

Hallux Valgus Recurrence After Simple Bunionectomy: Algorithm Treatment

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Abstract

Background: Recurrences of hallux valgus can be difficult to manage, especially after a prior simple bunionectomy. This study aimed to present a treatment algorithm for the correction of recurrences after a simple bunionectomy.

Methods: This was a single-center, descriptive, and retrospective comparative study. Thirty-four consecutive patients were classified according to the bone stock and the presence or absence of end-stage arthritis of the first metatarsophalangeal joint (MTPJ). According to our algorithm, we only performed an osteotomy as the salvage procedure in cases with sufficient bone stock and absence of or mild arthritis. In the other cases, we performed an MTPJ fusion. Exceptionally, we chose a Keller-Brandes arthroplasty for patients with advanced age and comorbidities.

Results: We performed 17 scarf osteotomies (50%), 15 MTPJ arthrodeses (44.1%), and 2 Keller-Brandes arthroplasties (5.9%). Following the algorithm, we achieved an improvement of the AOFAS score of >30 points without severe complications in all groups.

Conclusions: The proposed operative algorithm successfully addresses the recurrences considering the lack of bone stock and the presence of MTPJ arthritis.

Level of Evidence

Level 3: retrospective comparative study

Introduction

Surgical treatment of hallux valgus (HV) deformity is one of the most commonly performed foot and ankle surgeries. More than 150 surgical techniques have been described for the correction of HV[1–7].

Deformity recurrence occurs in 2.7-16% of total cases (Fig. 1). Its cause generally has a multifactorial character, including intrinsic factors of the patient, medical and social comorbidities, or surgeon-dependant factors such as the choice of the appropriate surgical technique or its incorrect execution[2, 8].

One of the surgical techniques used for HV correction is a simple bunionectomy. Although a bunionectomy without metatarsal osteotomy is not included in the most recent algorithms for HV treatment[9–12], it is not uncommon in daily practice to encounter patients with a recurrence after application of this technique. This procedure cannot correct the I/II intermetatarsal angle (IMA) and the hallux valgus angle (HVA) and does not reposition the metatarsal head over the sesamoids[13, 14], which is why recurrence has been described in up to 41% of cases[15].

Success in the surgical treatment of a recurrence requires a thorough knowledge of HV pathomechanics, a correct preoperative radiographic study, correction of bone alignment, restoration of joint congruence, and rebalancing of soft tissues[16].

The main concern for the revision of an HV recurrence after a prior simple bunionectomy is the lack of bone of the metatarsal head. Therefore, we consider the bone stock to be the key factor in determining the surgical procedure. There are also other important conditions that influence the choice of the technique, such as the presence of osteoarthritis at the first metatarsophalangeal joint (MTPJ) or a painful range of motion.

Therefore, we performed this study in which we considered the amount, in percentage (%), of the remaining head and the presence of osteoarthritis to propose a rescue algorithm for these patients.

Current literature on the surgical treatment for HV recurrence after a simple bunionectomy is limited, and to our knowledge, no surgical algorithm has been reported. The purpose of the present report was to provide a concise operative treatment algorithm for this operatively challenging problem.

Patients And Methods

Population and Clinical Presentation

We conducted a descriptive retrospective comparative study of thirty-four consecutive patients with recurrences of HV treated from 2010 to 2015. The inclusion criteria consisted of a symptomatic recurrent HV deformity after a prior bunionectomy of the first metatarsal without osteotomy.

The bunionectomy had been performed either with an open procedure (16 patients, 47%) or with a minimally invasive technique (18 patients, 52.9%), as well as a variety of procedures to treat the rest of the forefoot. (Table 1)

Patients mean age was 65.6 (range, 54 to 82) years, and the mean time to follow-up was 6.8 (range, 5.1 to 10.6) years. The mean period between the primary surgery and the recurrence surgery was 6.2 (range, 2 to 20) years. The data collected included age, sex, preoperative and postoperative American Orthopaedic Foot and Ankle Society (AOFAS) scale score[17, 18] (Table 2), painful range of motion of the first MTPJ, and radiographic evaluation. All procedures were performed by two senior surgeons.

Radiographic Evaluation

Weight-bearing radiographs of both feet were taken in anteroposterior and lateral projection, preoperatively and during long-term follow-up. The factors evaluated included HVA, I/II IMA, and the presence of arthritis of the first MTPJ. Arthritis was graded according to Coughlin and Shurnas' classification[19].

