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Original Article

Mid-term results of the posteromedial release in the treatment of relapse clubfoot

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Abstract

Background: Clubfoot (CF) is one of the most common musculoskeletal deformities in newborns, with an incidence of 1–2 per 1,000 live births. While the Ponseti method is the gold standard for initial management and achieves over 90% initial correction rates, relapse remains a significant challenge, particularly in severe cases or in instances of poor compliance with orthotic use. Recurrent CF may require surgical intervention when conservative measures fail. Posteromedial release (PMR) is a well-established surgical technique designed to correct all components of the deformity in a single stage. **Methods:** This retrospective study included 16 patients (20 feet) with relapsed idiopathic CF who were treated with PMR after unsuccessful conservative or previous surgical treatment. All surgeries were performed by the same surgeon using Turco's posteromedial approach. Clinical evaluation was conducted using the Pirani Score (PS) before and after surgery. Radiographic parameters including anteroposterior talocalcaneal angle (ATCA), lateral talocalcaneal angle (LTCA), and anteroposterior talo-first metatarsal angle (ATMA) were measured preoperatively and at final follow-up. **Results:** The mean patient age was 4.5 years, with a mean follow-up of 2.7 years. The mean PS improved significantly from 4.13 to 0.89 ($p = 0.001$). Radiological outcomes also showed significant improvement: ATCA increased from 21° to 23° ($p = 0.047$), LTCA from 20° to 30° ($p = 0.002$), and ATMA decreased from 45° to 11° ($p = 0.001$). In addition to PMR, the surgical procedures performed on the patients were as follows: cuboid decancellation, medial column lengthening, lateral cuneiform transfer of the tibialis anterior tendon, split tibialis posterior tendon transfer to the proneus brevis tendon, and multiple metatarsal osteotomies. **Conclusions:** PMR is a safe and effective surgical option for the treatment of relapsed congenital clubfoot when conservative methods fail. It allows for satisfactory mid-term correction both clinically and radiologically, with low complication rates and durable outcomes.

Keywords: Clubfoot, talipes equinovarus, recurrent, relaps, posteromedial release, Turco method

Introduction

Clubfoot (CF) is a common congenital malformation. CF is encountered in 1-2/1000 live births, bilateral involvement is observed in half of the patients, and it has been reported that the right foot is more frequently affected in unilateral cases [1-4]. Almost all musculoskeletal elements below the knee are affected [1-6]. One of the most important indicators of this dysplasia is that even in patients who have received appropriate treatment, the formation of a normal foot cannot be achieved [1-8].

CF may be positional due to foot posture during pregnancy [8,9]. It may also accompany congenital and neuropathic diseases such as arthrogryposis, Down syndrome, Streeter dysplasia, myelodysplasia, Möbius syndrome, and Freeman Sheldon syndrome [8-10]. However, the most common form is the idiopathic type, in which there is no accompanying deformity [1-4]. Although early results of conservative or surgical treatments are reported to be good, it is difficult and sometimes impossible to return the foot to normal [1-4,8-10]. The main goal of treatment should be to correct all components of the deformity to restore the physiological morphology and function of the foot as much

Table 1. Patients' demographic characteristics.

Number of patients	16 (20 feet)
Age, years, mean ± SD (range)	4.5 ± 3.05 (1–7)
Gender, n (%)	
Woman	1 (6)
Man	15 (94)
Localization, n (%)	
Right foot	10 (50)
Left foot	10 (50)
Follow-up, years, mean ± SD (range)	2.7 ± 1.39 (1–5)

Abbreviation: SD, standard deviation.

Table 2. Pirani classification for clubfoot.

Variables	Normal	Moderate	Severe
Mid-foot			
Curved lateral border	0	0.5	1
Medial foot crease	0	0.5	1
Talar head coverage	0	0.5	1
Hind-foot			
Posterior crease	0	0.5	1
Rigid equines	0	0.5	1
Empety heel	0	0.5	1

as possible and to allow plantigrade stance and proper walking [1-4,8-10].

