Achilles tendon surgery in clubfoot: Are long term sequelae predictable?

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Abstract

Congenital Clubfoot (CCF) treatment involves a surgical procedure on the Achilles tendon most of the time, *i.e.* tenotomy or, in selected cases, Z-plasty lengthening. Many authors have studied the outcomes of Achilles tenotomy, describing complete clinical and ultrasound tendon fibers integrity restoration 3-6 weeks after surgery. Nevertheless, little is known about the mechanical properties of the operated tendon. Recently, cases of subcutaneous rupture of the Achilles tendon have been described in adolescents who practiced sports and who had undergone Achilles tenotomy for congenital clubfoot in childhood. Authors report two cases of atraumatic Achilles tendon injury (subcutaneous rupture and intratendinous ossification) in adult patients who had been treated for congenital clubfoot in childhood. In both cases, no causes determining the injury were identified; in the medical history there was a Z-plasty lengthening of the Achilles tendon, performed within the first year of life, which could be considered a predisposing factor. The usefulness of long-term monitoring of patients treated for CCF with surgical procedures on the Achilles tendon is therefore hypothesized, in order to promptly identify by symptoms, clinical pictures and ultrasound criteria, tendon suffering that may predispose subcutaneous rupture.

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Introduction

Congenital Clubfoot (CCF) has an incidence of about 1/1000 births.[1] If left untreated, long-term persistence of the deformity causes pain and disability.[2,3] The most commonly accepted treatment is Ponseti casting technique, which involves the early execution of corrective manipulations, followed by the application of long leg casts and Achilles tenotomy most of the time. The correction achieved is maintained through the regular and constant use of a brace until the age of 4-5 years.[1,4,5] The surgical phase of the method is percutaneous tenotomy of the Achilles tendon, that is a minimally invasive procedure. However extensive soft-tissue releases are often performed when the results of the Ponseti method are inadequate in children with resistant clubfoot or because of recurrence. In addition, some surgeons still prefer open surgery. In these cases open surgical Z-lengthening of the tendon is performed.

Results of Achilles tenotomy surgery have been extensively studied, concerning recovering time, with tendon fibers continuity complete restoration 3-6 weeks after surgery.[6,7,8,9] Long-term clinical follow-up has shown that tendon cuts do not lead to late effects such as weakening or ruptures.[10] Ultrasonographic findings revealed minor abnormalities which did not appear to affect function.[11] There are no long-term studies on the functional results of Achilles tendon Z-plasty lengthening in CCF. Therefore, here we report two scenario of possible long-term outcomes of this surgery, referring to our experience, taking into account what is described in literature.

Case Reports

Case n. 1

M.L., 42 years old, was admitted to our department for atraumatic rupture of the right Achilles tendon: the patient reported the sensation of tearing in the calf during mild physical activity (treadmill 3 Km/h), with subsequent functional impotence. At the

age of 11 months he had been operated for bilateral CCF, with Achilles Z- plasty lengthening and enlarged postero-medial capsular release. He did not develop any recurrence of the deformity, neither pain or discomfort. No functional limitations were reported. General health conditions were good. The history was negative for drug use and no general disorders were reported. Clinically there was an alteration of the tendon profile, with surrounding ecchimotic soffusion. Palpatory, the sensation of stepping at the third middle tendon was appreciable, with positive Thompson test. Ultrasound examination confirmed the complete interruption of tendon fibers. The patient underwent surgery: the exploration confirmed complete interruption of the tendon, with a widely degenerated appearance of the fibers. After regularization of the ends of the tendon, a bundle to bundle suture and reinforcement with plantaris tendon were performed.

Case n. 2

V.S., 29 years old, came to our attention presenting pain in the right periachillear region since 2 months. The pain had arisen spontaneously, initially only on prolonged walking and later also during the weightbearing. In the anamnesis there was a corrective complete one-stage postero-medial release surgery, carried out at the age of 1 years old for bilateral clubfoot. The patient was not suffering from general disorders, she worked as healthcare worker and she did not practice any sport activity. She could walk with a slight lameness on the right. Physical examination showed a fusiform thickening of the tendon in its distal tract, of hard consistency, with pain on direct palpation and active mobilization of the ankle. The postero-medial scar of the previous surgery was modestly adherent to the superficial planes, without reduction of the dorsiflexion foot. Foot support was correct, in the absence of residual deformity or stiffness. There were no sensitivity or vascular disturbances. X-rays showed a calcification with a length of about 3 cm (Figure 1); MRI specified the characteristics of fusiform swelling of the Achilles tendon, with deformation of its anterior profile, maximum transverse diameter of about 11 mm and maximum antero-posterior diameter of about 4 mm. The proximal and distal portions of the tendon appeared regular. The patient underwent surgery to remove the swelling, which appeared tenaciously embedded in the tendon fibers, with persistence of only 1/3 of healthy tendon tissue (Figures 2 and 3). Therefore, it was necessary

Figure 1. Preoperative X- ray: Achilles tendon calcification.