We also evaluated the remaining head surface after the bunionectomy. The measurement technique of the remaining head was standardized for the study. Following the recommendations of the AOFAS committee[20], we drew a straight line through the longitudinal axis of the first metatarsal that crossed the remaining metatarsal head. For the purposes of this study and the algorithm, we considered bone

stock to be sufficient when the remaining metatarsal head medially on the diaphysis axis line was more than 50% of the head. (Fig. 2)

Algorithm

If the recurrence of the deformity is asymptomatic, the patient is advised not to undergo surgery. If symptoms are present that due to the recurrent deformity, then a revision surgery may be considered. Before performing surgery, it is imperative to determine why the initial surgery was not successful to reduce the risk of a second recurrence[2].

Kitaoka HB *et al* [15] reported that simple bunionectomy has long-term mild-bad results. But although all our patients underwent simple bunionectomy, we cannot exclusively blame the technique for the recurrence, and we must consider all the possible causes as systemic diseases or anatomic factors.

Radiographic evaluation should determine the remaining bone stock of the metatarsal head as this will influence treatment plans. Bone stock is the key in the revisions with simple bunionectomy because it is common the excessive bone resection due to an inadequate technique. Severe bone loss is a contraindication for an osteotomy as a salvage procedure, being the MTPJ arthrodesis the gold standard treatment[21].

The patients were divided into those with enough or insufficient bone stock and presence or not of end-stage arthritis of the first MTPJ: Shurnas and Coughlin Hallux Rigidus classification: Grade 4 or 3 with 50% loss of articular cartilage[19].

If good bone stock remaining without arthritis, the revision surgery can be done similar to a primary surgery, such as scarf or chevron osteotomy.

Otherwise, if there was a major lack of bone stock and/or the presence of end-stage arthritis, we performed a fusion of the MTPJ.

Finally, for more severe deformities, with an IMA greater than 20°, we performed arthrodesis of the first tarsometatarsal joint (TMTJ). (Fig. 3)

Exceptionally, elderly patients with an important associated morbidity could benefit from the Keller-Brandes technique, as the technique is less aggressive and does not require osteosynthesis hardware.

Statistical study

Variables were described by frequencies, mean \pm SD, and range. Differences among the subgroups regarding preoperative and postoperative differences between times (evaluation of improvement of clinical, functional, and radiographic outcome variables) were analyzed using the Mann-Whitney U test. Statistical analysis was performed using SPSS1 15.0 (SPSS Inc, Chicago, IL).

Results

We classified the 34 patients according to the radiographic evaluation. There were 9 patients (26.5%) with severe bone stock loss of the remaining metatarsal head.

We classified the remaining 25 patients (73.5%) with enough bone stock as follows:

- 8 patients (8/25) with end-stage arthritis of the first MTPJ.
- 17 patients (17/25) without arthritis or with low-grade arthritis.

Following the algorithm treatment, we performed 17 scarf osteotomies (50%), 15 MTPJ arthrodeses (44.1%), and 2 Keller-Brandes arthroplasties (5.9%). (Table 3)

Scarf osteotomy

In the 17 patients of the scarf osteotomy group, mean AOFAS hallux metatarsophalangeal-interphalangeal score improved from 41.9 ± 5.28 (range, 35-50) preoperatively to 71.8 ± 5.73 (range, 66 to 80) points. HVA improved from $38.6 \pm 8.45^\circ$ (range 36 to 57) to $16.9 \pm 7.91^\circ$ (range, 7 to 29). IMA improved from $15.2 \pm 2.48^\circ$ (range, 13 to 21) to $7.1 \pm 3.38^\circ$ (range, 3 to 15).

There were 3 complications: one patient with severe neuropathic pain on the medial side of the MTPJ, a lack of congruency of the first MTPJ in one patient, and one patient who developed arthritis of the MTPJ without clinical significance. (Fig. 4)

MTPJ arthrodesis

In the 15 patients of the MTPJ arthrodesis group, mean AOFAS score improved from 43.75 ± 6.73 (range, 35 to 50) preoperatively to 72 ± 5.59 (range, 60 to 80) points. HVA improved from $42.2 \pm 8.80^\circ$ (range, 29 to 58) to $15 \pm 4.09^\circ$ (range, 6 to 20). IMA improved from $16.6 \pm 2.77^\circ$ (range, 12 to 20) to $8.9 \pm 3.04^\circ$ (range, 7 to 13).

In all cases, we achieved fusion of the joint (Fig. 5). We had only 2 complications: One patient complained about dysesthesia and a hypertrophic scar, and the other patient complained about the hardware protrusion but rejected a new surgery to remove it.

