Clinical outcome after percutaneous flexor tenotomy in forefoot surgery

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Abstract The aim of this study was to evaluate the outcome of the percutaneous flexor tenotomy. We compared the results of two groups. The first group included 23 patients who underwent forefoot surgery without percutaneous flexor tenotomy, and the second group included 50 patients who underwent the same procedure combined with percutaneous flexor tenotomy for claw toe deformities, secondary to shortening metatarsal Scarf osteotomy. The average follow-up was 11.6 months. Three algoneurodystrophies were noted. No delayed wound healing was observed. Functional dissatisfaction rate (18% vs. 17.4%) and toe pulp contact defect (12% vs. 8.7%) were not significantly different in the two groups. Toe grasping defect rate (10% vs. 4.3%) was superior in the tenotomy group. Five recurring claw toe deformities of the second toe were noted in the tenotomy group. Percutaneous flexor tenotomy is a simple, rapid, and efficient method to correct reducible secondary claw toe deformities. However,

despite a significant postoperative loss of toe grasping function, no patient reported major dissatisfaction.

Résumé Devenir clinique après ténotomie percutanée des tendons fléchisseurs des orteils dans la chirurgie de l'avant pied. Le but de cette étude était d'évaluer le devenir de la ténotomie percutanée du fléchisseur. Nous avons comparé les résultats de deux groupes, le premier sous-groupe incluant 23 patients ayant bénéficié d'une chirurgie de l'avant pied sans ténotomie percutanée du fléchisseur et le second, incluant 50 patients, ayant bénéficié de la même chirurgie associée à une ténotomie percutanée du fléchisseur pour une déformation des orteils en marteau ou en griffe, secondaire au raccourcissement métatarsien après ostéotomie de Scarf. Le suivi moyen a été de 11,6 mois. Trois algoneurodystrophies ont été rapportées. Aucun défaut de cicatrisation n'a été observé. Le taux d'insatisfaction est de 18% (vs 17,4%) et le défaut d'appui pulpaire du gros orteil de 12% (vs 8,7%), ces taux ne sont pas significativement différents dans les deux groupes. Le taux de défaut d'agrippement des orteils est supérieur de manière significative dans le groupe avec ténotomie (10% vs 4,3%). Cinq récurrences de griffes du deuxième orteil ont été rapportées dans le groupe ténotomie. La ténotomie percutanée du fléchisseur est un geste simple, rapide et efficace permettant de corriger les déformations secondaires en griffes des orteils. Cependant, malgré l'existence d'un défaut d'agrippement des orteils postopératoire, aucun patient n'a rapporté d'insatisfaction majeure.

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Introduction

Mini-invasive surgery (MIS) of the foot appeared in the mid 1970s in the United States. In forefoot surgery, many

MIS techniques are under development but results published so far remain controversial. Good results have been reported for the hallux valgus correction [1], for which Kadakia et al. [2] found a high rate of complications and recurrences. Coillard et al. [3] and De Prado et al. [4] report encouraging results in percutaneous surgery for static metatarsalgia. The main aim of these percutaneous techniques is to ensure a quicker postoperative recovery with similar results to more conventional surgery. The "claw-like" position of the toe is physiological when walking. The claw toe deformity is a frequent yet painful pathology [5]. It can be primary or secondary to a shortening first metatarsal surgery, leading to what Gauthier [6] described as the "harness syndrome". When finding a secondary claw toe during forefoot surgery, we carried out percutaneous flexor tenotomies.

We report on the results of a continuous prospective study and investigate the clinical outcomes after percutaneous flexor tenotomy of the toe in 50 patients.

Materials and methods

Patients

Our study included 73 patients who underwent forefoot surgery from January to December 2005. There were 69 women and four men. The average age at surgery was 57 years (range 22–79). All patients suffered from hallux valgus with metatarsalgia. A flexor tenotomy was performed on three toes (the second, third and fourth) in 50 patients. The main characteristics of the global population and of the two sub-populations are described in Table 1.

The surgical procedure was a Scarf M1 osteotomy and Weil osteotomy of the second, and in some cases also the third, metatarsus. A percutaneous tenotomy was performed for management of a persistent flexible claw toe after the bone procedures. All tenotomies were performed by the same senior surgeon. A tourniquet was systematically used. Twenty-nine patients were operated on under general anaesthesia, 33 under local/regional and 11 under spinal anaesthesia. Two patients (women) had history of algoneurodystrophy.

Operative procedure

Percutaneous tenotomies of the second, third and fourth flexor tendons were performed at the end of the procedure. A short plantar incision was made just proximal to the toe metatarsophalangeal joint (MTPJ) mark (Fig. 1). A forced extension was then performed to obtain proper correction of the deformity. A sterile dressing was meticulously applied over the wound to maintain the toe in an appropriate position and the MTPJ in flexion. The vitality of the toes was systematically assessed at the end of the procedure once the tourniquet was removed.

Method of evaluation

All patients were followed-up regularly (D21, D45, three months, six months, one year and two years) by the same examiner. There was no patient lost to follow-up. Data were gathered from the medical records and from the surgical procedure record. The following parameters were analysed: age, gender, history of algoneurodystrophy, type of anaesthesia. We systematically evaluated the patient's functional dissatisfaction, toe pulp contact defects, toe grasping defects, recurrent claw toes, and cutaneous complications (Table 2). Both groups (with and without tenotomy) were compared using StatView statistic software (Abacus Concepts, Berkeley, California, USA). Nonparametric tests were used; the *P* value for statistical significance was set to 0.05.

Results

Average follow-up was 11.6 months (range 6–24).

