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Original Research Article

Comparison of the Ponseti method versus early tibialis anterior tendon transfer for idiopathic clubfoot: A prospective randomized study

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ABSTRACT

Objective: The aim of the study was to compare functional and radiological outcomes in clubfoot patients treated by early Tibialis anterior tendon transfer and Ponseti method.

Materials and methods: A prospective, randomized study was conducted. A total of 39 children with a mean age of 17.05 days (55 clubfeet) were randomly allocated into one of two groups: first (conservative Ponseti method) group ($n = 28$) or second (early tibialis anterior tendon transfer [TATT]) group ($n = 27$). Foot function and radiographic measurements were evaluated. The condition of the subjects was observed until they reached the age of 2 years.

Results: The clinical and radiological data did not differ between groups at the age of 6 months. No statistically significant difference regarding Pirani and Dimeglio scale among the groups was observed at the last follow-up. A statistically significant difference was observed in the foot dorsal flexion; it was lower in the second group ($P = 0.03$). Other clinical parameters did not differ between groups. According radiographic data, only the talocalcaneal angle (TCA) was significantly higher in the second group ($P = 0.003$). Children who underwent TATT were 5.00-fold ($P = 0.002$) and 1.67-fold ($P = 0.017$) more likely to have TCA larger than 30° (which reflects the normal range of the TCA) in DP and lateral views, respectively, and 3.40-fold ($P = 0.019$) more likely to have foot dorsal flexion of less than 15° than their counterparts undergoing the conservative Ponseti treatment.

Conclusions: Early TATT allowed a significant reduction in the brace wear duration and resulted in the same outcomes as using the Ponseti method. Additionally, TATT can provide some improvement of hindfoot varus. However, a possible weakening of dorsiflexion should be also taken into account. Our experience has shown the need for a larger sample and longer term studies.

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1. Introduction

Clubfoot is one of the most common and challenging orthopedic deformities in children. Many studies, in particular in short-term studies, demonstrate good clubfoot treatment outcomes, reaching up to 97%, as well as a reduced need for surgery [1–3] using the conservative Ponseti method. However, the relapse rate is also high and reaches 7%–78% [4–7]. The outcomes, especially those recently obtained, are highly dependent on the parent's compliance regarding the wearing of braces. Ponseti as well as other authors argue that the vast majority of relapses significantly depend on the brace wear mode and duration [5,8,9]. Goldstein et al. [10] state that noncompliance with brace wearing increases the need for surgery by 7.9 times. Scholars argue that compliance with brace wear protocol is observed in 47%–81% of cases [6,11,12]. Ponseti also provides a surgical treatment option: tibialis anterior tendon transfer (TATT) in the event of clubfoot relapse and/or noncompliance with brace wear in children older than 2 years. The TATT effect in the treatment of clubfeet in children over 2 years of age is described in retrospective scholarly literature [13–15], as well as in studies with cadavers [16]. Many studies provide favorable outcomes of the TATT procedure on previously operated feet [17–20]. A number of articles evaluating the impact of the foot abduction brace on relapse frequency are available [5,6,9,12]. However, prospective studies are scarce [21]. Meanwhile, no prospective randomized studies evaluating early TATT have been detected in the world literature. Therefore, taking into account a sufficiently serious problem of non-wearing brace and a high relapse rate, this topic is becoming increasingly more relevant; ways are being sought to assure a minimally invasive clubfoot correction, to avoid long-term brace wearing and to protect the feet from relapse at younger age. Our study introduces a modification of the treatment strategy recommended by Ponseti and applies early TATT, with the intention of reducing the relapse rate associated with the noncompliance of brace wear, and, having performed an early surgery and refused brace wearing, to achieve similar outcomes as in the case of the traditional conservative Ponseti method. The aim of this study was to find out whether foot function and radiological measurements of children treated with two different methods differ at the age of 2 years old. It is also important to identify whether this approach is relevant in today's practice, which served as the basis for this study.

2. Materials and methods

2.1. Study participants

A total of 44 children (63 feet) treated for idiopathic clubfoot at the Clinic of Paediatric Surgery, Hospital of the Lithuanian University of Health Sciences, from 2011 to 2013, who complied with the inclusion criteria and gave consent to participate in a prospective randomized study. After the dropouts of 5 children (8 feet) (12.7%), the data of 39 children (55 feet) were used for a functional and radiological analysis. The study involved 27 (69.23%) boys and 12 (30.77%) girls. Right clubfoot was diagnosed in 17 children (43.59%), left in 6 (15.38%), and bilateral in 16 (41.03%). The inclusion criteria were as follows: (1) patients with idiopathic clubfoot; (2) patients up to 3 months of age; (3) written consent to participate in the study; and (4) patients who underwent no other treatment. The exclusion criteria were as follows: (1) patients who refused to participate in the study; and (2) severe concurrent genetic or neurological pathology that is likely to affect the child's physical development and/or the function of the foot. At baseline patients were allocated randomly by the sealed envelope technique to one of two groups: (1) first group: treatment following the traditional conservative Ponseti method; (2) second group: early TATT into the cuboid bone. The condition of the subjects was observed until they reached the age of 2 years. Figure shows the flowchart of the study. The study was carried out under the permission of the Regional Biomedical Research Ethics Committee (No. BE-2-13).

2.2. Study design

First group patients, at the initial stage, underwent a traditional casting as recommended by the Ponseti method [22]. In the case of persistent equinus deformity after a casting course, percutaneous Achilles tenotomy was performed. After Achilles tenotomy, the feet were immobilized for 3 weeks. After removing the last plaster cast, the foot abduction brace was applied, to be worn 23 h a day for up to 6 months of age. The 6 month-old patients continued to be treated with the brace for 14–16 h a day throughout the study period up to 2 years of age, in accordance with the Ponseti method's recommendations.

The patients in the second group, up to 6 months of age, underwent the same treatment as the patients of the first group, as described above. The 6 month-old patients underwent TATT under the extensor retinaculum into the cuboid bone. The surgery was performed under general anesthesia, using a tourniquet and X-rays. After the surgery, the foot was immobilized in the plaster cast for 5 weeks. After removing the plaster cast, the patients did not wear the abduction brace anymore. The last follow-up was 1.5 years after surgery, until they reached the age of 2 years.

2.3. Measurements

At baseline, each patient underwent a thorough detailed orthopedic and pediatric examination. The severity of the clubfoot was estimated by the Pirani and Dimeglio scales at baseline, at 6 months of age and 2 years of age. Additionally, at 6 months of age and at the last follow-up (aged 2 years), the foot range of motion (ROM) (dorsal flexion, plantar flexion, supination, pronation) was rated using a goniometer, and a radiological examination was performed by obtaining the standard dorsoplantar (DP) and lateral foot X-ray. Talocalcaneal (TCA), tibiocalcaneal (TBCA), talo-first metatarsal and cuboid abduction angles, reflecting the main clubfoot components, were measured.