Keller-Brandes arthroplasty

The two patients of this group presented several comorbidities. Patient A was 80 years old with obesity, hypertension, diabetes, and dyslipidemia. Patient B was 82 years old with hypertension, diabetes, and stable ischemic heart disease. In these patients, mean AOFAS score improved from 44 ± 4.24 (range, 48 to 42) preoperatively to 72.5 ± 3.53 (range, 70 to 75) points. HVA improved from $35 \pm 11.31^\circ$ (range, 43 to 27) to $18 \pm 15.55^\circ$ (range, 7 to 29). IMA did not change from $14 \pm 1.41^\circ$ (range, 13 to 15).

There were no complications with this technique.

Technique comparison

We excluded from the statistical study the 2 patients operated with the Keller-Brandes technique due to the small number of cases. Therefore, we focused the comparison on the scarf osteotomy and first MTPJ fusion groups. We had two homogeneous groups without previous differences in age ($p = 0.71$), IMA ($p = 0.13$), HVA ($p = 0.29$), or AOFAS score ($p = 0.41$).

There were no significant differences in AOFAS score improvement between the osteotomy and fusion groups postoperatively ($p = 0.87$). There were also no significant differences in postoperative 1-2 IMA ($p = 0.12$) or HVA ($p = 0.56$) (Table 4).

Discussion

Before performing surgery, it is imperative to determine why the initial surgery was not successful to reduce the risk of a second recurrence[22, 23]. Improper procedural selection is one of the potential causes for the recurrence of HV.

Kitaoka et al. described the results of 33 patients (49 feet) who had a simple bunionectomy with medial capsulorrhaphy. Initially, the correction was satisfactory, but an average of 4.8 years after surgery, the hallux deformity was significantly greater than it had been before surgery. The rate of reoperation at 5 years was 20%[14].

This rate of revision is clearly superior to the most popular techniques currently. Xiaojun D et al.[2] reported that the rates of salvage surgery for HV recurrence were 1.85% after a chevron osteotomy procedure, 2.92% among patients who underwent the modified Lapidus arthrodesis, and 2.94% among patients who underwent a closing base wedge osteotomy.

As published, indication of bunionectomy has been limited to select patients with important comorbidities and elderly patients[15]. However, the salvage surgery of a previous simple bunionectomy is not uncommon, as it was a more used technique in the past. In our series, there were patients with recurrences after more than 20 years.

In our search of the literature, we were unable to find a specific algorithm for the salvage treatment of failed bunionectomies. Only Harold B et al.[21], in 1998, reported 18 patients (20 feet) that underwent revision surgery for recurrence of HV, mostly after a medial bunionectomy, but also after a proximal metatarsal osteotomy, Akin osteotomy, and failed arthrodesis. They performed 11 Keller-Brandes resection arthroplasties and 9 arthrodeses of the MTPJ. Their initial choice was arthrodesis, but for the elderly, they chose the Keller-Brandes procedure. The improvement of the HVA was better after arthrodesis, with an average of 23.7° compared to the 11.3° after Keller-Brandes arthroplasty. Patient satisfaction was good in 54.5% of the Keller-Brandes cases and 66.7% of the arthrodesis cases[15].

This initial algorithm was very interesting but did not consider the lack of bone and cartilage of the metatarsal head and the possibility of a procedure that preserves the MTPJ. In our opinion, the remaining bone stock is one of the main concerns for the revision after a prior simple bunionectomy.

It is hard to define when the remaining bone and cartilage can be considered sufficient. Rammel S et al., in their paper about MTPJ fusion, stated that if more than 50% of bone remains, metatarsal osteotomies may be feasible instead of a fusion[24]. We also chose the value of 50% as the minimum amount of bone stock. This is an arbitrary number but in our experience is a useful guide for preoperative planning. Intraoperatively, we also checked the loss of articular cartilage; when the loss is more than 50%, fusion is the gold standard treatment.

Several surgical options exist for the management of a recurrent HV deformity: first metatarsal osteotomies, resection arthroplasty, first MTPJ fusion, and first TMTJ fusion[16].

The salvage procedure for patients with pain-free MTPJ and mild or no arthritis is a new osteotomy that enables the correct positioning of the metatarsal head over the sesamoids[2, 8, 21, 25]. In our algorithm, we also consider the remaining bone stock because we do not indicate a distal osteotomy when there is not enough metatarsal head to achieve a stable and safe osteosynthesis. In our series, in the patients for whom we performed a distal osteotomy, we achieved an improvement of 30 points on the AOFAS scale and an average postoperative IMA of 7.1° . Our preferred distal osteotomy is the scarf osteotomy. The choice of the scarf procedure is based on our preferences, but other distal osteotomies could be done with comparable results. Jeuken M et al.[26] reported a series presenting the long-term follow-up of patients who were operated for HV by a scarf or chevron osteotomy. After a mean of almost 14 years of follow-up, no differences in clinical evaluation, recurrence, or reoperations were found between chevron and scarf osteotomy patients.

