

Avascular Necrosis Following Distal First Metatarsal Osteotomies: A Survey

A survey was developed and sent to members of the Northlake-St. Anne's Alumni Association. It was intended to ascertain the incidence of avascular necrosis following distal first metatarsal osteotomies. The data generated was then compared with previous reports in the literature.

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Many types of bunionectomies are performed annually throughout the United States. One of the more popular procedures in recent years is the distal first metatarsal osteotomy, especially the Austin type.³ There are many complications that can occur after any surgical procedure, let alone those peculiar to a bunionectomy. The latter include, but are not limited to: infection, decreased first metatarsophalangeal joint (MTPJ) range of motion, stiffness, chronic swelling, transfer lesions, and delayed or nonunions (1).

When performing a distal osteotomy for bunion deformity, avascular necrosis (AVN) of the head of the first metatarsal has to be included in any list of potential complications (1). AVN is defined as bone death secondary to impaired circulation (2). In its earlier presentation, the affected bone can heal if detected early and promptly treated.

Distal first metatarsal osteotomies are thought to be susceptible to AVN due to the amount of soft tissue dissection around the first metatarsal head and the placement of the osteotomy. The first metatarsal head is supplied by intramedullary and extramedullary (capsular) vessels (3, 4); the latter more concentrated dorsally and laterally. Stripping the soft tissues disrupts the extramedullary vessels, while the osteotomy through the head can disrupt the intramedullary ones, potentially leading to AVN. Additionally, procedures where a lateral release (fibular sesamoid release, adductor tenotomy and/or lateral capsulotomy) were performed

have been implicated in a higher incidence of AVN (5-7).

Why it does not appear in larger numbers than those reported has not been determined. In most instances AVN may be asymptomatic, which makes its detection difficult. Usually if symptoms develop there are radiographic signs of articular cartilage collapse in varying degrees. The end stage would be a total collapse of the first metatarsophalangeal joint with osteoarthritic changes evident (2, 3, 8).

Materials and Methods

The Northlake-St. Anne's Alumni Association is a group of podiatric physicians who completed either a 1- or 2-year surgical residency at Northlake Community Hospital (later St. Anne's Hospital), located in Northlake, Illinois. This association sponsors an annual alumni seminar. During the 1991 meeting this study was formulated.

A questionnaire (Fig. 1) was sent to 92 alumni. The group was asked to supply the number of cases of avascular necrosis after first metatarsal head (distal) osteotomies during the period from 1985 through 1990. The results were then tabulated (Fig. 2).

Results

Forty-five (49%) of those physicians polled responded. Thirteen thousand nine hundred fifty-two first metatarsal head osteotomies (Austin, Reverdin, Hohmann, Wilson, or Scarf⁴ (9-11)) were performed during that period. Fifteen (0.11%) were reported to have developed avascular necrosis. Thirteen (87%) of that total occurred after an Austin bunionectomy. The other two (13%) occurred following a Scarf procedure (Table

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³ The Austin procedure is a through and through, from medial to lateral, osteotomy, V-shaped with apex distal. The wings are 60° to each other. The osteotomy is located in the distal metaphysis.

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⁴ The Scarf procedure is a through and through, from medial to lateral, horizontal osteotomy, Z-shaped. The osteotomy is located in the diaphysis. The distal arm is angulated in a dorsoproximal direction, while the proximal arm is angled plantar-distal.

1. Total number of first metatarsal head osteotomies performed from 1985 to 1990 _____

9. Comments:

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TABLE 1. Numerical data from the surveys

Questionnaires sent = 92
Number returned = 45 (49%)
Total osteotomies performed = 13,952
A. Austin = 7946
B. Hohmann = 2552
C. Reverdin = 220
D. Scarf = 3155
E. Wilson = 79
Total avascular necrosis = 15 (0.11%)
A. Austin = 13 (0.093%)
B. Hohmann = 0
C. Reverdin = 0
D. Scarf = 2 (0.014%)
E. Wilson = 0
Percent avascular necrosis in each procedure:
A. Austin = 0.164%
B. Hohmann = 0
C. Reverdin = 0
D. Scarf = 0.063
E. Wilson = 0

1). Scarf bunionectomies were included due to the extensive dissection around the metatarsal head and distal most osteotomy placement.

On the average, AVN was recognized 4 months postoperatively. All of the reported cases had a resumption of the postoperative swelling, with most also experiencing an increase or resumption of pain at the level of the first metatarsal head (Table 2). There was no increased predilection for AVN with the various fixation techniques. The reported cases all had a lateral release.

All osteotomies were fixated with either a pin, screw, or absorbable rod. Each type developed AVN. Diagnosis was made primarily with conventional radiographs. Magnetic resonance imaging (MRI) was used in two of the cases and a technetium bone scan in another.

