

## Original Article

# Outcome of Z-Plasty Lengthening of Achilles Tendon for Correction of Equinus Deformity of Foot in Children with Cerebral Palsy

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**Objective:** To analyze the outcome of z-plasty lengthening of Achilles tendon for correction of equinus deformity of foot in children with cerebral palsy.

**Study Design:** Observational Study.

**Place and Duration of the Study:** The study was conducted at Liaquat University Hospital and a private practice set up between January 2008 and January 2012.

**Materials and Methods:** Inclusion criteria was ambulant children between 6-10 years of age, with spastic cerebral palsy, with one (hemiplegic) or both (diplegic) lower limbs involved, and inability to passively dorsiflex the ankle beyond 10 degrees of plantar flexion (minus 10 degree of dorsiflexion or 10 degrees of plantar flexion) with knee flexed. Z-Plasty lengthening of Achilles tendon was performed.

**Results:** A total of 30 patients (44 feet) were included in the study and followed for 2 year. The mean age was 8 years. Sixteen (53.33%) patients were spastic hemiplegic and 14 (46.66%) were spastic diplegic. A total of 44 feet were operated. Before surgery the passive range of movement was between 10 degree and 20 degree of plantar flexion in all 44 feet. After the surgery 36 out of 44 feet (81.81%) were pain free plantigrade with passive range of movement between 20 degrees of dorsiflexion and 20 degrees of plantar flexion. Six out of 44 feet (13.63%) had inadequate correction. The passive range of movement in these six feet was between 0° to 20 degrees of plantar flexion. One (3.33%) patient who was operated in both feet developed crouch gait. At two years of follow up there was no recurrence in fully corrected 36 feet but the remaining six feet which had inadequate correction after initial surgery showed increase in equinus with passive range of movement between 15 to 20 degrees of plantar flexion. Superficial wound infection was seen in 6/44 (13.63%) feet.

**Conclusion:** Z-Plasty lengthening of Achilles tendon for correction of equinus deformity of foot in children with cerebral palsy produces good short term results. Significant number of patients have pain free plantigrade foot after surgery. There is no recurrence written in two years. Patients with inadequate correction were worsening of the equinus deformity. Excessive lengthening should be avoided as it leads to crouch gait. Studies are needed to evaluate the long term results of this procedure.

**Key words:** Achilles, tendon, Lengthening.

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## Introduction

Equinus deformity of foot is common in children with cerebral palsy. It is caused by spasticity of the gastrocnemius-soleus muscle. The deformity often worsens during periods of rapid growth because of overgrowth of the tibia relative to the gastrocnemius and soleus muscles.<sup>1</sup>

Equinus is defined as inability to dorsiflex the foot beyond plantigrade position when hind foot is kept at neutral and knee extended.<sup>2</sup>

The goal of treatment in these patients is to improve gait in the mobile patient and to achieve plantigrade foot which improves the standing ability in non-ambulatory patient. This can be achieved by stretching and casting, physical therapy, braces, injection of botulinum toxin and surgical lengthening of tendo calcaneus.<sup>3</sup>

surgery typically is indicated when the ankle cannot be brought into the neutral position in an ambulatory child

and when it leads to difficulties with hygiene, shoe wear, and standing programs in a non ambulatory child.

Many surgical procedures are recommended for correction of equinus in children with cerebral palsy but successful procedure according to age has not been clearly defined.<sup>4</sup> The surgical treatment may result into overcorrection leading to crouch gait.<sup>5</sup>

The diagnosis of crouch gait is made when patient shows more than 30 degrees of knee flexion throughout stance phase and the ankle remains in dorsiflexion throughout stance phase.<sup>6</sup> One of the complications after surgery is recurrence. The reported rate is between 6% to 54%.<sup>7,8</sup>

Age of the patient at the time of surgery, type of surgery, and type of cerebral palsy are the factors associated with the recurrence of equinus deformity after surgery.<sup>9</sup>

Age is considered as the most important predisposing factor for recurrence of equinus. Children when operated at younger age have more chance of recurrence.<sup>10</sup>

## Materials and Methods

The study was conducted at Liaquat University Hospital and a private practice set up between January 2008 and January 2012.

Inclusion criteria were ambulant children between 6-10 years of age, with spastic cerebral palsy, with one (hemiplegic) or both(diplegic) lower limbs involved and having no history of previous surgery on the involved limb. The surgery was indicated when equines deformity of ankle interfered with walking and standing ability, and the ankle cannot be passively dorsiflexed beyond 10 degrees of planter flexion. (Minus 10 degree of dorsiflexion or 10 degrees of plantar flexion) with knee flexed. Primary outcome measures were pain free plantigrade foot. Secondary outcome measures were crouching gait, and recurrence of deformity.