Deenik et al.[27] in a prospective randomized study, reported no statistical differences in HVA and IMA between patients who underwent scarf and chevron osteotomies for mild-to-moderate HV.

We combined the scarf osteotomy with an Akin procedure of the proximal phalanx. After HV correction, HV interphalangeus could intraoperatively be found in many cases. Scarf osteotomy does not seem to influence the alignment of the first interphalangeal joint. The Akin osteotomy provides a predictable and direct correction of the hallux, realigning the great toe in a rectus position, which is the reason we combined a scarf osteotomy with an Akin procedure [28].

A scarf osteotomy is indicated at an IMA of up to 20° [29]. It is becoming accepted that the greater the width of the metatarsal head, the greater the potential lateral displacement of the metatarsal osteotomy, extending the potential of a translational osteotomy. As explained in our algorithm, for more severe deformities, with an IMA greater than 20° , a fusion of the first TMTJ (Lapidus) should be performed[30].

The other indication for the Lapidus procedure is the frank hypermobility of the first TMTJ, but this is controversial. Several studies have shown stabilization of the TMTJ, without fusion, following first-ray realignment procedures [31, 32]. This finding leads to the conclusion that hypermobility may be secondary to a decrease in soft-tissue stability as opposed to being a primary force behind the HV deformity[33]. However, apart from the controversy about the hypermobility, in recurrences with an IMA

greater than 20°, the Lapidus procedure is a powerful tool for correction and should be the salvage technique[34].

In our series, we did not perform any Lapidus procedures, there was no recurrence with an IMA greater than 20°, and we did not identify a major instability of the TMTJ. This is a limitation of our study, but in our opinion, a bunionectomy was prior indicated only in mild and moderate HV, which could be the reason for not encountering recurrences with severe deformations.

First MTPJ fusion has been successfully used for patients with end-stage MTPJ arthritis and a painful joint. According to our algorithm, we also indicated arthrodesis when there was a severe loss of bone stock that did not allow for a stable osteotomy[16].

Arthrodesis can be performed using different techniques, which have different advantages and disadvantages. The disadvantage of a cross-screw fixation compared with a locking plate is the need for exact positioning of the screws, as the intersection at the joint level can weaken the rotation stability and might support a delayed union or nonunion[35]. Arthrodesis with nickel-titanium staples does not provide adequate rotational control for first MTPJ arthrodesis in patients with severe HV deformity in comparison with dorsal plates[36].

All of our patients underwent MTPJ fusion with a dorsal locking plate and a lag screw after joint preparation. Cone B et al.[37] performed a study with the additional use of a lag screw. They found that the addition of a lag screw to a dorsal locking plate for MTPJ arthrodesis offered improved stability of the joint in the sagittal plane over time compared with a dorsal plate alone. We achieved a complete fusion in all the patients of our series.

Regarding the use of graft, even when mild bone loss is present (less than 5 mm), an *in situ* arthrodesis could be performed without graft. That leaves the hallux slightly short but does not affect the clinical results[38].

In our series, we performed 15 MTPJ fusions, in all cases without graft. The AOFAS score improved to 72 points, compared to the 71.8-point improvement after the scarf osteotomy. These small and nonsignificant differences could introduce controversy about the best technique for the salvage surgery.

Desmarchelier R et al.[39] published a comparative study between scarf osteotomy and fusion of the first MTPJ. They reported that global satisfaction was similar between the scarf osteotomy and arthrodesis groups: 91.4% and 90% of very satisfied or satisfied patients, respectively. Although satisfaction was the same for the two types of surgery, functional results were better in patients who underwent a scarf osteotomy of the first metatarsal than in those who underwent arthrodesis of the MTPJ of the hallux. The main limitation of this paper is that the pathologies leading to surgery were different in the two groups: HV for the scarf osteotomies and MTPJ arthritis for the fusions.

Ballas R et al.[40] found that after surgical correction for HV, patients who underwent a scarf osteotomy had a gait pattern similar to that of their nonoperated foot, in terms of forefoot propulsive forces, whereas

patients who underwent arthrodesis of the first MTPJ did not. The propulsive forces appeared to be better maintained after osteotomy than after arthrodesis.

As described in the algorithm, when possible, an osteotomy is preferred to an arthrodesis in terms of maintaining the propulsive forces and a normal gait. The preservation of the joint is also preferred to avoid the overload of adjacent joints that could evolve into arthritis[24].

