

The Role of Polypropylene Floor Reaction-Orthosis in Post Polio Patients with Quadriceps Weakness

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Abstract

A Study of 25 cases having post polio unilateral quadriceps weakness, who were given polypropylene floor-reaction orthosis is presented here. Age of patients ranged from 2-25 years. Cases with bilateral quadriceps weakness or a completely flail limb were excluded. The patients were graded by criteria based on gait characteristics and their functional activities. Mean follow up period was 11.4 months. Rejection rate of orthosis was only 4%. Complications were minor. The author concludes that polypropylene FRO has a definite role in patients with post polio quadriceps weakness. It is quite cheap and acceptable to patients.

Introduction

Poliomyelitis is the most important cause of physical disability in India. About 2,00,000 cases of paralytic polio occur here annually. The disability is mainly due to involvement of lower limb muscles of which the most challenging situation is posed by quadriceps paralysis; with this there is a constant fear of fall because of an unstable knee. Many patients stabilise such a knee by walking with their hands on thigh which certainly is not only an awkward way of walking but also restricts the activities of the patient who is converted from a quadripod to a tripod.

Usual solution to this problem has of long been to brace the patient with long metallic calipers which are heavy, cumbersome and energy consuming devices. Moreover they lock the knee producing an unphysiological and ungainly manner of walking. Though some people do perform a hamstring muscle of walking. Though some people do perform a hamstring muscle transfer also for this condition but that has not produced much convincing results.

Saltiel J. in 1969 first gave the idea of an

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orthosis made of reinforced laminated plastic which could stabilise such a knee without locking it by producing an artificial equinus at ankle. Later Lethneis (1972) and Rubin and Danisi (1975) suggested some modifications in the saltiel design.

Principle of Floor-Reaction Orthosis (FRO)

At heel strike the weight line of body passes posterior to knee joint which in a patient with weak quadriceps would cause the buckling of knee. By producing an equinus thus ensuring an initial forefoot contact the weight line is shifted anterior to knee and stabilises it. It is called an FRO because in this the floor reaction from below is utilised via the lateral uprights to press the knee in posterior direction.

We have worked on FRO made of polypropylene (PP) which is not only light thermoplastic material but also is quite resilient and tough.

Material and Methods

25 patients irrespective of age and sex having quadriceps weakness were given FROs at Orthopaedic workshop, MCH, Rohtak. Cases

with completely flail limb, bilateral quadriceps paralysis were not taken up for the study.

Fabrication of FRO

This involves the following steps :

1. Preparation of negative mould: This is done by wrapping POP bandages over the stockinette covered involved leg from toes to patella. Pressure sensitive points are marked on the stockinette. Foot is held in 10-15 plantar flexion.

2. Preparation of positive mould : The negative mould taken off the leg is filled with POP powder with an iron mandrel put in the centre. This produces a positive mould whose surface is made as smooth as possible.

3. Thermoforming Polypropylene : 3-5 mm PP sheets (depending upon the requirement) are heated in an oven at 180-1900 for 15 minutes. The patellar part and leg part are separately heated. These are applied on the positive mould and well moulded. No sharp corners are allowed.

4. Finalising FRO : The two parts are riveted together and velcro and leather straps attached and hence an FRO is formed.

Ours is basically a PTB design but with recontouring of the patellar piece so that it is much shallower and uses maximum area as advised by Dr. P.K. Sethi (1992). Grading of patients was done as shown :

Grade I

- a) Gait characteristics : Patient walks with
 - i) Hand on thigh
 - ii) Circumduction of limb
 - iii) External or internal rotation of limb
 - iv) Forward bending of trunk
- b) Activities : Patient requires an external aid e.g. crutch or stick for walking

Grade II

- a) Gait characteristics : Patient walks
 - i) Without hand on thigh
 - ii) Without circumduction of limb
 - iii) Without external or internal rotation of limb
 - iv) With slight forward bending of trunk
- b) Activities
 - i) Patient does not use any external aid
 - ii) Patient can walk on even surfaces only and cannot negotiate slopes or uneven surfaces.
 - iii) Patient cannot run without falling

Grade III

- a) Gait characteristics : Patient walks without
 - i) Hand on thigh
 - ii) circumduction of limb
 - iii) external or internal rotation of limb
 - iv) forward bending of trunk
- b) Activities :
 - i) Patient does not use any external aid
 - ii) Patient can walk on uneven surfaces and can negotiate slopes
 - iii) Patient can run without falling Results were termed excellent, good or poor on any improvement No improvement of grade.