Figure 2. Calcification embedded in Achilles tendon fibers.

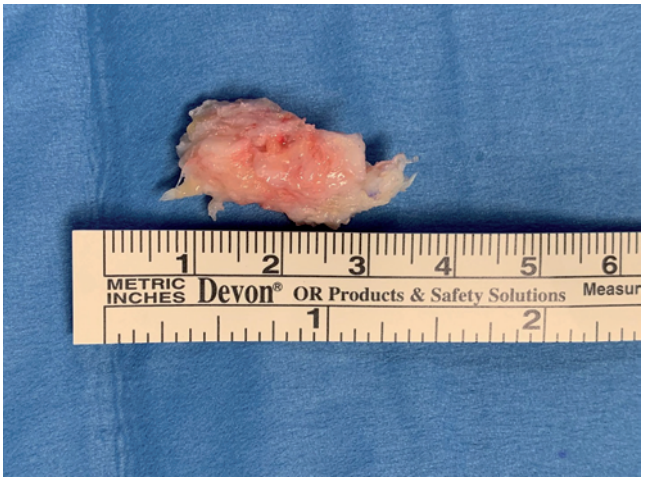

Figure 3. Calcification after removal.

to reinforce the residual fibers with a aponeurosis of the gastrocnemius plasty and a suture with an anchor. The histological report was of metaplastic ossification.

The patients were informed that data concerning the case would be submitted for publication.

Discussion

CCF has an incidence of about 1/1000 live births.[1] The malformation is characterized by a rotation of the navicular, calcaneus and cuboid around the talus, which causes the typical appearance in equinus and supination. If left untreated, clubfoot inevitably leads to significant long-term disability, deformity, and pain.[2-4] The goal of treatment is to achieve a functional, painless, plantigrade and flexible foot.[12] Equinus of the foot is a constant alteration, supported by retraction of the gastro-soleus complex, therefore the complete correction of the deformity cannot be separated from a restoration of the range of the motion of the ankle. Several treatments have been proposed: currently, the most widely accepted treatment of clubfoot consists of a series of long leg casts, and in most cases a percutaneous tenotomy of the Achilles tendon, followed by 4 years of foot abduction orthotic use.[1,4,5] The high percentage (65%-85%) of Achilles tendon tenotomy demonstrates its significance in this treatment.[13-15] Some variations of the casting technique have been proposed, which do not change the sequence of the corrective phases, and whose results did not differ significantly from those reported in literature.[17] Recurrences of deformities, which some authors still call incomplete corrections, are described in a variable percentage of cases. The equinus deformity, which is the last to be corrected, is the first to reappear in a relapsed foot. It can require the new application of casts rather than re-tenotomy or Z-shaped elongation of Achilles tendon and capsulotomies for the rigid equinus deformity. So extensive soft-tissue releases are sometimes performed when the results of the Ponseti method are inadequate, in children with resistant clubfoot, or because of recurrence. Additionally, some surgeons still prefer open surgery in severe clubfoot treatment. In these cases open surgical Z-lengthening of the tendon is performed. To date, surgical procedures on the Achilles tendon in CCF can therefore be of 2 types and sometimes one procedure follows the other.