Indications

Our indications for tenotomy were: a persisting claw toe deformity after Weil osteotomy, the correction of a claw toe secondary to a very shortening Scarf osteotomy on the first metatarsal, and the harness syndrome.

Table 1 Characteristics for global, tenotomy, and control groups

Characteristic	Global population	Tenotomy group	No tenotomy group	<i>P</i> value
Number of patients	73	50	23	
Age, y (range)	57 (22–79)	58 (22–79)	57 (32–75)	ns
Female proportion, <i>n</i>	69 (95%)	48 (96%)	21 (91%)	ns
Previous history of neuroalgodystrophy, <i>n</i>	2 (2.7%)	2 (4%)	0	ns

ns not significant

Fig. 1 Surgical procedure (flexor tendon tenotomy)

Clinical outcome

At last follow-up, five recurrent claw toes of the second toe were reported in the tenotomy group (10%). Functional dissatisfaction rate (18% vs. 17.4%) and toe pulp contact defects rate (12% vs. 8.7%) were similar in both groups; toe grasping defect rate (10% vs. 4.3%) was significantly greater in the tenotomy group. Three algoneurodystrophy syndromes were observed, two of which occurred in patients from the tenotomy group. No skin necrosis was noted.

Discussion

Percutaneous lateral flexor tenotomy proved to be a very simple, rapid, and efficient technique in the management of

claw toe deformities. Only five (10%) recurrences were reported in the tenotomy group. Given the short follow-up period of this study, our successful results need to be confirmed by longer studies. No other study about lateral flexor tenotomy has been reported in the literature.

Metatarso-phalangeal laxity associated with PIP claw can be managed using a tendon transfer of the flexor longus tendon to the extensor tendon. Boyer and DeOrio [7] reported this technique on 78 toes (38 patients) with an average follow-up period of 33 months, reporting 89% satisfied patients.

Fixed or reducible claw toe can also be managed using the classic PIP or DIP resection depending on the proximal or distal localisation of the claw. In a study including 75 PIP resections, O’Kane et al. [8] found two claw toe recurrences requiring second surgery. “Floating toe” was the most common complication and represented 18% of cases. According to Edwards and Beischer [9], PIP arthrodesis can be performed in secondary surgery to address claw toe deformities and/or fixed major deformities. They also demonstrated that arthrodesis was poorly tolerated in either very young or very old patients, for aesthetical reasons in the first group, and for functional dissatisfaction in the second. Lehman and Smith [10] found 15% of unsatisfied patients in a study involving 100 PIP arthrodeses. We highly recommend this technique for fixed claw toe deformities using a PIP arthrodesis for second and third rays, and a modelling PIP resection for the fourth and fifth rays. We performed a less aggressive flexor tenotomy in the management of flexible deformities.

Claw toes can be primary or secondary to a shortening procedure on the first metatarsal. This can lead to the harness syndrome as described by Gauthier [6]. In fact, it is explained by the anatomical arrangement of the aponeurosis connecting the flexor hallucis longus tendon to the flexor digitorum longus, which support the aponeurotic distal expansions of the quadratus plantae [11]. Therefore any procedure performed on the flexor hallucis longus can have a major impact on the tension in one or more terminal part of the toe flexor tendon. This can eventually lead to the claw toe deformity. We observed a high rate of

Table 2 Complications

Complications	Global (<i>n</i> =73)	Tenotomy group (<i>n</i> =50)	No tenotomy group (<i>n</i> =23)	<i>P</i> value
Algodystrophia	3 (4%)	2 (4%)	1 (4.4%)	ns
Claw toe recurrence		5 (10%)		ns
Functional dissatisfaction	13 (18%)	9 (18%)	4 (17%)	ns
Toe to ground contact defect	8 (11%)	6 (12%)	2 (8.7%)	ns
Grasping defect	6 (8%)	5 (10%)	1 (4.3%)	<i>P</i> ≤0.05
Stiffness Weil osteotomy	12 (16.4%)	8 (16%)	4 (17.4%)	ns

ns not significant

tenotomies in our study (68%), due to a high rate of severe deformity in the studied population. The alternative procedure to the tenotomy could be the section of the aponeurosis between the flexor hallucis longus and the toe flexor tendon, using a medial incision on the mid-foot [6]. According to Gauthier, this is a preventive as well as a correcting technique for the harness syndrome. The most frequent complication is the section of the medial plantar nerve, but the incidence of this complication is not given. Appropriate surgical exposure is required, but leads to a higher rate of postoperative haematomas. Our technique is easier to perform.

Nevertheless, the functional dissatisfaction concerning the toes is not higher in the tenotomy group (18%) compared to the control group (17.4%). The age at surgery and functional dissatisfaction were not related. We found more toe grasping defects in the tenotomy group ($p < 0.05$). Ross and Menelaus [12] report the results of open tenotomy to correct claw toe in a study of 62 children's feet. Mean age at surgery was four years and mean follow-up period was ten years. They reported a recurrence rate of 5% with no loss of toe flexion. In the adult, only the lumbricals and the interossei (i.e. intrinsic muscles) remain efficient after tenotomy, resulting in a lack of toe grasping. It thus lessens the propulsion capacity of the toe, particularly during fast walking and/or sporting activities. In effect, lack of toe grasping is functionally irrelevant except in the most fastidious of patients. Children reported better functional adaptation.

Conclusion

Percutaneous tenotomy of the toe flexor tendon is a simple, rapid and efficient technique to correct mobile secondary claw toes deformities in forefoot surgery. However we found

complications such as a lack of toe grasping. The theoretical risk of devascularisation wasn't encountered in our study. Therefore, we do not advise such procedure on young and active patients, but we continue to recommend it for older patients presenting with a complex forefoot deformity.

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