In this study, mid-term results of patients with CF relaps who were surgically treated with posteromedial release (PMR) were presented.

Materials and methods

A total of 16 patients (20 feet) with congenital CF were included in the study. Patients were evaluated retrospectively. All patients had recurrent CF that had previously been treated with the Ponseti casting method or surgical methods but had not responded. This retrospective study was conducted in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The University of Health Sciences Kayseri City Training and Research Hospital Clinical Research Ethics Committee approved the study protocol.

Demographic characteristics were recorded for all patients (Table 1). Patients were evaluated at the last follow-up for plantigrade position of each foot, joint stiffness, muscle function, pain, shoewearing, and walking. Clinical outcomes before and after treatment were evaluated according to the Pirani classification system (PCS) (Table 2) [11].

In cases of plantigrade feet, results were considered as excellent for scores between 0 and 1, good between 1.5 and 2.5, and poor if ≥ 3[11].

Anteroposterior and lateral foot radiographs of the patients were used for radiological measurements. Anteroposterior talocalcaneal angle (ATCA), lateral talocalcaneal angle (LTCA), anteroposterior talo-first metatarsal angle (ATMA) were measured from preoperative and final postoperative follow-up radiographs, respectively. Turco's PMR surgical method was used in the treatment relapse clubfoot disease. All surgical procedures of the patients were performed by the same surgeon (FO).

Table 3. Comparison of preoperative and postoperative clinical and radiographic results.

Variables	Preoperative	Postoperative	P-value
ATCA, median ± range	21° (2–40)	23° (7–54)	0.047
ATMA, median ± range	45° (12–76)	11° (3–37)	0.001
LTCA, median ± range	20° (0–48)	30° (4–55)	0.002
PS, median ± range	4.13 (3.5–5.5)	0.89 (0.5–2)	0.001

Abbreviations: ATCA, anteroposterior talocalcaneal angle; ATMA, anteroposterior talo-first metatarsal angle; LTCA, lateral talocalcaneal angle; PS, Pirani score.

Surgical technique

All the patients had Turco's [12] one stage procedure under tourniquet control and under general anaesthesia. Following posteromedial (PM) skin incision, the abductor hallucis muscle and plantar fascia were sectioned. The achilles tendon was lengthened by Z-plasty. The tibialis posterior (TP), flexor digitorum longus (FDL) and flexor hallucis longus (FHL) tendon were lengthened by z-plasty. Lateral, posterior and medial releases were performed in the subtalar region. The posterior capsules of the ankle and subtalar joint, entire medial and lateral capsule of sub-talar joint, the calcaneofibular ligament, superficial deltoid ligament and talo-navicular capsule were dissected. Henry's knot was released. After releases, the alignment of the 1st metatarsus, navicular and talus was achieved and fixed with a K-wire. After bleeding control, the layers were closed. A long leg cast was applied in the appropriate position. The cast and K-wires were removed after 6-8 weeks. Stretching exercises were then applied and a CF boot was given. The boot was applied for 6 months and it was also worn at night for the next 3 years.

Statistical analysis

All data analyses were performed using IBM Statistical Package for Social Sciences v. 27.0 (IBM Corp., Armonk, NY, USA). Percentages and means with standard deviations (SDs) were determined for categorical data and continuous variables, respectively. The normality of the data was tested using the Shapiro-Wilk test. Preoperative and postoperative radiographic results were compared using the Wilcoxon signed-rank test, and a p-value ¡0.05 was considered statistically significant.

Results

The study included 15 males and one female. Four patients had bilateral CF deformity. Mean age was 4.5 ± 3.05 years (range, 1–7 years), 10 patients had left and 10 patients had right recurrent CF, mean follow-up was 2.7 ± 1.39 years (range, 1 to 5 years).

