pain and flexion contracture.

**Conclusion:** The static progressive knee orthosis is an effective and low cost method for treatment of knee flexion contracture in case of burn scar contracture.

**Key words:** A Static Progressive knee orthosis, knee flexion contracture, pain, Numeric rating scale, knee range of motion

## INTRODUCTION

Knee post burn scar flexion contractures, making up 22% of large joint contractures, <sup>(1)</sup> affect the leg motion, impair the lower extremity function, present cosmetic defects, and requiring surgical and non-surgical treatment. The non-surgical method consists of passive stretching <sup>(2,3)</sup> with physical modalities, joint mobilization, traction and serial casting. Physical therapy needs experienced therapists and may fail in severe and fixed flexion contracture. Serial casting may result in pressure ulcers and stiffening of the joints. <sup>(4, 5)</sup> It must be done

by skilled personnel and requires re-casting every few days. Orthosis and splints were used to prevent deformities or maintain range of motion after stretching but not for increased motion.

A static progressive knee orthosis (Figure 1) was developed from daily use knee with turnbuckle mechanism, which provides low load, gradual and prolonged stretching. This orthosis was the first locally made static progressive splint in Thailand although it was not a new idea. There have been many designs of the orthosis, which differ from the one we have used. <sup>(6-14)</sup>

We describe here, the case of 3 patients who were unable to straight their leg through the knee due to knee flexion contracture resulting from burn accidents, but who could ambulate successfully with the use of static progressive knee orthosis and make progress in their daily rehabilitative program.

The Aim of the study was to design and fabricate the static progressive knee orthosis for the management of the reduction of knee flexion contracture and restore the joint active range of motion. Objective was to know the effectiveness of static progressive knee orthosis in knee flexion contracture by taking the knee range of motion and pain assessment.



FIGURE 1: Static Progressive Knee Orthosis



FIGURE 2: Case 1 with right knee flexion contracture 60 degrees before (A) and after (B) fitment of orthosis

## MATERIAL AND METHOD

### Subjects

A sample of convenience of three patients with knee flexion contracture took part in this study. The patients with fixed flexion contracture of knee joints were treated with the static progressive knee orthosis. Three females were included in the study. The patients were recruited from Chennai, India. The anthropometric data were collected from the patients. A detailed explanation of the study was given to all the patients, after they signed on an informed consent form. The average age was 19.33 years old (range 16 to 24 years). The etiologies of knee flexion contracture were burn scar contracture. All the patients received an operation before the study. The patients were instructed to wear the splint as much as possible or about 18 hours/day, including nighttime. The splint was taken off every 1 to 2 hours for range of motion exercises and hygiene care. The patients were taught to adjust the telescopic rod themselves for appropriate force for

stretching to the point of discomfort, but pain, four times a day.

### Methodology

The subjects were assessed and the following parameters were taken for knowing the effectiveness of the orthosis. Knee flexion angle, knee extension angle, the arc angle and the pain assessment by numeric rating scale. After using the orthosis for 2 months we had done the data analysis.

All knee range of motion measurements were made with traditional goniometer.

Pain assessment by an 11-point numeric rating scale (NRS-11):

The pain felt during walking is recorded by an 11-point numeric rating scale. It consists of pain intensities which range from 0 to 10, reflecting an increase in pain. The numeric rating scale (NRS) is a segmented numeric version of visual analogue scale (VAS) in which the respondent selects the whole number (0 - 10 integers) that best reflects the intensity of his/her pain. The common format is a horizontal bar or line.

## RESULT

The average knee flexion before orthosis was 125 degrees (range 105 to 135) whereas the average post orthosis knee flexion was 126.6 degrees (range 110 to 135). The average knee extension before orthosis was -56.6 degrees (range -45 to -65) whereas the average post orthosis knee

extension was -10 degrees (range 0 to -30). The average arc of knee motion was improved from 68.3 to 116.6 degrees.

Pain assessments were measured with 11-point numeric rating scale (NRS - 11). Mean pain score was found in pretest,  $8.333 \pm 0.5773$  decrease to  $1 \pm 1.7320$  after intervention.

**Table 1: Summary of clinical data**

Case No.	Age/Sex	Side	Timing Before Orthosis	Pre Orthosis ROM			Post Orthosis ROM			Pain Assessment		Duration OF Orthosis
				KFLA	KEXA	KARCA	KFLA	KEXA	KARCA	PAB	PAA	
1	16/F	Right	6 Months	135	-60	75	135	0	135	8	0	2 Months
2	18/F	Left	8 Months	105	-45	60	110	-30	80	9	3	2 Months
3	24/F	Right	5 Months	135	-65	70	135	0	135	8	0	2 Months

Abbreviations:

ROM: Range of Motion, KFLA: Knee Flexion Angle, KEXA: Knee Extension Angle, KARCA: Knee Arc Angle, PAB: Pain Assessment Before Intervention, PAA: Pain Assessment After Intervention

**Table 2: Comparison of Pre and post intervention values**

Parameters	Pre intervention values (SD ± Mean)	Post intervention values (SD ± Mean)
Knee Flexion Angle (in degrees)	$125 \pm 17.3205$	$126.6666 \pm 14.4337$
Knee Extension Angle(in degrees)	$-56.666 \pm 10.4083$	$-10 \pm 17.320$
Knee Arc Angle (in degrees)	$68.333 \pm 7.6307$	$116.666 \pm 31.754$
Pain Assessment	$8.333 \pm 0.5773$	$1 \pm 1.7320$

The comparison of post intervention values showed a significance differences in all the factors. So, this result stated that the static progressive knee orthosis has good effect on reduction of knee flexion contracture and Pain in knee flexion contracture deformity. All patients can ambulate with the orthosis and they can easily adjust the telescopic rod.