The outcomes of Achilles tenotomy interventions in clubfoot have been extensively studied as it regards recovering time. In fact, Barker and Lavy, in a study of 11 tendons in eight infants, showed a complete tendon fibers restoration 3-6 weeks after surgery.[9] Maranho *et al.*, in a prospective study, analyzed 37 tenotomies in 26 patients with congenital clubfoot treated by Ponseti technique; in all patients examined, they documented a fast reparative process after Achilles tendon percutaneous section that reestablishes continuity between the bundles.[10] Agarwall *et al.* report a series of 27 patients who underwent Achilles tenotomy and show functional continuity of the tendons 4 weeks after procedure, proven by clinical and ultrasonographic results.[6] An ultrasound scan performed on 23 patient (33 feet) after Achilles tenotomy shows that although tendon thickness recovered, slight irregularity of the internal structure persisted when compared with the nonaffected side, even two years after tenotomy.[8] Ultrasound evaluation makes it possible to follow the healing process evolution: six months after the operation the fibers are linear in appearance, but fewer in number, and less echogenic than those of the normal tendon, gradually becoming homogeneous and normal in appearance and size.[7] 15 children with idiopathic clubfoot were evaluated at a mean of 6.8 years after Achilles tenotomy: ultrasonographic findings revealed minor abnormalities which did not appear to affect function.[11] Despite the proven restoration of Achilles tendon continuity, its mechanical aspects have not yet been fully explored; as matter of fact Kadhum *et al.* only studied the mechanical properties of the stretched tendon in Ponseti method and discussed the theoretical possibilities of casting modification to preserve the functional integrity of the soft tissues.[19] There are no studies on Achilles tendon mechanical properties modifications after Z-plasty lengthening. Increased risk of future rupture is occasionally mentioned as a possible complication of Achilles tenotomy.[19] Achilles tendon rupture is one of the most frequent injuries in the adult sports population; predisposing factors such as mechanical, vascular, neural, and genetic factors, can initially only cause a tendinopathy. Systemic diseases and some medications also influence the development of this condition. Overload is the extrinsic factor most traditionally associated and which can lead to the breakdown of degenerated fibers.[20-23] Achilles tendon rupture is an extremely rare injury in the pediatric and adolescent population; only 5 cases have been described in the literature: of these, 3 occurred in adolescent previously treated for clubfoot. Aretakis and Georgopoulos reports a case of a boy who had undergone bilateral Achilles tenotomy for clubfoot at the age of 8 months; he suffered left Achilles tendon rupture at 16 years and at 18 years he suffered a contralateral Achilles rupture, during sports activities.[16] Egger presented a case of a 15-year-old girl who had a history of Ponseti casting. followed by Achilles tenotomies, for congenital clubfoot and subsequently suffered of acute traumatic Achilles tendon rupture on the left.[15] In these cases, the tear could be considered a rare complication of the tenotomy; however the overload due to sporting activity also played a role in the pathogenesis; so it is difficult to establish how much the event depends on the overload and how much on the weakness of the tendon due to the previous surgery. The case we observed concerned an adult patient, in whom the medical history was negative for trauma or functional overload from work or sports, and in which the only predisposing factor was the previous Achilles tendon Z- plasty lenghthening, performed during postero-medial release for clubfoot. In this case, therefore, a relationship between spontaneous rupture and previous surgery on the tendon could be hypothesized. The second case concerned a patient diagnosed with painful intratendinous ossification, who required surgery to be removed; ossification of the tendon is a very unusual clinical event and this is characterized by the presence of an ossified mass within the substance of the tendinous tissue. The etiology of ossification is multifactorial, however previous surgery, trauma and degenerative changes have been attributed to be the major causes.[24] Less than twenty cases of ossification in the Achilles tendon have been reported in the literature, out of which four cases had previous history of clubfeet surgery in their childhood.[24-27] In one of these cases, the presence of ossification had been diagnosed together with the subcutaneous rupture of the tendon, in a patient asymptomatic until that moment.[27] Even in our case the patient had never reported symptoms, nor predisposing factors had been identified, with the exception of the previous Z-plasty lenghthening of the Achilles tendon.

These observations are not sufficient to demonstrate a direct relationship between late atraumatic injuries of the Achilles tendon and previous surgery on the tendon itself; however it is not possible to exclude that the Achilles tendon surgery in CCF, beyond the restoration of the anatomical continuity of the tendon fibers, may cause an alteration of its mechanical strength in the long term.

Conclusions

The goal of CCF treatment is to obtain an asymptomatic, mobile and plantigrade foot. Complete correction in a high percentage of cases can only be achieved by performing a procedure on the Achilles tendon such us tenotomy in young children and Z-plasty lenghthening in older children or in relapses. The short-term and long-term studies on CCF treatment generally describe and compare the morphological, functional and radiological results of the used methods. No author has described the late effects on the Achilles tendon, both in the case of percutaneous tenotomy practiced in the Ponseti method, and in the case of open lengthening performed in enlarged surgery. On the basis of our observations and the review of the literature, it is possible to hypothesize that both types of intervention, percutaneous and open causes an alteration of the structure of the tendon which, in the long run, could alter its mechanical properties. This could lead to the onset of chronic pathology, up to subcutaneous rupture. Further observations are needed to understand how much the changes are secondary to surgery and how much they are part of the disease itself. In patients treated for CCF a prolonged follow-up is recommended, so that distress tendons signs can be identified. In case of subjective discomfort or ultrasound signs of tendon distress, changes of the patients lifestyles could be advised, in order to possibly prevent subcutaneous rupture.

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