The mean value of the Pirani score (PS) before treatment was 4.13 ± 0.76 (range 3.5–5.5) and at the last follow-up it was 0.89 ± 0.45 (range 0.5–2) (p = 0.001). The median values of the radiological values measured from the preoperative and postoperative final control radiographs of the patients are as follows: ATCA 21 ± 10.7° (range, 2–40) and 23 ± 12.3° (range, 7–54) (p = 0.047); ATMA 45 ± 20.5° (range, 12–76) and 11 ± 11.06° (range, 3–37) (p = 0.001); LTCA 20 ± 14.5° (range, 0–48) and 30± 12.3° (range, 5–54) (p = 0.002), respectively (Table 3).

In addition to PMR, the surgical procedures performed on the patients were as follows: Cuboid decancellation in nine patients, medial column lengthening in three patients, lateral cuneiform

Figure 1. a, c) Preoperative antero-posterior and lateral radiographs of a 5-year-old patient with clubfoot relapse. **b, d)** Control radiographs of the same patient two years after posterimedial release.

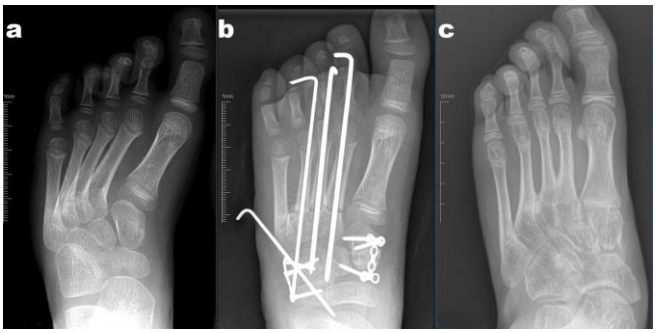

Figure 2. A 7-year-old patient's **a)** preoperative radiograph, **b)** postoperative radiograph, **c)** follow-up radiograph of the patient 6 years later.

transfer of the tibialis anterior tendon in three patients, split tibialis posterior tendon transfer to the proneus brevis tendon in two patients, and multiple metatarsal osteotomy in one patient (Figures 1-3). During the follow-up period, the patients did not develop any problems such as wound problems or infection.

Discussion

There is a consensus that the first step in the treatment of CF should be conservative [3,8,9]. The first step of treatment in the newborn period is manipulation and serial casting [3,8]. The Ponseti method is highly successful in the treatment of CF, with initial correction rates exceeding 90% [1-7,13,15,17]. There are numerous studies in the literature reporting that the recurrence rate after initial Ponseti correction method is an average of 40%, similar to that after surgical correction [1-7,13-17]. Although there are many reports on techniques for treating recurrence after initial correction with the Ponseti method, there are no clear recommendations regarding the most appropriate treatment for these patients [1-7,13,15]. Equinus and adductus, alone or in combination, with or without dynamic supination, are the most common signs of recurrence [1-7,13,15]. However, recurrence after treatment with the Ponseti method tends to be less persistent and better functional results are achieved with less invasive procedures [13]. Also, the favorable fibroelastic properties of the ligament, joint capsule and tendons, which are composed of connective tissue, in the first days of life provide advantages in conservative treatment [3,8]. Since early surgical treatment induces fibrosis, scarring and joint stiffness, surgical treatment is not recommended as the first treatment [3,8,9]. In cases where complete correction cannot be achieved with conservative treatment, surgical treatment is resorted to [6,12,13]. Not all feet with CF are the same [3,8,9]. Therefore, the remaining components of the deformity should be carefully evaluated [3,8,9]. In CF patients, when it is predicted that conservative treatment will fail, surgical treatment should be planned and applied without delay in order to prevent the formation of possible secondary disorders such as flattening of the talus head [1-5]. Insisting on plaster corrections in feet resistant to conservative treatment causes both more fibrosis and permanent bone deformities such as flattening of the talus head [5,6,12]. The maximum duration of conservative treatment should be accepted as three months [5,6,12]. After this age, the earlier the deformity is corrected, the more secondary deformities will be prevented and the greater the chance of the articular cartilage surfaces to regain their normal physiological structure [5,6,12]. Turco recommended that surgical treatment should be applied at one year of age and later in terms of both tissue dominance and sufficient fixation of the repaired tissues in the correct position [12]. Simons advocated that the foot should be 8 cm or more in size for surgical treatment [14]. For all these reasons, the most appropriate time for surgery is after 6 months of age or after the foot size reaches 6-8 cm [1-7,14]. The upper age limit for soft tissue surgery is the formation of secondary bony structures. Therefore, the upper age limit can be accepted as 18 months [1-7,14]. The general approach in surgery is to release as much as necessary to achieve complete correction [7]. Depending on whether the remaining deformity is complete or partial, complete subtalar or PMR, posterior capsulotomy and achilloplasty, and interventions for adduction of the forefoot can be selected. Although complete subtalar release has complications such as wound site problems and overcorrection, it is the most commonly used surgical procedure today because it can provide complete correction [1-7,10,13].

