MEDICAL CHANNEL

Original Article

SURGICAL TREATMENT OF EQUINOVARUS DEFORMITY OF FOOT IN CHILDREN WITH CEREBRAL PALSY

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ABSTRACT

Introduction:Foot deformities e.g., ankle equinus, equinovarus and equinovalgus, are common in patients with CP. Varus deformity which is usually accompanied by equinus, is commonly caused by an abnormal posterior tibial muscle,anterior tibial muscle or both. If left untreated, may cause severe fixed foot deformity .Various methods of treatment have been reported.

Material and Method:Twenty patients (25 feet) were included in this study.The patients were assessed clinically and patients with forefoot varus and aquinus were treated by split transfer of tibialis anterior to the cuboid and patients with hind foot varus and equinus were treated by split transfer of tibialis posterior tendon through interosseous membrane, to the lateral cuniform. Percutaneus lengthening of tendocalcaneus was performed in all patients. The outcome was analyzed.

Results:The age range at the start of study was between six to ten years (mean 8years.), and at the last follow up was eight to fourteen years (mean 11.5 years). Mean follow-up was 3.5 years.The range of varus deformity was $15^0$to 20^0 and range of equinus was between 16^0 to 25^0. Split transfer of tibialis anterior tendon was performed in seven patients (8feet) presenting with fore foot varus and equinus. Split transfer of tibialis posterior tendon was performed in thirteen patients (17 feet) presenting with hind foot varus and equinus. Percutaneustendocalcaneuas lengthening was done in all cases. Open release of planter fascia was performed in fourteen feet as there was mild cavus deformity. The results were graded according to Kling's clinical criteria. The results were excellent in fourteen feet, good in 7 feet, and poor in four feet. Poor results were seen in four of our patients with marked tendocalcaneus shortening, as the deforming force was not successfully determined clinically in these cases. Most of our patients had excellent results.

Conclusion: split tibialis anterior tendon transfer to cuboid in patients with forefoot varus and split tibialis posterior tendon transfer through interosseous membrane to lateral cuniform in patients with hind foot varus, are good and rewarding procedures. However accurate diagnosis of deforming muscle i.e, tibialis anterior or tibialis posterior is essential to produce good results.

Key WordsS: cerebral palsy, equinovarus, tendon transfer.

INTRODUCTION

Cerebral palsy (CP) is a disorder of movement and posture caused by nonprogressive injury to immature brain.[1]The incidence is two to three per thousand live births.[2] Spastic CP is the most common subtype which is seen in 70% to 80% of CP patients.[3]In the patient with CP, there is change in muscle tone and posture which is evident both during rest and voluntary activity. [4] Foot deformities e.g., ankle equinus, equinovarus and equinovalgus, are common in patients with CP. Varus deformity which is usually accompanied by equinus, is commonly caused by an abnormal posterior tibial muscle that is overactive or firing out of phase. In normal individuals posterior tibial muscle is active during stance phase to stabilize the foot and inactive during swing phase. In patients with CP the posterior tibial muscle contracts during swing phase causing varus position of the foot at heel strike. The anterior tibial muscle dysfunction may be

associated. The gastrocnemius and soleus contracture usually accompanies the varus contracture and hence contributes to the vaurs deformity of foot. EMG studies are helpful in determining the activity of muscles.[5]Spastic equinovarus deformity, if left untreated, may cause severe fixed foot deformity and painful callosities under metatarsal heads and on the lateral side of the foot. The gait pattern becomes less effective and needs more energy.[6]

Various methods of treatment had been advocated over the years for equino varus foot in patients with CP. The procedures practiced and recommended have been, ·split transfer of tibialis anterior tendon to the cuboid.[7] Split transfer of tibialis posterior tendon to the peroneus brevis tendon.[8] split transfer of tibialis posterior tendon anteriorly through interosseous membraneto lateral cuniform.[9]rerouting of tibialisposterior tendon anterior to medial malleolus.[10] tenotomy of tibialis posterior tendon.[11]Shortening of tibialis anterior tendon.[12]

In this study the patients with forefoot varus and aquinus were treated by split transfer of tibialis anterior to the cuboid and patients with hind foot varus and equinus were treated by split transfer of tibialis posterior tendon through interosseous membrane, to the lateral cuniform.Percutaneuslengtheningof tendocalcaneus was performed in all patients. The outcome was analyzed. Split tendon transfer as compared to whole tendon transfer is considered more effective as it distributes equally the muscle power and eliminates the possibility of residual deformity or overcorrection.[13]

MATERIAL AND METHODS:

The study was conducted between January 2005 and January 2009 in a private tertiary care setup.

