ORIGINAL ARTICLE

Role of Leg Lengthening and Foot Stabilization on Gait in Single Leg Post-Polio Paralytic Patients

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ABSTRACT

Twenty two patients (14 males and 8 females) of post-polio paralytic (PPP) involving one lower limb only, were selected for studying the outcome of leg lengthening and foot stabilization on gait. The cosmetic and functional improvements were evaluated preoperative and post-operative gait analysis was performed. Limb lengthening was done by distraction osteogenesis through NA (Naseer-Awais) and foot stabilization by triple fusion/pantalar fusion. Finally 14 cases were rated as good and 5 fair. It was observed that locally made Naseer-Awais fixator is cost-effective and well tolerated by the patients. Surgery has significant role on gait in single leg PPP patients. There is need for a proper gait analysis laboratory to plan the treatment of disabled patients.

Key words: Leg lengthening, foot stabilization, post-polio paralystic

INTRODUCTION

Normal walking is relatively effortless with minimum expenditure of energy[1]. The primary objective of human gait is translation of body from one place to another place[2]. The neuromuscular skeletal disorders have an impact on walking ability[3]. Most common cause of pathologic gait is muscular weakness.[4,5] Poliomyelitis is the most common cause of muscle weakness or paralysis[6]. In Pakistan poliomyelitis, still a big problem and bulk quantity and improvement of limb is largely concerned with restoration of muscle balance and equalization of leg[7,8]. There is no study is present which describes the gait improvement in single leg PPP patients after surgery.

In the present study, patients of single leg PPP with mentioned disability of deformities have been selected. In these patients leg lengthening has been made by fixator (Naseer-Awais) in tibia or femur. Foot stabilization has been made by pantalar/triple fusion. Gait was analyzed by visual methods before and after surgery and patient trained to walk without any orthotics.

PATIENTS AND METHODS

Twenty two patients of single leg PPP have been included in the study which have shortened lower limb, flail/weak ipsilateral foot requiring stabilization with fusion and with deformity of knee (upper limit of deformity knee flexion 40°), with no instability and deformity of hip. The hardware which were used, Naseer-Awais external fixator, Kuntscher-wire, staples, plaster of Paris, and synthetic cast material. Leg length discrepancy has been investigated with the help of scannogram. Gait of patient is analyzed by visual method, gave the detail of gait cycle events and position of foot during walk and by walk exertion data of 100 meters which gave the idea of energy consumption during walk. Comparison of gait analysis before and after surgery detailed the usefulness of surgery in single leg PPP patients. On follow-up radiographs were taken to see the progress of distraction regeneration of bone in distraction gap and angulation or deviation of the fragments, the range of joint motion of the limb checked; pin site (discharge, infection, loosening of pins), deformity contractur, subluxation of joint and neurovascular status of the limb are monitored. After leg reaches the goal of lengthening, the distraction stopped and patient is encouraged to bear weight on limb. When one regenerate (radiological +4), cast replaced the fixator and cast removed (radiological +5), walk weight-bearing allowed and trained the patient to walk without orthotic in front of mirror and role of leg lengthening and foot stabilization on gait has been evaluated.

RESULTS

In the present study the age of onset of poliomyelitis all cases ranged between 1-4 years (2±0.87), only 3 (13.4% patients of this series gave history of vaccination. The mean age of patients at the time of surgery between 10-28 years (18.5±4.65). The sex distribution in this series, males 14(63.64%) and female 8(36.36%) and involvement is more in right 16(72.73%), left 6(27.27%). The leg length shortening was observed in all patients ranged 24-

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90mm (mean 47.31±17.13). The amount of leg shortening was 104 cm, 1(4.55) patient had single level shortening in tibia and 21(95.45%) had double level shortening in both tibia and femur. The gait assessment briefs the pattern of gait of the polio patients and support status during walk, 13(59.09%) patients have gross limp knee flexion deformity, flail ankle with support) and 9(40.9%) patients have moderate limb (flail knee without support before surgery. The support status and walk stability evaluation reveals that 12(54.54%) patients put their hand on knee and 5(22.73%). Patients walk with crutches/brace and 5(22.73%) walk without support surgery. The surgical techniques are selected according to weakness, deformities and amount of shortening of leg (Table 1).