Treatment consisted of nonweightbearing, usually in a cast, in all but one case. In that instance no treatment was instituted. Nonsteroidal anti-inflammatory drugs

TABLE 2. Cases of AVN and pertinent information

Type	Pain	Swelling	Inflammation	Months Postoperative	Lateral Release	Fixation
Austin	X	X	X	4	Yes	0.062K ^d
Austin	X	X	X	2	Yes	0.062K
Austin	X	X	X	2	Yes	0.062K
Austin ^a	X	X		6	Yes	Herbert
Austin ^a	X	X		6	Yes	Herbert
Austin	X	X		6	Yes	0.062K
Austin	X	X		6	Yes	0.062K
Austin	X	X		6	Yes	0.062K
Austin	X	X		2	Yes	Absorbable
Austin ^b	X	X		3	Yes	0.062K
Austin		X		6	Yes ^c	Screws
Austin		X		6	Yes ^c	Screws
Austin		X		6	Yes ^c	Screws
Scarf		X		6	Yes ^c	Screws
Scarf		X		6	Yes ^c	Screws
How Long Fixated	NWB Postop		TX		X-Rays Normal	How Long
4 weeks	No	None			Yes	1 year
4 weeks	No	NWB ^e -2 months/NSAID ^f -2 months			Yes	6 months
4 weeks	No	NWB-2 months/NSAID-2 months			Yes	6 months
Indefinitely	4 weeks	Bone stim-3 months/NSAID-4 months			No	
Indefinitely	4 weeks	NSAID-4 months			No	
4 weeks	No	NWB-6 weeks/NSAID-3 weeks/injection			No	
4 weeks	No	NWB-6 weeks/NSAID-3 weeks			No	
4 weeks	No	NWB-6 weeks/NSAID-3 weeks			No	
Indefinitely	No	NWB-3 weeks			No	
3 weeks	No	NWB-6 weeks			No	
Indefinitely	Yes	NWB-4 weeks/NSAID-2 weeks			No	
Indefinitely	Yes	NWB-4 weeks/NSAID-2 weeks				
Indefinitely	Yes	NWB-4 weeks/NSAID-2 weeks			No	
Indefinitely	Yes	NWB-4 weeks/NSAID-2 weeks			No	
Indefinitely	Yes	NWB-4 weeks/NSAID-2 weeks			No	

^a MRI used.

^b Bone scan used.

^c No lateral capsulotomy performed.

^d Kirschner wire.

^e Nonweightbearing.

^f Nonsteroidal antiinflammatory drugs.

were routinely used, and a bone stimulator was also utilized in one case. Additionally, in one case, an intra-articular steroid injection was administered.

In the majority of cases, post-treatment radiographs still demonstrated some sclerosis, cystic degeneration, or collapse, but all patients were asymptomatic at completion of treatment regardless of treatment method utilized. To date, no cases of AVN have needed additional surgery. No attempt was made through the questionnaire to determine the long-term consequences of AVN on range of motion or patient satisfaction.

Discussion

An attempt was made in this study, using a large number of respondents to a survey, to quantify the incidence of AVN after distal osteotomies of the first metatarsal in the treatment of bunion deformities.

Questionnaires of this type have been utilized before in the podiatric literature (12). Naturally, a study of this type has several inherent weaknesses: 1) The study relies heavily on the integrity of the reporting physicians to accurately answer the survey and supply the necessary information. Bias cannot be ruled out. 2) A patient experiencing difficulties after a prolonged postoperative recovery may not necessarily return to the initial surgeon. The number of cases of AVN reported, therefore, may be artificially low. 3) The index of suspicion must be high to determine the etiology of a resumption of swelling and possible discomfort, especially if the postoperative period was uneventful. 4) AVN may be developing in bone prior to any evidence on conventional radiographs. However, it has been reported that the use of MRI may yield an AVN rate of 50% after a distal osteotomy even in patients without any symptoms (13). 5) Although all respondents trained at the same insti-



Figure 3. A, Preoperative radiograph of 56-year-old white female (anteroposterior radiograph). B, Immediate postoperative (anteroposterior). C, Immediate postoperative (lateral). D, 2 months postoperative. Note changes beginning to become evident (anteroposterior). E, 3 months postoperative. Note more pronounced changes occurring. F, 3 months postoperative (lateral). G, 7 months postoperative. Note that the osteotomy site is filling in without collapse of the metatarsal head (anteroposterior).

tution under similar circumstances, variations in the performance of the procedures and postoperative treatment may exist from respondent to respondent.

AVN is defined as death of bone due to impaired circulation which, under the proper circumstances, can heal if detected expeditiously (2). Radiographically, it can appear as varying degrees of radiolucency, cystic degeneration, fragmentation, actual collapse of the site, and finally a narrowed joint space (Fig. 3). Circulation can be impaired with extensive dissection around the metatarsal head in conjunction with a distal osteotomy and lateral release (2-4, 6, 7). Given that the dissection technique is the same for each patient by any individual physician, the fixation identical, and the postoperative care consistent, why AVN does not occur in larger numbers cannot be readily explained.

