

Avascular Necrosis Of The First Metatarsal Head Following Distal Reconstructive Osteotomy

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INTRODUCTION

The occurrence of avascular necrosis (AVN) of the first metatarsal head following distal reconstructive osteotomy has become a topic of frequent discussion and concern for the foot surgeon. Several notable studies have related ranges from 0% to as high as 40% for the incidence of AVN of the first metatarsal head following the traditional Austin osteotomy and its variations.¹⁻⁵ The purpose of this study was to determine the incidence of radiographic evidence of AVN following distal osteotomy of the first metatarsal head and metaphysis, in patients from one surgeon's practice.

MATERIALS AND METHODS

In a retrospective analysis performed by the author, the radiographs of 31 patients who underwent distal first metatarsal osteotomy for repair of hallux abducto valgus deformity were reviewed. The surgical procedures were performed between August of 1986 and September of 1990. Each patient had a soft tissue reconstruction in the form of either a modified or true McBride bunionectomy, with complete plantar-lateral release and transfer of the adductor hallucis tendon, in combination with either a traditional Austin osteotomy, the Kalish modification of the Austin, or a Reverdin osteotomy.

The true McBride procedure (with excision of the fibular sesamoid) was only used in conjunction with a Reverdin osteotomy. The technique used for execution of the Reverdin osteotomy (in all cases where this osteotomy was used) involved maintenance of an intact lateral cortical bone hinge and placement of the osteotomy distal to the weight-bearing level of the sesamoid apparatus, thereby making the capital segment of bone very narrow (Fig. 1). Moreover, all osteotomies were stabilized with internal fixation; either *Orthosorb*[®] absorbable

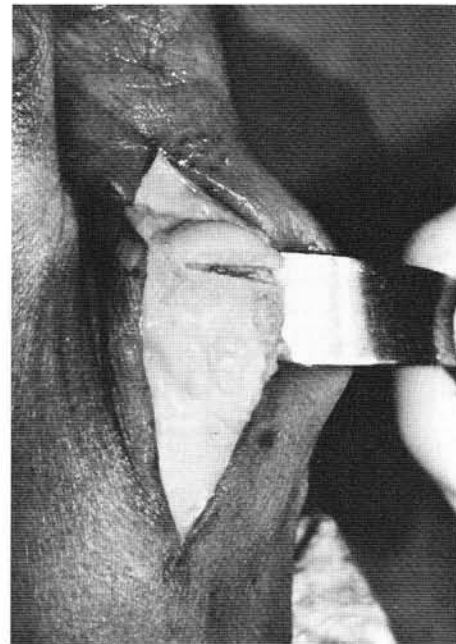


Figure 1. Reverdin osteotomy positioned distal to the first ray sesamoid apparatus, effecting a very narrow capital segment with an intact lateral cortical hinge, and preservation of only a very small amount of the soft tissue attachment to the distal-lateral aspect of the capital segment.

pins or intra-osseous non-absorbable suture in the Reverdin cases, a single buried 0.062 inch Kirschner-wire in the traditional Austin case, and two 2.7 mm interfragmental screws in the case of the Kalish-modified chevron osteotomy.

Every osteotomy was performed with a fresh blade and concomitant use of intermittent saline irrigation during the time that the saw was in contact with the bone (continuous irrigation was not used in general). All of the subjects in the analysis were patients of the author, and the soft tissue manipulations and osteotomies had been performed by the author or by a surgical resident under the author's direct supervision.

A total of 41 osteotomies were evaluated, as ten patients had bilateral reconstructive foot surgery. Five of the patients had simultaneous

bilateral foot surgery, while the remaining five patients had surgery on one foot at a time, on separate occasions. The mean patient age was 48.7 years (range 18-75 years), and the mean follow-up period was 9.9 months (range 8.5-13 months).

Postoperative radiographic evaluation included standard anterior-posterior (dorsoplantar) and lateral views, and all films were independently reviewed by the author. AVN was determined to be present in the postoperative period by identifying radiographic changes, consistent with AVN as described by Meier and Kenzora² (Table 1, Fig. 2).

