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Management of Crouch in Cerebral Palsy Diplegia

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Abstract

Crouch gait or posture is one of the most resistant conditions to treat in cerebral palsy with spastic diplegia. Twenty nine such patients (19 males, 10 females); aged between 3 to 16 years (mean 8.9 years) were treated at the Department of Physical Medicine & Rehabilitation, Regional Institute of Medical Sciences, Imphal from January 1992 to December 2003 by partial transfer of distal hamstrings to correct crouch gait. Semitendinosus and biceps femoris tendons were transferred to lower femoral condyles by fixing to tendinous origins of corresponding gastrocnemi. Semi-membranosus tendon was not transferred; but lengthened and it was left to serve as knee flexor. Results were assessed at 6 weeks, 3 months, 12 months after operation based on reduction of popliteal angle, increase of hip extensor power, improvement in balance and gait. Accordingly, 6 cases were graded as excellent; 16 as good; 2 as fair and there was no patient in poor grade. Genu-recurvatum occurred in 2 cases. Patients were followed up for a period ranging from 1 to 10 years (mean 5.5 years). This method of partial transfer of distal hamstrings is effective in relieving crouch gait in spastic diplegic cerebral palsy.

Key Words: **Cerebral palsy, Crouch gait, Spastic, Diplegia, Hamstrings transfer, Hamstrings lengthening**

Introduction

Crouch gait/ posture is one of the most resistant conditions to treat in cerebral palsy with spastic diplegia. Conservative treatments like stretching of spastic knee flexors, strengthening of knee and hip extensors, fitting of orthosis fail to address this problem in majority of cases. Most popular method of treatment of crouch gait is lengthening of hamstrings which reduces knee flexion – the most important component of crouch complex directly. Injection of botulinum toxin in hamstrings to weaken it is also another method of treatment. More rational approach in treating crouch gait is to transfer distal hamstrings to distal femur in which the deforming force is utilized for improving hip extension. The earliest reported operation of this type is Egger's operation[1]. In this operation, the problem of pelvic tilt is solved by improving hip extension. However, genu-recurvatum is the common complication after this procedure. Evans[2], Ray and Ehrlich[3] reported modifications to Egger's technique to avoid this complication. In this study we transfer semi-tendinosus and biceps femoris to femoral condyles to function as hip extensor and retain semi-membranosus as knee flexor to prevent genu-recurvatum. Semi-membranosus is appropriately lengthened to correct knee flexion deformity.

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Objective

The objective of this was to test the effectiveness of our method of partial transfer of distal hamstrings combined with appropriate lengthening of remaining hamstrings in correcting crouch gait in CP diplegic; and of minimizing the usual complications like pelvic tilt, genu-recurvatum associated with transfer of hamstrings reported earlier.

Materials and Methods

Twenty nine CP diplegic patients (19 M, 10 F); aged between 3 to 16 years (mean 8.9 years) who attended Department of Physical Medicine and Rehabilitation from Jan 1992 to Dec 2003 were included in this study. Out of 29, 13 children were delivered at hospital; rest 16 children at home. Fourteen cases were born premature; remaining 15 were full term. There was one case of instrumental delivery.

Inclusion criteria for this study were:

- Cerebral palsy with spastic diplegia.
- Popliteal angle more than 40^0
- Presence of kneel standing balance.

Patients with the following conditions like ilio-psoas spasticity, mental retardation, hearing impairment, visual impairment were excluded from this study. Cases which were previously operated by neurectomy, tendon transfer etc. were also excluded, except in two cases. Presence of calf spasticity and ankle clonus was not considered as contraindication.

Method

Surgery was performed in prone position under GA. Fifty-eight limbs of 29 patients were operated. Both the limbs of the same patient were operated simultaneously by two teams under tourniquet. The hamstrings tendon insertions and tendinous origins of gastrocnemi were exposed through a horizontal incision at popliteal crease. Tendons of semi-membranosus and biceps femoris were divided near the insertions and secured with stay sutures. Short head of biceps was resected from the tendon. Tendon of semi-membranosus was lengthened by z-plasty or fractionally lengthened according to the degree of tightness. Superficial halves of tendinous origins of gastrocnemi were sliced off and reflected proximally (Fig.1). Tendons of semi-membranosus and biceps femoris were fixed to the reflected origins of gastrocnemi (Fig.2). Wound was closed in layers and long leg plaster cast was applied.

TA tightness or / and calf spasticity were released in the same sitting by lengthening or selective tibial neurectomy in 5 cases in addition to the above procedure to prevent genu- recurvatum and stiff knee gait.

Post-operative care

At 3 weeks, cast and sutures were removed. Active hip extension, knee flexion and ankle dorsi-flexion exercises were done with manual assistance in few weeks after removal of cast. Retraining of transferred tendons by faradic stimulation was also started during this period. Standing and weight bearing were started after 4 to 6 weeks after surgery. When standing balance was achieved, patients were allowed to walk inside parallel bar.