There are other procedures for end-stage arthritis of the MTPJ. Park YH et al.[41] published a meta-analysis reporting that arthroplasty and synthetic cartilage implant hemiarthroplasty could lead to similar clinical outcomes, but arthrodesis achieved better pain relief in the scores. However, the authors recommend further studies of higher methodological quality to confirm these conclusions. As a salvage procedure, our recommendation is to use a safer and more reliable technique.

Finally, for elderly patients with comorbidities and limited functional demands, we consider the Keller-Brandes procedure [8, 42]. This technique has potential complications of transfer metatarsalgia, shortening of the hallux, and loss of hallux purchase[43–46]. All these risks could be assumed in some patients for whom we look for a short-term treatment. In these select patients, the Keller-Brandes advantages are technical simplicity, satisfactory pain relief, and easy postoperative care[47].

Limitations of this study include the small sample size and being a descriptive retrospective comparative study. Other limitation is the use of a non-validated outcome measure tool, as the AOFAS forefoot scale, for the final follow-up.

Conclusions

Bunionectomy without metatarsal osteotomy is a technique with a high rate of recurrences and salvage procedures. The proposed operative algorithm successfully addresses the recurrences considering the lack of bone stock and the presence of MTPJ arthritis. Even though an MTPJ arthrodesis means revoking motion, it is a practicable treatment that can result in good functional outcomes when preservative joint surgery is not possible. The present data suggest that using the treatment algorithm, metatarsal osteotomy and MTPJ fusion could achieve good results and relief of symptoms.

Abbreviations

MTPJ: metatarsophalangeal joint

HV: hallux valgus

IMA: intermetatarsal angle

HVA: hallux valgus angle

AOFAS: American Orthopaedic Foot and Ankle Society

TMTJ: tarsometatarsal joint

Declarations

Ethics approval and consent to participate

This study has been approved by the local ethical committee of the University Hospital Mutua Terrassa. The approval reference number is 25/2017. Due to the retrospective nature of this study, no consent to participate was obtained.

Consent for publication

Not applicable

Availability of data and material

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

JT conceived of the study, and participated in its design and coordination and drafted the manuscript. RF drafted the manuscript. ER helped to draft the manuscript. IC participated in the design of the study and performed the statistical analysis. All authors read and approved the final manuscript.

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Tables

Table 1. Previous Surgical Procedures

	Patients	Percentage
Bunionectomy + Akin osteotomy MIS ¹	8	23.5%
Bunionectomy + Akin osteotomy + DMMO ² MIS	9	26.5%
Bunionectomy + Akin osteotomy + fifth metatarsal osteotomy** MIS	1	2.9%
Bunionectomy + Akin osteotomy open	14	41.2%
Bunionectomy + Akin osteotomy + Weil osteotomy lesser toes open	2	5.9%

¹Minimally Invasive Surgery ²Distal Metatarsal Minimal Invasive Osteotomy

Table 2. AOFAS Hallux Metatarsophalangeal Interphalangeal Scale

	Points
Pain	40
Function	
Activity limitations	10
Footwear requirements	10
Metatarsophalangeal joint motion	10
Interphalangeal joint motion	5
Stability of metatarsophalangeal and interphalangeal joint	5
Callus related to metatarsophalangeal and interphalangeal joints of hallux	5
Alignment	15
Total	100

Table 3. Preop and postop evaluation of the techniques

	Scarf Osteotomies		Arthrodesis 1st MPJ		Keller-Brandes	
	17 (50%)		15 (44.1%)		2 (5.9%)	
	Preop	Postop	Preop	Postop	Preop	Postop
AOFAS score ¹	41.9 ±5.36 (35-50)	71.4 ±6.93 (66-80)	43.75 ±6.73 (35-50)	72 ±5.59 (60-80)	44 ±4.24 (48-42)	72.5 ±3.53 (70-75)
HVA ²	38.6° ±8.45 (36-57)	16.9° ±7.91 (7-29)	42.2° ±8.80 (29-58)	15° ±4.09 (6-20)	35° ±11.31 (43-27)	18° ±15.55 (7-29)
IMA ³	15.2° ±2.48 (13-20)	7.1° ±3.38 (3-15)	16.6° ±2.77 (12-20)	8.9° ±3.04 (7-13)	14° ±1.41 (13-15)	14° ±1.41 (13-15)

¹AOFAS Hallux Metatarsophalangeal Interphalangeal Scale ²Hallux Valgus Angle

³Intermetatarsal angle 1-2 metatarsal

Table 4. Postoperative improvement

	Scarf Osteotomies	Arthrodesis 1st MPJ	<i>P</i> value
AOFAS score ¹	30 ±8.2 (10-43)	28 ±6.82 (15-41)	p 0.87
HVA ²	22° ±7.89 (9-32)	27° ±10.15 (16-47)	p 0.56
IMA ³	8° ±2.49 (7-12)	8° ±4.1 (1-16)	p 0.12

¹AOFAS Hallux Metatarsophalangeal Interphalangeal Scale ²Hallux Valgus Angle ³Intermetarsal angle 1-2 metatarsal

Figures



Figure 1

Hallux valgus recurrence after a prior bunionectomy.



