International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

The Role of Anterior Tibial Muscle Tendon Transfer as a Miniinvasive Surgical Step in Primary Relapse of Clubfoot Deformity, Following Ponseti Method

Raykov D.[1], Penev P.[2]

Department of Orthopaedics and Traumatology, Varna University of Medicine, St. Anna Hospital- Varna

Abstract: ***Introduction: Ponseti protocol is widely accepted contemporary method for treatment idiopathic clubfoot deformity and provides up to 95 % success. I correct heel varus and equinus and forefoot adductus when is early started and properly applied. The optimal correction should be acquired by gentle manipulations, followed by several plaster casts. Usually the mininvasive procedure – achilotenotomy provides final correction of the heel equinus. In spite of following this protocolstrictly, first relapse evidences may appear at the age of 2 ½ year. Thereare many studies, proving the disastrous late results after the classic surgical procedure, like open posterior or posteromedial release, applied in relapse cases. The early assessed successful results – primary aligned foot further are followed by high grade displaced tarsal bones with total talocalcaneal and midtarsal rigidity in adolescent age. The miniinvasive approach of anteriortibial tendon (ATT) transfer provides constant correction and interruption of the clubfoot relapse with a minimal rate of any side deformities. Materials: ATT is applied in 21 from a total of 165 patients (228 feet) with idiopathic clubfoot for a period of 10 years. The mean followup period is 5 years with assessment of the growing plantigradefoot, as measurements of talocalcaneal angle – in anterior- posterior and lateral X-ray projections. Results: The followed treated club feet present constant correction of the elements of plantigradidity in a period of 1 year. Talocalcaneal angle improves as follows: Anteroposterior projection varies: before operation - 6 - 22 ° (mean 13, 7°), post op - 13 to 29 ° (mean 20, 7 °). Lateral projection varies: before operation - 16 - 31° (mean 20, 1°), post op - 15 - 41 ° (mean 31, 6 °). Conclusions: The principle of miniinvasive surgery, as a step in treatment of relapses after Ponseti clubfoot protocol, presents a new attitude and prevents the growing foot from many of the late disastrous results that usually occur after aggressive early surgery. It is based on the main Ponseti postulate "les – surgery – better results in equinovarus treatment" and has to be accepted as general principle.***

Keywords: Talipesequinovarus, Ponseti method, tibialis anterior tendon transfer

1. Introduction

Clubfoot deformity is the most common congenital musculo-skeletal disease with average frequency 1 to 4/1000 deliveries (Figura 1 – A, B)(1, 8, 14). The deformity consists of adductus and varus of forefoot and equinus of the rarefoot.

Figure 1 (A): Club foot with foot adductus and varus.

Figure 1 (B): Posteriorly presentedequinus.

Figure 2: Late foot deformity when clubfoot is not treated

When not treated, the clubfoot deformity progresses to grave foot deformity (Figure 2) (2, 3, 14).Historically the attempts for correction were addressed mainly to surgical intervention. One of the first authors, Arthur Steindler (1920), who published a surgical treatment of clubfoot deformity, assessed his results as late rigid, weak and painful feet as a result of performed surgery. Few decades later other authors Codivilla(1962), Turco(1971) published their results too, that seemed to be the same – initially good foot alignment, but an year later recurrence, together with rigidity, and at an older age – weakness and pain. Contemporary understanding of problems for this congenital disease leads to explain the reasons for unsatisfactory results. Many authors proved the role of "embryonic" myosin that is very thin and sensitive to surgical incisions. Its prevalence in the connective tissue of the embryo and the newborn is the reason for a fast cicatrisation of soft tissues in clubfoot. This new theory made many authors to re-orientate to conservative treatment of clubfoot as well as applying, but mini-invasive corrections (6, 7).

Timely Ponsetitreatment(10, 12, 13, 14), starts with gentle manipulative and plaster cast treatment(Figure 3), gives excellent and very good results in 92-95% of cases and the only surgical intervention in this primary stage is percutaneous achilotenotomy. This is applied in 85% of all treated feet. Compulsory element in treatment is use of abduction devise of Denis Broun, which continues at least 24 months and after an individual estimation, probably one more year after that.

Figure 3: Plaster treatment by Ponseti protocol

The final successful treatment gives the foot normal plantigrade appearance, aligned and restored dorsal flexion (Figure 4 – A, B)

Figure 4 (A): Aligned foot

Figure 4 (B): Restored dorsal flexion

First signs of recurrence appear in 6.6% of treated feet, usually at the age of 24-28 months after initiating of treatment. The signs of recurrence are dorsal flexion limitation of ankle joint up to 0º, rigid heelvarus (5-6 º) and forefoot adduction (Figure 5 – A, B) (4, 5). "Late Ponsetti"starts with 2-3 plaster casts, with or without achilotenotomy and night Denis Broun splints afterwards for one more year. If the clubfoot case is not successful to correction, then subsequent surgical intervention has to be performed by a transfer of anterior tibial tendon (ATT).

