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ORIGINAL ARTICLE

Hallux valgus correction in metatarsus adductus

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KEYWORDS
Metatarsus adductus;
Hallux valgus;
Low correction

Abstract
Background: To describe the frequent association of metatarsus adductus and hallux valgus in the adult foot as a cause of insufficient correction after application of common surgical techniques.
Method and material: A retrospective review was made of 16 cases in 15 patients with clinical and radiological metatarsus adductus operated by Hallux valgus from 2006 to 2008. In all cases, a correction of the deformity lower than 10° was observed.
Results: The mean postoperative correction was 9°. The mean inclination of first cuneum-metatarsal joint was 65°. We did not find any relationship between Metatarsus adductus magnitude and postoperative Hallux valgus correction. The best results were observed with Scarf Osteotomy.
Discussion: There is controversy on the Metatarsus adductus and Hallux valgus relationship. Although poor application of the surgical techniques is the most important cause of correction failure, the limited literature references and the comparison with similar results, may show this association as a cause of the difficulty in the application of conventional surgical techniques. Poor performance of these techniques is an important cause of correction failure and must be evaluated.
Conclusion: Metatarsus adductus in the adult foot with Hallux valgus to be operated must be detected and seen as a deformity that is difficult to correct. Preoperative planning and choice of surgical technique must assess these angular deformities to avoid a poor result for the patient.

PALABRAS CLAVE
Metatarso *adductus*;
Hallux valgus;
Hipocorrección

Corrección del *Hallux valgus* en metatarso *adductus*

Resumen
Objetivo: Señalar la frecuente asociación de metatarso *adductus* y *Hallux valgus* en el adulto como causa de corrección insuficiente de éste tras la aplicación de técnicas quirúrgicas comunes.

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Material y método: Se han revisado retrospectivamente 16 casos en 15 pacientes operados de *Hallux valgus* entre los años 2006 y 2008, presentaban metatarso adductus clínico y radiológico y en los que se observaba una corrección de la deformidad inferior a 10°.
Resultados: La corrección media presentada fue de 9°. La oblicuidad media de la primera articulación cuneometatarsiana fue de 65°. No apareció relación entre grado de metatarso adductus y corrección observada. Las mejores correcciones se obtuvieron con la osteotomía en Scarf.
Discusión: Existe controversia en cuanto a la relación entre metatarso *adductus* y *Hallux valgus*. Aunque una inadecuada aplicación de las técnicas quirúrgicas es la causa más importante de fracaso en la corrección, la poca bibliografía existente y la comparación con resultados propios, nos pueden señalar esta asociación como una causa de dificultad en la aplicación de técnicas quirúrgicas convencionales.
Conclusión: La presencia de metatarso adductus en un paciente adulto que va a ser operado de *Hallux valgus* debe ser detectada y consignada como una causa que dificulta la corrección. La planificación y la elección de la técnica deben tener en cuenta estos defectos angulares para evitar un resultado decepcionante para el paciente.

Introduction

Metatarsus adductus is a congenital deformity of the foot described by Henke in 1863. It is present in 3% of all live births[1] and is considered to be one of the so-called rotational syndromes of childhood.[2]

The relationship between persistence of *metatarsus adductus* in the adult and the appearance of *hallux valgus* elicits a fair degree of controversy[3,4] and has not been proven, albeit it is an association that is seen very often in daily clinical experience. Many adult patients with *hallux valgus*, either alone or associated with small toe deformities, present a remarkable variety of residual forms of *metatarsus adductus*, with a varying degree of obliquity of the first cuneiform-metatarsal joint. In our experience, the use of conventional surgical techniques for the correction of *hallux valgus* is challenging and often yields disappointing outcomes, for both the patient as well as the surgeon.

We have revised a series of patients with *hallux valgus* and *metatarsus adductus*, who underwent surgery with different surgical techniques, and who presented clinical and radiological undercorrection, in order to point out the importance of an association that sometimes goes unnoticed in clinical practice.

Figure 1 Bilateral *metatarsus adductus*. *Hallux valgus*. Obliquity of the first cuneiform-metatarsal joint.

Material and methods

A retrospective study was carried out on 16 cases in 15 adult patients with *metatarsus adductus* who had undergone surgery for *hallux valgus* between 2006 and 2008, with a result of undercorrection of the deformity. The review of the outcomes was performed at least 1 year after intervention. The mean follow-up at the time of the review was 18 months, ranging from 12 to 34. For the purposes of this study, undercorrection was defined as a reduction of less than 10° in the metatarso-phalangeal angle of the hallux with respect to the pre-operative value.