## DISCUSSION

This orthosis is the first locally made static progressive splint in Thailand although it is not a new idea. But the static progressive knee orthosis is locally made, simple to fabricate and can be reused. It is effective for correcting knee flexion contractures formed by burn injuries without the need of surgeries. When compare to a previous study that used distraction with external fixator in same degree of burn scar knee flexion contracture, <sup>(15)</sup> the results were better without the need of surgery. The force of tissue stretching is controlled by the patient. The compliance of splint use is good. The patients can tolerate the pressure and be a part of the active treatment program. They

can ambulate and do daily activities with the splint. Admission to hospital is not necessary in most cases except for the patients with learning or cognitive problems.

The results depend on severity of the intra-articular damage, age of the patient, timing of the contracture, surgical procedure before the treatment, and other causes of mechanical obstruction in or around the joint.

The most dramatic result was found in all the 3 cases after the use of Static Progressive Knee Orthosis. It is important to instruct the patient to take the orthosis off regularly for range of motion exercises, especially flexion motion. There were decreases in flexion in the patients who wore the splint for a long time without range of motion exercise that could be improved after appropriate instruction. The total time of using the splint per day varied among the patients. There were many reasons why the patients did not follow the instructions such as discomfort from improper orthosis fitting, skin allergy to the material of the orthosis, rather heavy weight of the orthosis in the

patient with weakness, embarrassment, and some activities in the water or a dirty environment.

## CONCLUSION

The static progressive knee orthosis is an effective and low cost method for treatment of knee flexion contracture formed through burn injuries. Hence it can be concluded that, A Static Progressive Knee Orthosis can be used as an effective knee orthosis for treatment of Knee Flexion Contracture. However, a further analysis including more 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.

## REFERENCES

1. Schneider JC, Holavanahalli R, Helm P, Goldstein R, Kowalske K (2006) Contractures in burn injury: defining the problem. *J Burn Care Res* 27: 508-514.
2. Taylor DC, Dalton JD Jr, Seaber AV, Garrett WE Jr. Viscoelastic properties of muscle-tendon units. The biomechanical effects of stretching. *Am J Sports Med* 1990; 18: 300-9.
3. Threlkeld AJ. The effects of manual therapy on connective tissue. *Phys Ther* 1992; 72: 893-902.
4. Anderson JP, Snow B, Dorey FJ, Kabo JM. Efficacy of soft splints in reducing severe knee-flexion contractures. *Dev Med Child Neurol* 1988; 30: 502-8.
5. Phillips WE, Audet M. Use of serial casting in the management of knee joint contractures in an adolescent with cerebral palsy. *Phys Ther* 1990; 70: 521-3.
6. Green DP, McCoy H. Turnbuckle orthotic correction of elbow-flexion contractures after acute injuries. *J Bone Joint Surg Am* 1979; 61: 1092-5.
7. Gelinas JJ, Faber KJ, Patterson SD, King GJ. The effectiveness of turnbuckle splinting for elbow contractures. *J Bone Joint Surg Br* 2000; 82: 74-8.
8. Doornberg JN, Ring D, Jupiter JB. Static progressive splinting for posttraumatic elbow stiffness. *J Orthop Trauma* 2006; 20: 400-4.
9. Jansen CM, Windau JE, Bonutti PM, Brillhart MV. Treatment of a knee contracture using a knee orthosis incorporating stress-relaxation techniques. *Phys Ther* 1996; 76: 182-6.
10. Hepburn GR. Case studies: contracture and stiff joint management with dynasplint. *J Orthop Sports Phys Ther* 1987; 8: 498-504.
11. MacKay-Lyons M. Low-load, prolonged stretch in treatment of elbow flexion contractures secondary to head trauma: a case report. *Phys Ther* 1989; 69: 292-6.
12. Bonutti PM, Windau JE, Ables BA, Miller BG. Static progressive stretch to reestablish elbow range of motion. *Clin Orthop Relat Res* 1994; 128-34.
13. Nelson IW, Atkins RM, Allen AL. The management of knee flexion contractures in haemophilia: brief report. *J Bone Joint Surg Br* 1989; 71: 327-8.
14. Yates P, Cornwell J, Scott GL, Atkins RM. Treatment of haemophilic flexion deformities using the Flowtron intermittent compression system. *Br J Haematol* 1992; 82: 384-7.
15. Barquet A, Suero C, Cortes O, Lopez L. Slow, gradual external fixation distraction for treatment of postburn knee flexion contracture. *Plast Reconstr Surg* 1993; 91: 946-9.

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