Generally, the PM incision applied by Turco, the Cincinnati incision or the two separate incisions applied by Caroll and their modifications are frequently used in surgical incisions [4,7,12-14]. The important thing in these incisions, which vary according to the surgeon's preference, is that they are made in a way that is sufficient to correct the deformity in a single session and does not cause skin necrosis after the deformity is corrected [4,7,12-14]. We used the PM incision applied by Turco in our patients. All of our patients had recurrent CF who had previously undergone either Ponseti casting and failed or surgery and failed. We achieved satisfactory results with Turco's PMR technique, which corrects all deformity elements in the same session. Despite complications such as wound site problems and ovarian correction, complete subtalar release is still the most commonly used surgical procedure [4,7,12-14]. We did not encounter any serious complications in our patients. The cause of relapse in most of the cases is primarily mismanagement or patient non-compliance. In our study, a low result was obtained according to the PS in two legs of one patient due to family non-compliance.

Several scoring systems have been developed for the evaluation of the severity of congenital CF, such as the Ponseti-Laaveg classification and the Dimeglio classification, international clubfoot study group classification system [9,15]. The PCS developed by Pirani has become a popular scoring system due

Figure 3. a, c, e) Preoperative appearance of the deformity in the right foot of a 2-year-old patient with bilateral relapsed clubfoot. **b, d, f)** Follow-up view of the left foot of the same patient, which had previously been operated on with the posterimedial release technique, at 9 months.

to its ease and ability to evaluate the severity of each component of the deformity [11]. In the PCS, examination findings of foot deformity are scored numerically. The PCS is reliable, quick, and easy to use [16,17]. In our study, we evaluated the clinical status of the patients with the modified PS.

Poor outcomes in CF are dependent on multifactorial parameters [13]. One reason for this is that the vast majority of patients have a severe deformity at birth and are therefore more resistant to well-applied nonsurgical treatment [13]. Management of recurrent deformities remains controversial [1-7,13]. However, most studies have shown low efficacy of recasting, so surgery should not be avoided if necessary [1-7,13]. In very long-term follow-up studies, CF deformity cannot be completely corrected despite extensive surgical procedures or conservative treatment [13].

Recasting, repeat Achilles tenotomy, Achilles tendon lengthening and tibialis anterior tendon transfer or more invasive surgical treatments are additional surgical procedures that may be required for patients with recurrent CF [1-7,13,15]. The most severe cases of recurrent CF can be treated with osteotomies and fusions [1-7,13,15]. As a last resort, triple arthrodesis can be used, but this should be reserved for older patients [1-7,13,15].

Conclusion

The treatment of recurrent CF varies from the least invasive to the most invasive. The main reason why invasive treatments are not initially preferred is the difficulty, high risks of these surgeries and the stiffness that develops in the feet of the patients. However, when deemed necessary, children with recurrent CF can be successfully treated with PMR technique and good patient management.

Author contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by SY, KS, FO. The first draft of the manuscript was written by SY and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Statements and declarations

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Conflict of Interest

The authors declare that they have no conflict of interest.

Ethical statement

The University of Health Sciences Kayseri City Training and Research Hospital Clinical Research Ethics Committee approved the study protocol, informed consent was obtained from each patient, and the study was conducted in accordance with the principles of the Declaration of Helsinki.

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