Table 1

**RADIOGRAPHIC CLASSIFICATION
OF OSTEONECROSIS**

(adapted from Meier and Kenzora²)

Stage I (Pre-collapse)

- A. Early: Normal density (localized cold bone scan)
- B. Intermediate: Surrounding disuse osteoporosis, relative sclerosis of necrotic bone
- C. Late: Osteotomy healed, true sclerosis (hot bone scan) with new bone accretion

Stage II (Collapse)

- A. Early: Mild step-defect, loss of joint sphericity
- B. Late: Fragmentation of articular cortex

Stage III (Arthritis)

- A. Early: Joint space narrowing, subchondral cysts formation, osteophytosis
- B. Late: Joint sclerosis, ankylosis, mechanical erosion

RESULTS

Interpretation of radiographs for 41 osteotomies in 31 patients, following distal first metatarsal reconstructive osteotomy, revealed seven cases of AVN of the metatarsal head in the postoperative phase. Radiographic evidence of AVN was observed in 17.1% of the cases reviewed. Only one patient, or 2.4% of the cases, displayed radiographic evidence of AVN in conjunction with subjective complaints of pain, and objective signs of limited first metatarsophalangeal joint motion. Of the seven cases displaying AVN, five of these (71.4%) were associated with the distally-placed Reverdin osteotomy, and one each (14.3%) with the traditional Austin and Kalish-modified chevron osteotomies.



Figure 2. Stage I-B osteonecrosis of the first metatarsal head at four months status, post-modified McBride-Reverdin procedure in a 61 year-old patient. Note the relative sclerosis of necrotic bone and surrounding osteoporosis of hyperemic viable bone, with maintenance of a normal cortical contour.

Moreover, the mean age of patients undergoing Reverdin osteotomy and displaying postoperative AVN was 65.2 years (range 56 - 75 years). The results are summarized in Tables 2 and 3.

Table 2

**SUMMARY OF 41 DISTAL FIRST METATARSAL
OSTEOTOMIES IN COMBINATION WITH
MUSCLE-TENDON BALANCING**

- A. 41 osteotomies, 31 patients, 10 bilateral cases
- B. Mean patient age 48.7 years, range 18-75 years
- C. Mean follow-up 9.9 months, range 8.5-13 months
- D. Osteotomies: 19 Reverdin, 16 Austin, 6 Kalish
- E. 7 cases displayed radiographic evidence of AVN
- F. 1 case displayed clinical symptomatology (pain and stiffness) secondary to AVN-induced arthritis
- G. 17.1% occurrence rate of AVN, 2.4% symptomatic

Table 3

**CASES DISPLAYING RADIOGRAPHIC EVIDENCE
OF AVASCULAR NECROSIS OF THE
FIRST METATARSAL HEAD**

PATIENT	AGE	OSTEOTOMY	FOLLOW-UP (mos.)	STAGE of AVN
O.F.	56	Kalish	8.5	II-A
D.C.	60	Reverdin	9	I-C
R.L.	61	Reverdin	9	I-C
H.E.	63	Reverdin	13	III-A
A.L.	63	Austin	10	III-A
E.C.	67	Reverdin	10	I-C
E.B.	75	Reverdin	10	I-B

All of the surgical procedures included anatomical dissection of the first intermetatarsal space and transfer of the adductor hallucis tendon, as well as stabilization of the head or metaphyseal osteotomy.

DISCUSSION

The importance of adequate soft tissue release in the first intermetatarsal space at the plantar-lateral aspect of the first metatarsophalangeal joint, with respect to long term correction of the deformity of hallux abducto valgus, has been well established and understood for many years. Proper soft tissue dissection and rebalancing can be achieved without detrimental disruption of the blood supply to the first metatarsal head, as long as care is taken to preserve capsular and periosteal attachments to the dorsal and lateral aspects of the epiphysis and, to a lesser degree, the metaphysis.

The addition of some form of osteotomy fixation is also considered important with respect to enhanced stability of the capital fragment, and increased likelihood of normal revascularization during the initial postoperative period. Preservation of the epiphyseal vessels is clearly of paramount importance as these vessels maintain vascularity to the head despite a more proximal osteotomy. Placement of the Reverdin osteotomy distal to the first metatarsal's sesamoid apparatus, however, diminishes the cancellous bone content of the resultant capital fragment, and appears to substantially increase the likelihood of AVN, despite stabilization of the osteotomy.

SUMMARY

This study provides preliminary results from a small number of subjects, from one surgeon's practice, representing isolated distal first metatarsal head and metaphyseal reconstructive osteotomies for the repair of symptomatic hallux abducto valgus. Avascular necrosis of the first metatarsal head was radiographically identified in 17.1% of cases involving distal first metatarsal head or metaphyseal osteotomy. Only one case (2.4%), involving a traditional Austin osteotomy in a 63 year-old individual, displayed clinical symptomatology consistent with degenerative joint disease secondary to AVN of the first metatarsal head.

Although the radiographic incidence of first metatarsal head avascularity is relatively frequent, clinical symptomatology appears to be rather uncommon in this retrospective study. It is suggested that use of the distally-positioned Reverdin osteotomy be avoided, as patients having undergone this particular procedure comprised 71.4% of those cases displaying radiographic evidence of AVN.

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