All the cases were operated on at our hospital, except for one individual who underwent percutaneous surgery and who came to our centre after undergoing surgery elsewhere. The procedures were performed by different surgeons, not all of whom belong to the specific unit for foot surgery.

Those cases in which Weil or similar osteotomies had been performed on the smaller metatarsals were excluded from the review.

None of the patients had received orthopaedic or surgical treatment for *metatarsus adductus* during childhood; only one reported having been treated with orthotics.

Table 1 Surgical techniques used

Scarf osteotomy	6
Keller-Brandes	6
External release. Resection Exostosis. Akin	3
Percutaneous surgery. (Performed at another centre)	1

Table 2 Angles

Angle	No. of cases	Range	Mean
Joint obliquity. CM	13	40-75	65°
Pre-op. *hallux valgus*	16	15-65	40°
Post-op. *hallux valgus*	16	10-65	31°
Metatarsus adductus	16	15-40	22°
Pre-op. 1st and 2nd MTT ang.	16	8-10	10°
Post-op. 1st and 2nd MTT ang.	16	6-10	10°
Pre-op. PASA	16	0-12	4°
Post-op. PASA	16	0-10	4°

The review included 12 females and 3 males and 12 right feet and 4 left. The mean age of the patients was 54 years; with a range of 38 to 76.

Coughlin's method[5] was used to measure the following angles: metatarso-phalangeal, distal metatarsal, intermetatarsal and *metatarsus adductus*.

The obliquity of cuneiform-metatarsal joint was measured indirectly using the angle made up by the greater axis of the cuneiform and that of the articular surface of the first metatarsal; obliquity was deemed to be an angle of less than 75° (fig. 1).

The surgical techniques used to correct the *hallux valgus* are detailed in table 1.

Figure 2 Bilateral *metatarsus adductus*. Scarf osteotomy with scant correction.

Results

The angular measurements are presented in table 2. Only three of the 16 cases did not present obliquity of the cuneiform-metatarsal joint. The mean post-operative correction of the metatarso-phalangeal angle of *hallux valgus* was 9°. In 6 cases, correction was less than 5° and was imperceptible to the patients. No appreciable variations were recording in the intermetatarsal angle or in the distal metatarsal angle (PASA).

No relationship was detected between the magnitude of *metatarsus adductus* and the degree of *hallux valgus* correction; nor was any relationship seen between the angular correction and the surgical technique used. However, in 2 of the cases that underwent Scarf osteotomy, it was clear that the surgical technique used was insufficient (fig. 2).

The best result in terms of correction and aesthetic outcome was seen in one case that was similar to a skew foot, in which a short Scarf osteotomy with moderate correction of the PASA (the angle of orientation of the distal articular surface of the first metatarsal) and Akin osteotomy (fig. 3) were used.

Nine of the patients (60%) were satisfied with the result of the intervention. Of the remaining 6, two complained of a poor cosmetic outcome and the other four complained simply that the deformity had been scantly corrected.

The two patients in whom poor technique was used in the Scarf osteotomy underwent subsequent surgery.

Discussion

Our study collects a group of cases that were selected retrospectively for having a striking undercorrection of

Figure 3 *Metatarsus adductus*. Scarf osteotomy, one year following the intervention. The case corresponds with the one in figure 1.

the angle of *hallux valgus* following the use of some of the surgical techniques commonly used in our setting, such as the Scarf osteotomy and the Keller-Brandes arthroplasty, and for presenting associated *metatarsus adductus*.

Insufficient angle correction in *hallux valgus* surgery may be due to several causes, the most common of which is an improper surgical technique[6] that also fails to act on the distal angle of the first metatarsal,[7] or that does not manage to reposition the head of the metatarsal so as to allow it to be relocated on the sesamoid bones.[8]

As our own reference, we took our general prospective series with Scarf osteotomy,[9] in which a mean reduction of 20° was achieved in the metatarso-phalangeal angle of the hallux, with a contrastingly low rate of corrections seen in the cases studied. Using other techniques such as the Keller-Brandes arthroplasty, high rates of undercorrection and relapse[10] are not uncommon, sometimes within a short interval.

In *metatarsus adductus*, the intermetatarsal angle generally presents values considered to be normal (less than 10°), and this has been the case in our series. The angle of orientation of the distal articular surface of the metatarsal (PASA) has tended to present very low values (mean of 4° and none of more than 12°), the majority with an incongruent metatarso-phalangeal joint. No appreciable post-operative variations have been attained in any of these angles in the cases reviewed.