**Technique: Z-plasty lengthening of Achilles tendon:** Patients were operated under general anesthesia. Patients were placed supine on table. Posteromedial incision was made midway between the Achilles tendon and the posterior aspect of medial malleolus. The lower extant of the incision was at the superior border of the calcaneus and then extended proximally for 4-5 cm. the Achilles tendon was exposed and its sheath split longitudinally and the tendon was freed from the surrounding tissues. A longitudinal incision was made in the center of the Achilles tendon from proximal to distal, and the scalpel was turned medially distally, and half of the tendon was divided transversely. The cut portion was held with forceps and the scalpel was brought to the proximal part of the longitudinal incision in the tendon. The scalpel was turned opposite to the distal cut and the half of the tendon was cut transversely to free the Achilles tendon completely. The plantaris tendon on the medial aspect of Achilles tendon was divided

transversely. Passive excursion of triceps surae muscle was evaluated by pulling the proximal stump of the tendon to its maximally stretched length. The tendon was allowed to retract halfway back to its resting length and then sutured to the distal tendon by keeping ankle at 10 to 15 degrees of dorsiflexion. The repair was performed with heavy absorbable sutures. The wound was closed and long leg cast was applied. Ambulation was allowed soon as the patient became pain free. Long leg cast was continued for 4 weeks and then changed to short leg cast which was continued for further 2 weeks. Brace was advised for 6 months.<sup>11</sup>

The follow up period was two years. Once discharged from hospital, patients were called every two weeks for six weeks. Once cast is removed the follow up visits were every three months. On every visit after removal of cast the range of movement at ankle was recorded with knee extended. Observational gait analysis was made at follow up visits.

## Results

Total number of patients was thirty. Eighteen (60%) were male and 12(40%) were female. The age range was between 6 to 10 years (mean 8 years). Sixteen (53.33%) patients were spastic hemiplegic and 14(46.66%) were spastic diplegic. Surgery was performed on both feet in 14 diplegic (28 feet) and on one side in 16 hemiplegic patients. A total of 44 feet were operated. At the time of surgery all the patients were ambulant and were able to walk with heel off the ground. The passive range of movement was between 10 degree and 20 degree of plantar flexion in all feet. After the surgery 36 out of 44 feet (81.81%) were plantigrade and pain free, with passive range of movement between 20 degrees of dorsiflexion and 20 degrees of planter flexion. Six out of 44 feet (13.63%) had inadequate correction. The passive range of movement in these six feet was between 0° to 20 degrees of planter flexion. One (3.33%) patient who was operated in both feet developed crouch gait. At two years of follow up there was no recurrence in fully corrected 36 feet, and they remained pain free. The remaining six feet which had inadequate correction after initial surgery showed increase in equinus with passive range of movement between 15 to 20 degrees of planter flexion.

Superficial wound infection was seen in 6/44(13.63%) feet, which was treated by dressings and oral antibiotics according to culture and sensitivity. All wounds healed well.

## Discussion

The average age at the time of surgery in our patient was 8 years. We did not include patients under the age of 6 years in our study because it has been reported

previously that recurrence of deformity was more common in patients in younger age group.<sup>12</sup>

Few studies have shown no relationship between age at the time of surgery and recurrence.<sup>13, 14</sup>

After two years of follow up , 81.81% of operated feet in our series remained plantigrade and pain free. Borton DC et al reported good early postoperative, result with plantigrade feet, in most of the 134 children ( 195 procedures) but long term follow up showed good results in 42% of feet.<sup>9</sup>

We had no recurrence in our series in 81.81% of operated feet which were fully corrected with surgery. Recurrence was seen in 13.63% of feet which were not fully corrected by surgery. This shows some relationship between inadequate correction at the time of surgery and early recurrence of the deformity.

Sun Young Joo et al reported 43.8% recurrence rate. They were of the opinion that recurrence risk factors were, younger age at primary surgery, and pattern of Cerebral palsy. The risk increase in hemiplegic as compared to diplegic or quadriplegic patients.<sup>15</sup>

The lower rate of recurrence in our study may be due to the fact that we operated upon patient in higher age group, but the other reason could be the short follow up of two years. Recurrence has been reported many years after the surgery in patients with cerebral palsy. Recurrence of equinus may require more than five years to develop. Some authors are of the opinion that child should be evaluated up to skeletal maturity for recurrence.<sup>16, 17</sup> Long term follow up could have made our results more significant.

One spastic diplegic patient in our series who was operated on both feet, developed crouch gait. This was due to excessive lengthening of Achilles tendon. This risk has been reported in the literature. It has been advised that lengthening of Achilles tendon should be performed with caution especially in patients with bilateral spastic cerebral palsy. These patients have high risk of developing calcaneovalgus feet and crouch gait.<sup>18</sup>

Superficial infection rate of 13.63% in our series is high by any standard. As the infection was superficial and subsided early, we think that it has not affected the results of surgery.

## Conclusion

Z-Plasty lengthening of Achilles tendon for correction of equinus deformity of foot in children with cerebral palsy produces good short term results. In Significant number of patients the equinus deformity is corrected to pain free plantigrade foot after surgery. There is no recurrence within two years. Excessive lengthening should be avoided as it leads to crouch gait. Studies are needed to evaluate the long term results of this procedure.

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