Twentypatients (25 feet), twelve female and eightmale, with CP were included in this study. The inclusion criteria was CP withflexibleequino varus deformity, age between six to ten years, patients with ability to walk or having potential of walking, and minimum follow up of two years.The patients were assessed clinically, and decisions regarding split transfer of either tibialis anterior or tibialis posterior, and tendo calcaneus lengthening were made. Thedecision was made on physical examination as facility of dynamic electromyography and gait analysis was not available. In patients with hind foot varus split transfer of tibialis posterior muscle tendon to the lateral cuniform was performed and the tendon was passed through the interosseous membrane. In patients with fore foot varus split transfer of tibialis anterior tendon to the cuboid was performed. Percutaneus lengthening of Tendocalcaneus was performed in all case.

Surgical procedures: Split transfer of Tibialis posterior tendon. (M.J.Saji at.al.1993).[9]

Tibialis posterior tendon was exposed by incision posterior to medial malleolus from 5cm proximal to the medial malleolus to the navicular. The tendon was split longitudinally up to the musculotendenous junction, and the anterior half was released from navicular. Through a separate anterior incision a window was made in the interosseous membrane just proximal to the inferior tibiofibularsyndesmosis and the detached half of the tendon was passed through this hole. Third incision, 2cm long was made over the lateral cuniform and the tendon was passed subcutaneously to this incision and through a drill hole in the lateral cuniform. The tendon suture was passed to the sole of foot and tied with tension to a button. The junction of tendon to the bone was also reinforced.Postoperatively above knee POP cast was applied with ankle in neutral position. Touch down weight bearing was allowed after 3 weeks.Skinstitches were removed after three weeks, and cast after six weeks. After the removal of cast ankle foot orthosis(AFO) was given for 6 months. Split transfer of Tibialis anterior tendon:(Hoffer et al 1974).[7]

Three incisions were made for this transfer. First incision was made on medial cuniform to expose the insertion of tibialis anterior. The second incision was made on the anterior aspect of leg at the site of the musculotendinous junction of the tibialis anterior and the tendon was exposed. The lateral half of the tendon was released from its insertion and delivered through second incision. A third incision was made over the dorsal aspect of cuboid and the lateral half of tendon was passed subcutenously and delivered through third incision by help of sutures tied on the end of tendon. A hole was made in the cuboid and the tendon end was passed and stitched to itself with foot in slight dorsiflexion and eversion.. The wound was closed with foot in corrected position and long leg cast was applied. The sutures were removed after 3 weeks and cast after six weeks. AFO was worn for six months.

Percutaneus lengthening of tendocalcaneus was done concomitantly in all patients before the tibialis tendon transfer.

The results were graded according to Kling clinical criteria.[8]

*Excellent.*The foot was plantigrade with no fixed or postural deformities. Normal shoes could be worn. There were no callosities and the patient was pleased with the result.

Good. There was less than 5degree of varus, valgus or equines deformity. Normal shoes could be worn. There were no callosities and the patient was satisfied with the procedure.

Poor.There was recurrent equinovarus deformity or a reverse deformity of more than 5degree.

RESULTS:

Twenty patients (25feet) were included in the study. Twelve patients were female and eight were male.Table I.

The age range at the start of study was between six to ten years (mean age 8years.).The age range at the last follow up was eight tofourteen years (mean 11.5 years). . Mean follow-up was 3.5 years. (Range 2-4years). Fifteen patients were hemiplegic, 4 diplegic and one was quadriplegic. The range of varus deformity was $15^0$to 20^0 and range of equinus was between 16^0 to 25^0.

TABLE 1

GENDER DISTRIBUTION

SEX	Number	Percentage%
Male	12	48
Female	8	32
	25	100

Table II

Procedures	Number	Percentage%
Split transfer of tibialis anterior tendon	7	28
Split transfer of tibialis posterior tendon	13	52
Percutaneustendocal caneuas lengthening	25	100

Split transfer of tibialis anterior tendon was performed in seven patients (8 feet) presenting with forefoot varus and equinus. Six patients were hemiplegic and one was diplagic. Split transfer of tibialis posterior tendon was performed in thirteen patients (17 feet) presenting with hind foot varus and equinus. Nine patients were hemiplegic, three diplagic and one was quadriplegic. Percutaneustendocalcaneuas lengthening was done in all cases. Table II.