The possible influence of Weil osteotomies as the cause of undercorrection or relapse of the deformity that we see in one of our own series,[11] and not corroborated by the literature, has been the reason for this review to exclude cases that associated metatarsal shortening osteotomies.

Childhood *metatarsus adductus* resolves spontaneously prior to the age of 4 years in 95%of cases.[4] Few require care from the orthopaedic surgeon and only the severe, irreducible forms will demand surgical treatment. A certain degree of residual metatarsal adduction persists in a percentage of cases that ranges from 4 to 14%[5]

Insofar as evolving into *hallux valgus*, the bibliography presents contradictory data. Whereas in the opinion of Leraux and Lee,[3] a child with *metatarsus adductus* is 3.5 times more prone to developing *hallux valgus* than a child with normal feet, studies with a long follow-up time[4] do not find that it evolves into the appearance of *hallux valgus*. There are radiological studies[12] that establish a relationship between both pathologies, finding the prevalence of *metatarsus adductus* to be 55%in cases of adults with *hallux valgus*; Coughlin,[13] however, does not find a significant relation between these two entities.

There are several pathogenic theories that would account for the appearance of *hallux valgus* in *metatarsus adductus*:[14]

1. The hallux cannot follow the longitudinal direction of the first metatarsal and is pushed toward valgus by footwear.
2. The adduction of the smaller toes gives rise to instability in the metatarso-phalangeal joints, diminishing the supporting effect of the hallux exerted by the 2nd toe.
3. In order to make up for the adductus of the forefoot, the foot pronates in order to obtain the biomechanical benefit in the direction of the abductor.

From an anatomical point of view, the internal obliquity of the first cuneiform-metatarsal joint is characteristic and has been observed radiologically in 81% of our cases. Although the radiological obliquity of this joint may be altered by the projection and bearing in mind that given the modest size of the series, a statistical correlation cannot be established, the cases with the most pronounced *metatarsus adductus* correspond to greatest obliquity of the first cuneiform-metatarsal joint. For Knorr,[15] the key to surgical treatment of *metatarsus adductus* would lie in correcting this obliquity in the cuneiform itself or associating osteotomies in the metatarsals.

There would be two special clinical forms of presentation of *metatarsus adductus*. The first would be in the form of a cross over second toe, commonly the form in which *hallux valgus* makes its clinical presentation. We have detected one such case in our series. Kaz and Coughlin,[16] however, deny any relationship between the two pathologies. Skew foot[17] would be the second special form. It is a distinct and uncommon clinical entity that would incorporate *metatarsus adductus* as one of the components of the deformity, perhaps the most striking. The skew foot, unlike *metatarsus adductus*, would show valgus of the heel, be hereditary in nature, resist to treatment, and have a strong tendency to relapse.[18,19] Only one of our cases presented certain clinical characteristics of skew foot, albeit without valgus of the hindfoot.

The scant bibliography found dealing with correction of *hallux valgus* in *metatarsus adductus*[14] acknowledges the difficulty in obtaining an acceptable degree of correction. Okuda[20] proposes performing a dome-shaped osteotomy at the base of the first metatarsal and osteotomies of the second and third metatarsals. We have run into reluctance on the part of patients when they have been presented with proximal actions on the smaller metatarsals or the tarsus in order to treat *hallux valgus*.

As generally occurs in *hallux valgus* surgery, most of our patients have been satisfied with the outcome of the interventions performed despite the scant mean correction achieved (9°). Only two have undergone further surgery to revise Scarf osteotomies that had initially been performed with an improper technique.

In the cases studied, short Scarf osteotomy with slight correction of the PASA associated with an Akin osteotomy and external release has yielded the best cosmesis and angle correction.

Hundreds of patients undergo surgery at our centre every year with a diagnosis of *hallux valgus*; likewise, our hospital receives many others who have already been operated on. Among them, there are a significant number of feet with *metatarsus adductus* often quite noticeably detected as presenting undercorrection or relapse of the deformity following surgery.

It is our opinion that this anatomical characteristic should be detected, measured, and duly noted in the case history and in the informed consent as a possible cause of undercorrection. In these cases, pre-operative planning

must be particularly meticulous, followed by an appropriate surgical technique in the scope of specialized foot surgery departments.

Level of evidence

Case series without a control group. Level of evidence IV.

Conflict of interest

The authors state that they have no conflict of interest.

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