Figure 5 (A), (B): A, B. Signs of relapse

2. Materials and Methods

Twenty one feet (9%) of a total of 228 clubfeet (165 patients), who had followed the Ponseti protocol, developed relapse on a mean age of 2.9 years (2.5-5). The whole group was treated and followed during a period of 10 years (2006-2016).

Primary Ponseti treatment was fulfilled from the very beginning at the same hospital and doctors, who performed the examination in 16 children. The primary treatment in 5 children was started in another hospital and because of relapse signs; they were added to the above mentioned group and treatment. Up to that moment none of the children were operated.

Criteria for monitoring end results estimation were changes in foot plantigradity and in talo-calcaneal angle in anteroposterior and lateral X-Ray projections. Tarsometatarsal and other foot angles were not included in this study, because of technical difficulties of fixation of thesmall foot and insufficient maturity of forefoot tarsal bones, so that they obtained angle metrics are not reliable.

Surgery is initiated after the first or second recurrencein children above 2.5 years of age, when anterior tibial muscle becomes a strong supinator. This tendency occurs when the navicular bone remains partially medially dislocated and calcaneal bone is not fully corrected and is in varus. That is a result of insufficient external rotation of the calcaneo - foot block below the talus.

Figure 6 (A): Exploration of the ATT near to its insertion.

Surgical intervention begins with 2 cm. incision along the ATT passage above its insertion to the medial cuneiformebone and little more distally to the first metatarsal (Figure 6-A). After the release of the tendon, 0.5cm proximally to the insertion, the tendon is fixed by a temporary thread. By straining the disinserted tendon, its passage is identified as well as it is located right under its way out under the horizontal strip of Y-shaped retinaculum extensorum. There, a second incision of 2cm. is performed. It appears in the anterior ankle joint aspect, distally under the retinaculum (Figure 6-B).

Figure 6 (B): Second incision and exploration of ATT bellow the extensor retinaculum.

A third two centimeters incision is performed on the dorsal part of the foot, centered above the lateral cuneiform bone (Figure 6-C).

Figure 6 (C): Localization of the lateral cuneiforme bone and drilling a hole in it for insertion of the ATT

It is easily identified by a palpation of the joint between the bone and the third metatarsal base (it should be pressed dorsally and plantar to locate the joint space). Radiography identification can be used as well for this purpose. In order to reach the bone, lateralseparation of the extensor digitorum longus tendon is required, as well as splitting of extensor

digitorum brevis muscle. The bone is bored with 3.5-4.5mm drill right in its center, with slight inclination - dorsally to plantar with 20° and medially - posteriorly of 5°in order to avoid damage of the plantar vessels and nerves. Using a straight needle the threads lead the tendon through the bone canal in a plantar direction, where they are going out of the skin (Figure 7- A, B).

Figure 7 (A): The thread is out of the planter skin

Figure 7 (B): The thread is fixed by a button

Then the threads are pulled and fixed to the skin by a button. An additional strengthening of fixation on the dorsal aspect is also performed with two periosteal stitches. An additional cut of the lateral wall of extensor retinaculum is performed in some cases to avoid lateral wind of the tendon at its way. The surgery ends with skin closure and a long plaster cast above knee for four weeks with a foot in a neutral position and knee in 60-90 degree flexion.

3. Results

The ATT transfer leads to smooth and gradual correction, that occurs fora period of 1 year post op. A plantigrade foot is achieved, which is functional, painless, normally looking and fit for walking with good mobility with no rigidity and not requiring supporting shoes(Figure 8 – A, B).

Figure 8 (A): Plantigrade foot at the end of treatment

Figure 8 (B): Corrected heel varus

A reduction of varus is observed too, as well as of supination, while walking. X-Ray improvement of the talo-calcaneal angle is observed (Figure 9). An anterior posterior radiography varies from 6°- 22°before surgery (mean 13, 7 °) and in post operative period – 13° - 29° (mean 20.7 °). The lateral X-Ray before surgery are within the range of 16°- 31° (mean 20.1°) and after surgery 15° -41°(mean 31.6°) (Table 1).The passive dorsal flexion varies 0°-25°(mean 13.4°). Fourfeet present reduced dorsal flexion ≤5°, 7feet – from 6°-15° and 10 feet – >15 °. The ATT motor power is normal at 19 patients and good in 2.