Observations

Of 25 patients 13 (52%) were males and 12 being females. Age varied from 2 years to 25 years, mean age being 12.4 years. 15 cases (60%) were old i.e. they had previously used the KAFO while 40% were fresh cases 22 cases (88%) had one or other associated deformity at knee, ankle or foot (Table I). Equinus was the most Common

associated deformity. 22 cases (88%) had shortening of the affected limb ranging from 0.5 cm to 3 cm. All but one case were followed up for more than 6 months. Maximum follow-up was of 18 months in 4 patients. 24 cases (96%) could sit cross legged and squat and they did not report any pain in the patellar area. No patient developed any reaction to PP. At 2 weeks of follow up, results were excellent in 13 cases (52%) and good in 11 cases (44%). Only 1 case (4%) had poor result. At 6 months of follow up 4 patients

having good result further improved to excellent thus making the final results excellent in 68% good in 28% and poor in 4% (Table II). Cost factors were taken into account and the cost ranged from Rs. 195 to 330 according to the FRO. The weight of orthosis ranged from 250 g to 500 g. No orthosis broke before 6 months. Only 4 cases (16%) broke their orthosis during follow up of which 3 were heavy weight adults. Maximum breakage was at ankle.

Table I
Associated Deformities at Knee /Ankle /Foot

Sr. No.	Type of Deformity	No. of Patients	Percentage
1.	Mild knee flexion <10.	5	20%
2.	Equinus	9	36%
3.	Cavus	4	16%
4.	Cavo-varus	2	8%
5.	Cavo-valgus	2	8%
6.	No deformity	3	12%
Total		25	100%

Table II
Results of Patients after Fitting of FRO

Pre FRO Grade	Post FRO Grade	Results	No. of pts. at 2 weeks	%age	No. of pts. at 6mths.	%age
I	III	Excellent	9	36%	9	36%
II	III	Excellent	4	16%	8	32%
I	II	Good	11	44%	7	28%
I or II	No change	Poor	1	4%	1	4%
Total			25	100%	25	100%

acceptable as any ordinary shoe can be worn over it and clothes can completely conceal it. Though the series presented is quite small, but the results are convincing and the design needs to be tried on a large scale.

Discussion

Age is no bar for an FRO as the minimum age in the study was 2 years and maximum 25 years. 60% cases had previously used a KAFO of which only 1 patient (4%) who had poor result did not accept the design while all others readily discarded KAFOs. It was seen that mild deformities at knee, ankle and foot are no contra-indication for FRO as PP being thermoplastic can be easily moulded to accommodate these. Equinus was the most common deformity found and it is rather beneficial because we produce the same by an FRO. It is known that a poliottic limb is usually shorter than the normal side. In our study shortening upto 3 cm was well compensated by FRO as the equinus induced by FRO increases the limb length. It is rather beneficial for the affected limb to be slightly shorter otherwise the shoe on normal side wears out early.

Only one patient in our study had poor results with FRO and had to be given a KAFO. Reassurance to the patient thereby developing his confidence does affect the results as shown by improvement of grade of 4 cases from good to excellent at 6 months. These cases had previously been using KAFO which though locks the knee undoubtedly provides a stable limb. They were unsure of stability an FRO could provide. But or repeated assurances and practice by themselves improved their results. Squatting and sitting cross legged forms an integral part of our life-style especially in villages. An FRO does not make these impossible thus taking care of our social needs. Pain in the patellar are was a major problem with Saltiel design. In our study no patient who had accepted an FRO developed this complication emphasising the significance of

differentiating pressure sensitive and pressure tolerant areas of knee and distributing the force over a larger surface area. Though plastics can cause skin reactions, no patient in our series reported this complication, though some patients did complain of excessive sweating in the limb wearing PP FRO which definitely is a problem with PP as it blocks the ventilation of part covered by it. PP is a fairly resilient material as is evident from the fact that no FRO broke before 6 months and total breakage during the follow up period of around 1 yr. was 4 cases (16%) of which 3 patients were heavy weight adults. In such patients stronger materials may be used like reinforced polypropylene in which glass fibre is sandwiched between two polypropylene sheets to provide extra strength or a Carlson fibre orthosis may be used. Maximum break points were at ankle area (12%) which should be made stronger because it bears maximum stress; for this raising corrugations in PP is a useful method.

The orthosis is quite light (250 g to 500 g) as compared to a conventional caliper (about 2000g), this reduces the energy consumption considerably and increases the activities of patient by increasing his fatigue period.

Cost is a very important factor for applicability of any new design as ours is a poor country and many patients are leading a treacherous life for want of funds. An FRO is quite cheap (Rs. 195 to Rs. 330) as compared to a KAFO made from Alimco components (around 1100 Rs.).design.

The present design could be fabricated in about 3 hours which is quite less and the patient can be given the orthosis even on the same day he reports to us thus minimizing his visits and expenditure.

To conclude the present design of polypropylene has a definite role in the rehabilitation of patients with post polio quadriceps weakness. It not only provides a

physiologic gait by keeping the knee free but is cheap, light weight and strong. The fabrication is not a difficult procedure and no sophisticated appliances are required for it. It is cosmetically acceptable as any ordinary shoe can be worn over it and clothes can completely conceal it. Though the series presented is quite small, but the results are convincing and the design needs to be tried on a large scale.

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