Open release of planter fascia was performed in fourteen feet as there was mild cavusdeformity.The supplementary procedures were performed at the same time with the index operation. The results were graded according to Kling's clinical criteria. The results were excellent in fourteenfeet (mean planter flexion of 45^0, dorsiflexion of 10^0, inversion 30^0 and eversion 15^0), good in 7 feet (three feet had 4^0 degree of residual varus and four feet had $4^0$of residual equinus) and poor in fourfeet (two feet had 8 degrees of residual varus and two had 10 degrees of equinus).Nopatients presented postoperatively with mild or sever valgus.Patients with excellent and very good results showed improvement in gait and were able to walk with plantigrade feet. They were wearing regular shoes and do not need brace. The patients with good results were advised to wear night splint.The patients with poor results needed brace during walking and at night as well. They were advised calcaneocuboid fusion to be done 18 months after the initial operation.

DISCUSSION:

One of our inclusion criteria was age between six and ten years. Various authors have reported recurrence of deformity in patients under the age of six years who underwent tibialis tendon transfer. The reason being the rapid bone growth below the age of six years.Ruda and frost[14] reported two recurrences in varus, in there series of 29 patients operated for intramuscular posterior tendon lengthening.Lee and Blek[15] reported 29% recurrence rate in patients less then 8 years of age.

In patients with cerebral palsy, the hyperactive tibialis anterior is responsible for forefoot inversion and varus, and the hyperactivity of tibialis posterior tendon causeshind foot varus and equinus. The dynamic electromyography and gait analysis is helpful in diagnosis but these facilities were not available in our setup. The patients were clinically evaluated and split transfer of tibialis anterior tendon was performed in patients with forefoot varus, and splittransfer of tibialis posterior tendon was performed in patients with hind foot varus. All of our patients had some degree of equinus due to short tendocalcaneus.Percutaneustendocalcaneuslengthening was done in all cases.Percutaneoustendocalcaneuslengtheninghas shorter operating time,lower complication rate andgives better active dorsal and plantar flexion abilities.[16]

Fourteen out of twenty-fivefeet in our series had mild cavus deformity for which plantar fascia release was performed at the time of tendon transfer.

Equino varus deformity of foot in patients with cerebral palsy has been treated by various methods.Baker and Hill (1964)[10] advocated rerouting of the tibialis posterior tendon anterior to the medial malleolus with satisfactory results, but Bislaet at (1976)[17] failed to achievethe adequate correction of deformity in their patients.

Banks and Panagakos (1967)[18] described lengthening of tibialis posterior in these cases.Hoifer (1967)[19] advocated the same. On long term follow up many authors reported high incidence of recurrence after lengthening of tibialis posterior (Ruda and Frost 1971)[14](Root et al 1987).[20] Lengthening of the tendon weakens the muscle. With additional lengthening of tendo calcaneus the planter flexion strength is reduced.

Tenotomy of tibialis posterior tendon at the site of its insertion resulted in many cases into collapse of talonavicular joint. (Green et al 1983)[11] (Root et al 1987)[20]

Kaufer H (1977)[21] and Kling TF et al (1985)[8] reported their results of split transfer of tibialis posterior tendon to the peroneus brevis passing posterior to the tibia.The results were satisfactory but their study included patients who developed spasticity after encephalitis and head injuries.

Grzegorzewski A et al (2007)[6] reported 89%good clinical and functional results after 4.6 years of follow up after split tibialis posterior transfer to peroneus brevis tendon.

M.J.Saji et al (1993)[9], reported their results of surgical procedure for spastic equinovarus deformity of foot in patients with cerebral palsy. They transfer the anterior half of the split tibialis posterior to the dorsum of the foot through the interosseous membrane on 23 feet in 18 children. In their 8.4 years of follow up, using the criteria of Kling et al (1985)[8]excellent results were obtained in 14 feet, good in eight, and poor result in only one.

In our study, using criteria of Kling et al (1985)[8]out of twenty five feet, results were excellent in fourteen feet (mean planter flexion of 45^0, dorsiflexion of 10^0, inversion 30^0 and eversion 15^0), good in 7 feet (three feet had 4^0 degree of residual varus and four feet had $4^0$of residual equinus) and poor in four feet (two feet had 8 degrees of residual varus and two had 10 degrees of equinus). Patients with poor results(four feet) presented with equinus of about 25^0 and varus of about 20^0at the time of surgery. In two of these patients split tibialis anterior and in two split tibialis posterior tendon was transferred along with percutaneustendocalcaneus lengthening and planter fascia release.In patients with marked equinus it became difficult to decide weathertibialis anterior or tibialis posterior or both are the deforming force. Poor results were seen in four of our patients with marked tendocalcaneus shortening, as the deforming force(tibialis anterior or tibialis posterior) was not successfully determined clinically in these cases.

Most of our patients with split tibialis anterior and split tibialis posterior tendon transfer had excellent results. The muscle which was responsible for deformity was converted into a balancing structure.