A. Insufficient bone stock.
There is not remaining metatarsal head medially the diaphysis axis line



B. Good bone stock.
The remaining metatarsal head crosses medially the diaphysis axis line

Figure 2

Enough bone stock is determined when there is remaining metatarsal head medially on the diaphysis axis line. A: Insufficient bone stock. B: Good bone stock.

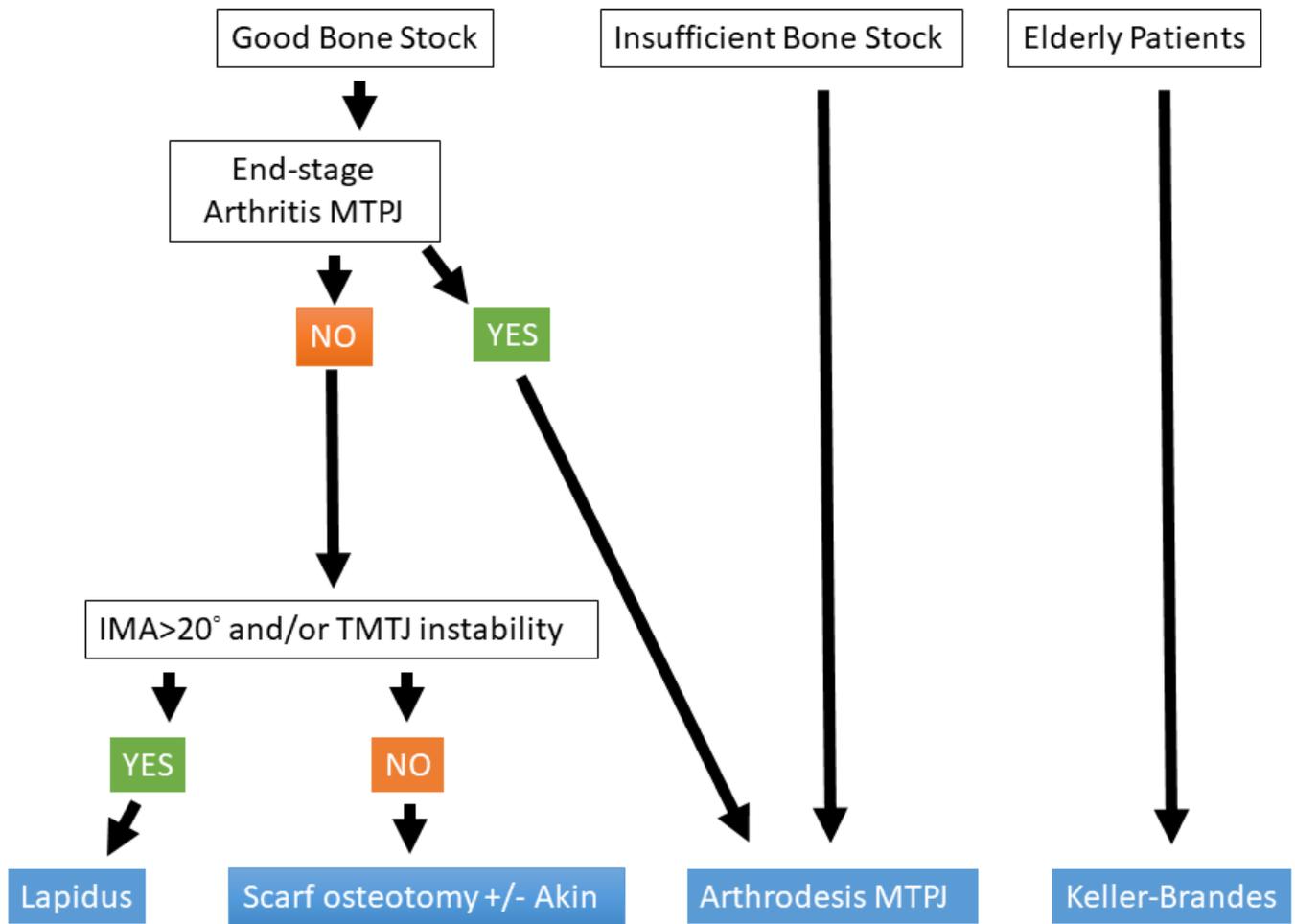


Figure 3

Algorithm for revision of HV deformity correction. IMA, intermetatarsal angle; MT, metatarsal; MTPJ, metatarsophalangeal joint; TMTJ, tarsometatarsal joint. End-stage MTPJ arthritis: Shurnas and Coughlin Hallux Rigidus classification: Grade 4 or 3 with 50% loss of articular cartilage. (17)