Figure 9: Talocalcaneal angle in various projections after ATT transposition.

Table 1: Dynamics of talocalcaneal angle before and after ATT transfer

Change of talocalcaneal angle			
	Angle before preoperative plaster casts	Angle after the surgery (av. 2.1 years)	Change in ^{0} (%)
AP radiography	6°-22° (av.13.7^0)	13°-29° (av. 27°)	13.3^0(97%)
Lateral radiography	16°- 31° (av. 20.1°)	15 - 41 ° (av. 31.6 °).	11.5^0 (57.2%)

4. Discussion

The active surgical behavior of congenital clubfoot, which consists of soft tissue release (posterioror posterior-medial, bone alignment corrections, etc.) Provide good results in a medium term in only 55% of the cases (3, 6, 7, 8, 15). According to many authors, late results are far more unsatisfactory – rigid and quite often painful foot.

ATT transfer is applied in recurrences after initial treatment with Ponsetimethod (4, 5,9, 11, 14). It is mini invasive, extra articular intervention for a correction of additional negative factors such as disturbed balance between evertors and invertors in clubfoot. Except for the successful correction with which this tendon transfer strengthens the conservative treatments so far, the ATT transfer leaves an open door and can be followed by many other corrective procedures, which according to the Ponseti's followers are not necessarily applied.

5. Conclusions

ATT transfer is a minimal invasive treatment in cases of recurrence after a proper primary clubfoot treatment by Ponseti method. Lack of intervention and surgical treatment of the basic stabilizing ligaments provide gradualness and stability in bone and ligament corrections. The method leads to reduction of the late recurrence rate, whereas its application is appropriate for children aged above 4.5 years, at which the correction by "late Ponsetti" is uncertain relating to its duration. The ATT transfer is an important part of the Ponseti method in clubfoot treatment. This procedure should be mastered by every surgeon who starts clubfoot treatment. The decision for its application should not be postponed when it is required on the basis of the developing recurrence.

References

[1] Dobbs MB, Rudzki JR, Purcell DB, Walton T, Porter KR, Gurnett CA. Factors predictive of outcome after use of the Ponseti method for the treatment of idiopathic clubfeet. *J Bone Joint Surg [Am]* 2004**;86**-A:22-7
[2] Dobbs M, Nunley R & Schoenecker P (2006) Long term follow up of patients with clubfeet treated with extensive soft tissue release. The Journal of Bone and Joint Surgery 88-A (5): 986-996
[3] Evans D. Relapsed club foot. J Bone Joint Surg [Br] 1961;43-B: 722-33.
[4] Ezra E, Hayek S, Gilai AN, Khermosh O, Wientroub S. Tibialis anterior tendon transfer for residual dynamic supination deformity in treated club feet. J Pediatr Orthop B 2000;9:207-11
[5] Farsetti P, Caterini R, Mancini F, Potenza V, Ippolito E. Anterior tibial tendon transfer in relapsing congenital clubfoot: long-term follow-up study of two series treated with a different protocol. J PediatrOrthop 2006;26:83-90
[6] Green AD, Lloyd-Roberts GC. The results of early posterior release in resistant clubfeet: a long-term review. J Bone Joint Surg [Br] 1985;67-B:588-93.
[7] Hudson I., Catteral A. Posterolateral release for resistant club foot. JBJS (BR) 1994 ,105
[8] LohanI. „Treatment of Congenital ClubfootUsing ThePonseti Method"; Workshop Manual [2nd Edition]; Global-help.
[9] Kuo KN, Hennigan SP, Hastings ME. Anterior tibial tendon transfer in residual dynamic clubfoot deformity. J PediatrOrthop 2001;21:35-41.
[10] Laaveg SJ, Ponseti IV. "Long-term Results of Treatment of Congenital Clubfoot." Journal of Bone & Joint Surgery 62A(1):23–31.
[11] McKay DW. New concept of and approach to clubfoot treatment: section I: principles and morbid anatomy. J PaediatrOrthop 1982;2:347-56.
[12] Ponseti IV, Smoley EN. Congenital club foot: the results of treatment. J Bone Joint Surg [Am] 1963;45-A:261-75
[13] Ponseti IV, Smoley EN. "Congenital Clubfoot: The Results of Treatment." Journal of Bone & Joint Surgery 45A(2):2261–2275.
[14] Ponseti I. Congenital clubfoot. Fundamentals of treatment, second edition. Oxford university press 1996 87 - 89
[15] Wesley MS, Barenfeld PA, Barrett N. Complications of the treatment of clubfoot. ClinOrthop 1972;84:93-6.