CONCLUSION

Inchildren with cerebral palsy, presenting with forefoot varus , split tibialis anterior tendon transfer to cuboid, and in those presenting with hindfoot varus, split tibialis posterior transfer through interosseous membrane to the lateral cuniform, are procedures with good results. However accurate diagnosis of deforming muscle prior to surgery is essential to achieve the optimum results. The dynamic electromyography and gait analysis should be performed before surgery.

REFERENCES

1. Molnar GE. Long-term treatment of spasticity in children with cerebral palsy. IntDisabil Stud.1987; 9:170–2.
2. Kiely M, Lubin RA, Kiely JL. Descriptive epidemiology of cerebral palsy. Public Health Rev.1984; 12:79–101.
3. Anupam Gupta, AbhishekSrivastava, Arun B Taly, ThylothMurali.Single-stage multilevel soft-tissue surgery in the lower limbs with spastic cerebral palsy: Experience from a rehabilitation unit. Indian J Orthop. 2008 Oct-Dec; 42(4): 448–453
4. Naeye RL, Peters EC, Bartholomew M, Landis JR. Origins of cerebral palsy. Am J Dis Child.1989; 143:1154–61.
5. Jeffrey R. Sawyer: Cerebral Palsy, Chapter 30, in Canale&Beaty edits. Campbell's Operative Orthopaedics, 11th ed. 2007 MosbyELSEVIER 1600 John F. Kennedy

Boulevard Suite 1800
Philadelphia, Pennsylvania 19103-2899 pg. 1366-80.

6. Grzegorzewski A, Borowski A, Pruszczyñski B, Wranicz A, Domzalski M,Synder M. Split tibialis posterior tendon transfer on peroneus brevis for equinovarus foot in CP children. ChirNarzadowRuchuOrtop Pol. 2007 Mar-Apr;72(2):117-20.
7. Hoffer MM, Reiswig JA, Garrett AM, Perry J. The split anterior tibial tendon transfer in the treatment of spastic varus hind foot of childhood.OrthopClin North Am. 1974 Jan; 5(1):31-8.
8. Kling TF, Kaufer H, Hensinger RN: Split posterior tibial tendon transfers in children with cerebral spastic paralysis and equinovarus deformity. J Bone Joint Surg 1985, 67-A: 186-194.).
9. M. J. Saji. S. S. Upadhyay, L. C. S. Hsu, J. C. Y. Leong.Splittibialisposteriortransfer forequinovarusdeformityin cerebralpalsy. Long termresults of a newsurgicalprocedure.*J Bone Joint Surg [Br]* 1993: 75-B: 498-501.
10. Baker LD, Hill LM. Foot alignment in the cerebral palsy patient. JBoneJointSurg[Am]. 1964: 46-A:l-l5
11. Green NE, Griffin PP, Shiavi R: Split posterior tibial tendon in spastic cerebral palsy. J Bone Joint Surg 1983, 65-A: 748-754.
12. Rutz E, Baker R, Tirosh O, Romkes J, Haase C, Brunner R. Tibialis anterior tendon shortening in combination with Achilles tendon lengthening in spastic equinus in cerebral palsy. Gait Posture. 2011 Feb; 33(2):152-7.
13. Vlachou M, Dimitriadis D. Split tendon transfers for the correction of spasticvarus foot deformity: a case series study. J Foot Ankle Res. 2010 Dec 14;3:28.
14. Ruda R, Frost HM: Cerebral palsy. Spastic varus and forefoot adductus, treated by intramuscular posterior tibial tendon lengthening. ClinOrthop 1971, 79:61-70.
15. Lee CL, Bleck EE: Surgical correction of equinus deformity in cerebral palsy. Dev Med Child Neurol 1980, 22:287-92
16. Jaddue DA, Abbas MA, Sayed-Noor AS. Open versus percutaneous tendo-Achilles lengthening in spastic cerebral palsy with equines deformity of the foot in children.J SurgOrthop Adv. 2010 Winter; 19(4):196-9.
17. Bisla RS, Louis HJ, Albano P. Transfer of tibialis posterior tendon in cerebral palsy. J Bone Joint Surg [Am] 1976; 58-A: 497-500.
18. Banks HH, Panagakos P. The role of theorthopaedic surgeon in cerebral palsy. PediatClin N Amer1967; 14:495-515.
19. Hoifer MM. Basic considerations and classifications of cerebral palsy. Instructional course lectures, the American Academy of OrthopaedicSurgeons [St Louis, CV Mosby] 1976; 25:96-106.)
20. Root L, Miller SR, Kirz P. Posterior tibial-tendon transfer in patients with cerebral palsy. J Bone Joint Surg [Am] 1987; 69-A: 1 1 33-9.
21. Kaufer H: Split tendon transfers. Orthop Trans 1977, 1:191.