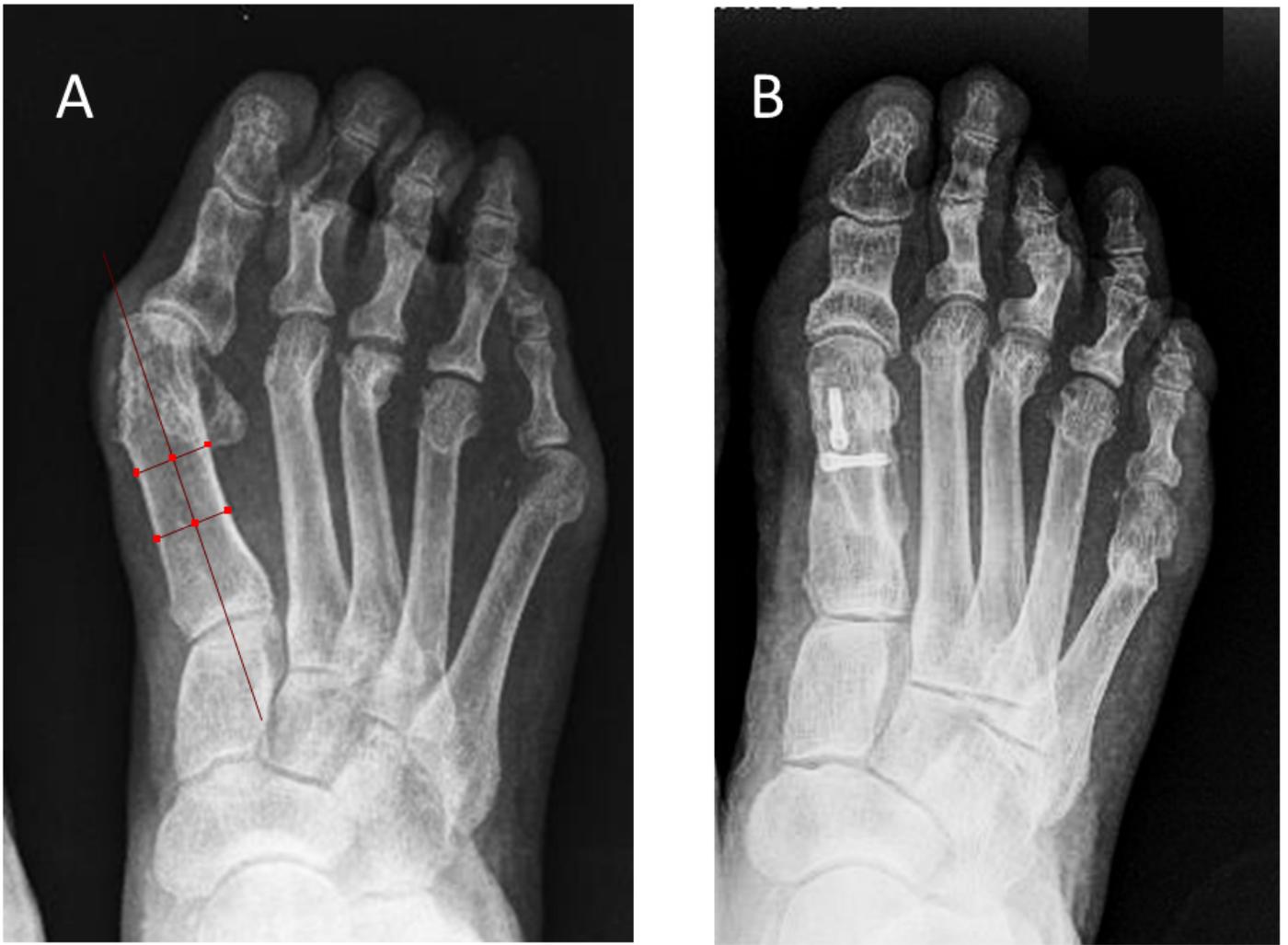


Figure 4

Preoperative radiograph of a patient who underwent a prior bunionectomy and Akin osteotomy with recurrent deformity. Enough bone stock was considered because the remaining metatarsal head medially crossed the diaphyseal axis line (A). Salvage was performed with a scarf osteotomy and Akin osteotomy that corrected both IMA and HVA. An osteotomy of the fifth metatarsal was also performed for a symptomatic Quintus Varus (B).