The fusion of foot stabilization in all cases was satisfactory (mean 77.21±113.9), The union of supracondylar osteotomy of femur in all cases was 100%. One case of this group lost during follow-up (mean 122.5±6.45). In all cases desire length was achieved the minimum tibial length was 24 mm and maximum length was 60mm (41.06±10.96). Minimum femoral length 30 mm and maximum 50 m (mean 38.6±13.03). The total lengthening achieved 932 mm (mean 47.4±17.25) P<0.0001. During follow-up of two years, 3 patients lost and complication were found in 2 (10.59%) patients which was pin tract infection respond on oral antibiotics. The second valuation of patient after surgery revealed the successfulness of one stage surgery in term of cosmetic acceptance function ability, stability and energy consumption. The cosmetic acceptance of patients improves after surgery. Four (21.05%) out of 19 patients have excellent cosmetic acceptance (P>0.1) and good acceptance in 9 (47.34%) out of 19 cases (P<0.01), only 4 (19) 21.05% have fair (P>0.0) and 2 (19) 10.53% have poor cosmetic acceptance (P<0.05). 22 (100%) patients had leg length discrepancy, after lengthening the residual shortening was present in 3 (15.79%) patients (P<0.0001) which was 2 cm maximum. The walk aid status also improved after surgery (P<0.01), only 5 (26.32%) patients on crutches and limp grade improved (P<0.0001). The difference between variations of vital signs on walk exertion also reveals the successfulness of surgery in term of energy/oxygen consumption. Fourteen (73.68%) patients had less consumption and only 5 (26.32%) patients had more consumption (P>0.05). The cosmetic acceptance percentage also improved after surgery. The excellent acceptance was in 4 (21.05%) patients (P>0.01). Good acceptance in 9 (47.36%) patients (P<0.01), fair acceptance in 4 (21.05%) patients (P>0.1) and poor in 2 (10.52%) patients (P>0.05) [Table 2]. The improve values after surgery reveal the successful role of surgery on gait in single leg PPP patient. The good result was achieved in 14(73.68%) and fair in 5(26.32%) patients (Table 3).

Table 1: Surgical procedures (n = 22)

Procedure	**=n**	**%**
Osteotomy for distraction osteogenesis	22	100.0
Foot stabilization		
Triple fusion	11	50.0
Pantalar fusion	11	50.0
Supracondylar osteotomy femur	5	22.7
Stretching & POP casting	7	31.8
TA lengthening	12	54.6
Steindler's release	5	22.7
Modified John's	5	22.7

Table 2: Final outcome

Problems	**Before surgery (n=22)**	**After surgery (n=19)**	**P value**
Trunk muscle abnormality	-	-	-
Hip instability	-	-	
Knee flexion deformities			
Severe (25-30°)	5(22.73%)	-	
Mild (5-10°)	7(31.82%)	-	P>0.05
Absent (0°)	10(45.45 %)	19(100%)	P<0.02
Quadriceps power			
Weak	20(90.91 %)	17(89.47 %)	
Flail	2(9.09%)	2(10.52%)	
Normal	-	-	
Ankle stability			
Flail	11(50%)	9(47.37%)	
Weak	11(50%)	10(52.63 %)	
Leg length discrepancy	22	3(15.79%)	P<0.000 1
Aid support during walk with			
crutches/braces	5(22.73%)	5(26.32%)	P<0.01
Hand on knee	12(54.54 %)	-	
Without support	5(22.73%)	14(73.68 %)	
Limp			
Gross	13(59.09 %)	-	P<0.001
Moderate	9(40.91%)	5(26.32%)	
Mild	-	14(73.68 %)	
Energy/O_2 consumption			
Much	2(9.09%)	-	P>0.05
More	11(50%)	5(26.32%)	
Less	9(40.91%)	14(73.68 %)	
Cosmetic acceptance			
Excellent	-	4(21.05%)	P>0.1
Good	-	9(47.36%)	P<0.01
Fair	11	4(21.05%)	P>0.1
Poor	11	2(10.52%)	P>0.05

Table 3: Final results (n = 19)