Results

Patients were assessed at 6 weeks; 3 months; 6 months; 1 year after surgery. Minimum follow-up period was 1 year and maximum 10 years (Mean 5.6 years). Of 29 patients, 5 were lost to follow-up; hence, only 24 patients were assessed as per following criteria:

- Decrease in popliteal angle: Pre and post operative values were recorded. Average values of right and left were plotted for each patients in chronological order of timing of operation as in Diagram 1a. Grading was done according to the degrees of reduction of post-operative measure compared to pre-operative value of this angle; poor – less than 15^0; fair - more than 15^0, less than 30^0; good – more than 30^0 and less than 40^0; excellent – more than 40^0 or normal post – operative Population.
- Increase in hip extensor strength: Hip extension was tested while the patient was in prone position. Power was graded in MRC scale 1 to 5. Difference between pre-operative and post-operative measures were plotted as in Diagram 1b. Grading of result was done as: poor – no improvement in grade; fair – 1 grade improvement; good – 2 grade improvement; excellent – 3 grade improvement.

Improvement of Balance: Scores were assigned to the level of balance achieved pre-operatively and post–operatively as follows: kneel standing with minimal support – 1; kneel standing without support – 2; kneel walking – 3; single leg standing with support – 4; single leg standing without support – 5. Pre and post-operative values were plotted as in Diagram 2. Grading was done as in hip extensor.

Global assessment of gross motor function : This was done by observing (i) decrease of hip flexion, (ii) decrease of knee flexion during stance and swing and dorsiflexion or decrease of plantar flexion during swing. Grades were given as poor, fair, good and excellent.

The patients were assigned a particular grade if he scored the same grade in at least three categories. Accordingly, 6 patients were graded as excellent; 16 as good; 2 as fair. There was none in poor grade.

Minor complications like stitch infection in two patients, painful nodules at the site of tendon attachment in six were managed conservatively. There were two cases of genu-recurvatum; of which one was severe, needing KAFO; other needed AFO. Both were able to walk without pelvic tilt with support of crutches. Knee flexor weakness was observed in all cases in the first six months after operation. However, we observed that all patients achieved knee flexion at least 3/5 at six months and none had disability on this account.

Discussion

Crouch gait is the most resistant condition to treat in the diplegic spastic cerebral palsy. Crouch complex consists of flexion at hip and knee; planter flexion at ankle. Weakening of hamstrings to reduce knee flexion which is the most important component of crouch is the commonest technique used to treat this condition. Partial distal lengthening of medial or lateral

hamstrings;[4,5,6] total distal lengthening;[7,8,9,10,11,,13,14,15,16] and proximal hamstrings lengthening[17,18] by fractional lengthening or z-plasty are reported recently. Partial lengthening usually leads to re-appearance flexion attitude[8].Whereas, total release is associated with incidence of pelvic tilt [6,7,19] and genu-recurvatum[4,7]. Pelvic tilt is due to weakness of extensor of hip, even if there is no spasticity or contracture of ilio-psoas. Hoffinger and Abou Ghaida[19](1993) had shown that Hamstrings function as important hip extensor in CP diplegics as shown by dynamic electromyography of hamstrings. Other method of weakening of the hamstrings is by injection of Botulinum toxin in the hamstrings[20] This effect of toxin is at the best and temporary and last only for few months and this is costly. Hence, transfer of distal hamstrings to lower femur relieves pelvic tilt as it will function as hip extensor. Egger's operation is total transfer of distal hamstrings to femoral condyles without leaving any muscle to flex the knee[1]. Hence, genu-recurvatum is the common complication of this operation. We transfer only Semi-tendinosus and Biceps femoris; leaving Semi-membranosus to act as knee flexor. Semi-membranosus appropriately lengthened to prevent knee flexion; to reduce popliteal angle at the same time.[3,8,13,15]

In original Egger's operation fixation of tendons to the posterior surface of femoral condyles is technically difficult as it lies in the deeper plane[1] and presence of popliteal vessels, genicular arterial anastomosis is the cause of significant bleeding in this operation. In our technique tendons are attached indirectly to femoral condyles through tendinous origins of gastrocnemi which is attached to the femoral condyles. Hence surgery is practically same as distal lengthening of hamstrings, taking no more operating time. Ray and Ehrlich (1979)[3] transferred tendons of Semi-tendinosus and Semi-membranosus to lateral inter-muscular septum and tendon of Biceps femoris respectively with good results in relieving knee flexion attitude. In our technique, emphasis is more on hip extension than decrease of popliteal angle Of the important complications reported by other workers, like knee flexor weakness,[11] genu-recurvatum,[3,4,7] lack of knee extension,[9,10,12] we enounter hamstrings weakness in 9 cases; 2 cases of genu-recurvatum; none of the last. However, all the nine cases of hamstrings weakness achieved 3/5 power at six months after operation.

Conclusion

Partial transfer of distal hamstrings using semi-tendinosus and biceps femoris to femoral condyles through tendinous origins of gastrocnemi, combined with appropriate lengthening of semi-membranosus is effective in relieving crouch gait in cerebral palsy with spastic diplegia. Operation is technically same as any type of distal hamstrings lengthening. Serious complications of both hamstrings lengthening and transfer are avoided in this technique.

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