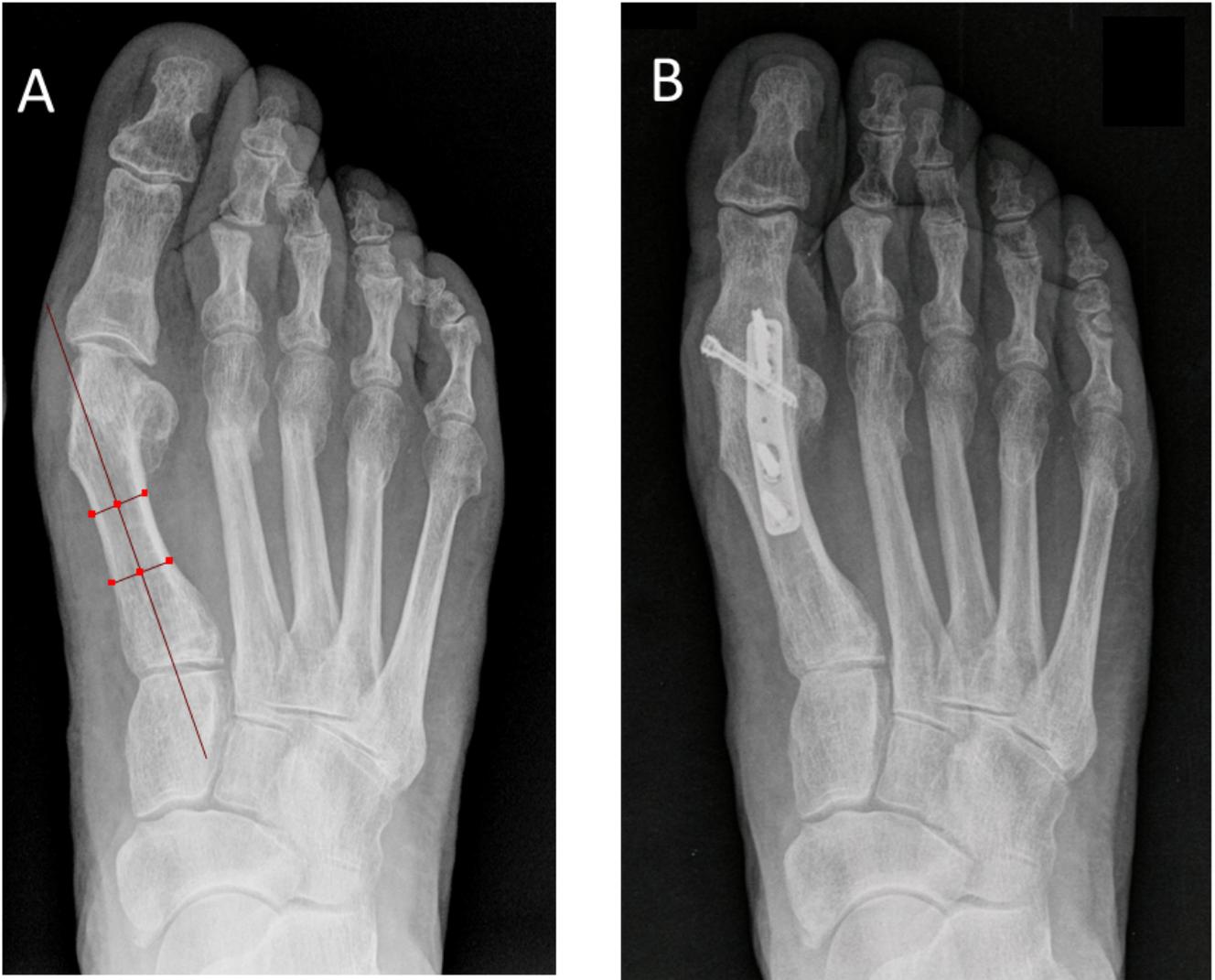


Figure 5

Preoperative radiograph of a patient who underwent a prior bunionectomy and Akin osteotomy with recurrent deformity. Insufficient bone stock was considered because the remaining metatarsal head did not medially cross the diaphyseal axis line (A). Salvage was performed with an MTPJ fusion (B).