Results	n=	%
Excellent	-	-
Good	14	73.68
Fair	5	2.32
Poor	-	-

DISCUSSION

Each person's unique pattern of walking represents his solution to the problem of how to get from one place to another upon minimum effort, adequate stability and acceptable appearance[9]. The inability to walk with security and stability are the principal handicaps felt by individuals in single leg post-polio paralysis (PPP). The emphasis in the lower limb is placed on stability, which in the foot may mean by fusion of several joints to give a firm base on which to take weight[7]. In this series 12(54.54%) patients had flexion deformity of knee joint, out of these 5(27.73%) had 30 degree (severe), 5(27.73%) had 5 degree, 2(9.09%) had 10 degree and 10(44.45%) had no flexion deformity. The severe (30 degree) flexion deformity was corrected by supracondylar osteotomy of femur, union was achieved 100% in average 2 months without any complication, except transient stiffness of knee 1 case, which was improved by physiotherapy. Out of these five patients, one patient lost during followup and mild (5-10 degree) flexion deformity was corrected by stretching the soft tissues of knee and POP casting. In this series, 12(54.55%) patients had equinous deformity 3 (13.64%) cases of 15 degree, 4(18.18%) of 10 degree 3 (13.64%) of 5 degree, 1(4.55%) of 20 degree and another 1(4.55%) of 25 degree plantar flexion. Only 1(4.55%) of this series had 20 degree dorsiflexion deformity. Twelve (54.55%) of this series had tight tendon achillus (TA) and 5(22.73%) had clawing of big toe which were corrected by modified John's procedure and TA was lengthened in 12(54.55%) (Table 1). Foot was stabilized in all patients by anthrodesis. Union was achieved in 100% in 19 (86.36%), three patients (13.64%) had lost during follow-up.

The discrepancies of legs were equalized by slow distraction osteogenesis method through N-A fixation. A single bone segment can be lengthened safely to 130-140% or the original bone length.[10] Most recent techniques adopt the common principle of osteotomy and subsequent slow progressive distraction of bone using an external fixation device[11-13]. The basic biologic phenomena during distraction of tissue have been described by Illizarove[14,15]. In the present study total lengthened segment were 26, tibial 21 and femoral 5. The single level of lengthening was done in 18(81.82%) patients, 1 (4.55%) femoral and 17(77.27%) tibial lengthening done. The double level of lengthening was done in 4(18.18%) cases. The level of osteotomy was diaphyseal in all patients. In the present study, load transmission line and lever system of foot were corrected and gait training was given to all patients on parallel bare in front of mirror and trained them to walk without orthotics. Gait analysis is very difficult in our setup. In Pakistan 'gait laboratory" is not present. WE faced the difficulty to evaluate the role of surgery on gait in single leg polio patient but we had used the method Inman et al[16] and Rose[17], in which blood pressure, pulse and respiration rate of patients were monitored after walk before and after surgery. The second evaluation of patients shows the significant role of surgery. Cosmetic acceptance improved after surgery. The 11 patients (50%) had fair cosmoses and 11(50%) had poor cosmoses of their leg, but after surgery 4(21.05%) had excellent, 9(47.34%) had good, 4(41.05%) had fair and only 2(10.52%) patients had poor cosmetic acceptance (Table 2).

Before surgery 13 (39.09%) patient had gross limp which was not seen after surgery, 9(40.91%) had moderate limp, the number of patients of moderate grade decreased after surgery. Fourteen (73.68%) patients were on mild limp after surgery. The support status also improved after surgery. All patients were taken the support before surgery, 5(22.73%) were on crutches and 12 (54.54%) put their hand on knee, this status is totally changed, 14(73.68%) patients were walking without support and only 5(22.73%) were taken the crutches as previous. Before surgery on walk exertion, 11 (50%) patients had moderate increase in blood pressure, 9 (40.91%) had mild increase and only 2 patients (9.09%) had severe increase. But this ratio of high blood pressure was changed after surgery, 14(73.58%) cases had moderated increase. This significant change showed less consumption of energy and oxygen after surgery. The increased percentage of patients had mild increase in pulse and respiratory rate on walk exertion after surgery, also the sign of less consumption of energy/oxygen. The comparison of pre and postoperative evaluation reveals the successful role of surgery on gait in single leg PPP patients (Table 2).

CONCLUSION

Rehabilitation of people with locomotion disabilities requires repeated evaluation. The evaluation must be inevitably based upon information about the patients gait and observation by investigators. Therefore, the need for repeatable and objective gait assessment techniques within the clinical hospital environment has been felt. The gait assessment has marked a new direction in the treatment of polio-patients. First it

has allowed accurate dynamic assessment of pre-operative status. Secondly gait analysis has allowed a precise evaluation of the treatment outcome, which in turn prevent perpetuation of error. Finally it has increased the understanding of cause of movement abnormalities and unable us to discriminate between the primary problems i.e. true pathology or cause and the resulting compensation on adaptation to the problem. Locally made device, Naseer-Awais fixator" is cost effective and well tolerated by patients and there is less risk of complications. Bone formation with Naseer-Awais fixator equals that obtained with other fixators. We have a need to proper gait analysis laboratory, to plan the treatment of disable patient and should use the local made devices to improve the cost effectiveness of surgery.

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