Using MRI, Wilkinson *et al.* (13) demonstrated that 50% of postoperative Austin bunionectomies studied had evidence of AVN, while only 10% had evidence of AVN on plain radiographs. Other authors have reported AVN to be from 0% to 40% (2, 6, 14-25). This suggests that AVN occurs at a much larger frequency, but clinical symptoms are either nonexistent or "recognized" as a normal part of the healing process.

This study with the incidence of 0.11% in over 13,000 first metatarsal head osteotomies reports AVN to be low. However, as previously stated it has been evident when MRI is used in 50% of those studied (13). Why symptoms do not develop in more cases is open to conjecture. Unlike other studies various distal osteotomies were reported.

Even though the clinical representation of AVN is low in this study, this does not obviate the necessity for careful dissection around the first metatarsal head, within the first interspace, and a high index of suspicion for its appearance. Figures 2 and 3 demonstrate changes on radiographs. Differential diagnoses need to include but not be limited to osteomyelitis, Charcot changes, septic arthritis, or delayed or nonunion. Bone scans and MRI may be used to aid in the diagnosis of AVN (2, 13). If AVN should occur, the site must be protected to prevent collapse of the metatarsal head and early degenerative joint disease. The possibility of additional surgery cannot be ruled out if AVN results in severe degenerative joint changes of the first metatarsophalangeal joint; ultimately leading to either hallux limitus or rigidus.

Summary

Through a questionnaire of a group of physicians in an alumni association, the incidence of AVN in distal first metatarsal osteotomies was determined. Although some bias in responding may be apparent, the reported

incidence of AVN after distal first metatarsal osteotomies is low. This study relied primarily on the resumption or continuation of symptoms postoperatively around the first metatarsophalangeal joint to arouse the physician's suspicions. The diagnosis of AVN was then confirmed with radiographs. Routine use of MRI postoperatively would potentially demonstrate many more subclinical patients with AVN.

References

1. Lawton, J. H. Forefoot surgery, Ch 14. In *Complications in Foot and Ankle Surgery*, 3rd ed, pp. 283-396, edited by J. M. Carrel, Williams & Wilkins, Baltimore, 1992.
2. Resch, S., Stenstrom, A., Gustafson, T. Circulatory disturbances of the first metatarsal head after Chevron osteotomy as shown by bone scintiphography. *Foot Ankle*. 13:137-142, 1992.
3. Mann, R. A. Complications following the Chevron metatarsal osteotomy. *Contemp. Ortho*. 23:113-119, 1991.
4. Shereff, M. J., Yang, Q. M., Kummer, F. J. Extraosseous and intraosseous arterial supply to the first metatarsal and metatarsophalangeal joint. *Foot Ankle*. 8:81-93, 1987.
5. Austin, D. W., Leventen, E. D. A new osteotomy for hallux valgus: A horizontally directed "V" displacement osteotomy of the metatarsal head for hallux valgus and primus varus. *Clin. Orthop*. 157:25-30, 1981.
6. Meier, P. J., Kenzora, J. E. The risks and benefits of distal first metatarsal osteotomies. *Foot Ankle*. 6:7-17, 1985.
7. Jahss, M. H. Editorial. *Foot Ankle*. 2:1-2, 1981.
8. Mann, R. A. Letter to the editor. *Foot Ankle*. 3:125-129, 1982.
9. Fenton, C. F., Alvarey, G., Mehnert, J. A., Marcinko, D. E. The Reverdin osteotomy and its many modifications, Ch 4. In *Comprehensive Textbook of Hallux Abducto Valgus Reconstruction*, pp. 87-109, edited by D. E. Marcinko, Mosby Year Book, St. Louis, 1992.
10. Elleby, D. H., Kostakos, D. P., Mariash, S. A., Marcinko, D. E. Distal and subcapital metaphyseal osteotomy techniques, Ch 5. In *Comprehensive Textbook of Hallux Abducto Valgus Reconstruction*, pp. 111-138, edited by D. E. Marcinko, Mosby Year Book, St. Louis, 1992.
11. Shaffer, M. W. The Meyer-Scarff midshaft osteotomy, Ch 6. In *Comprehensive Textbook of Hallux Abducto Valgus Reconstruction*, pp. 139-146, edited by D. E. Marcinko, Mosby Co., St. Louis, 1992.
12. Roth, R. D. Utilization of epinephrine-containing anesthetic solutions in the toes. *J.A.P.A.* 71:189-199, 1981.
13. Wilkinson, S. V., Jones, O. R., Sisk, L. E., Sunshin, K. F., Van Manen, J. W. Austin bunionectomy: post-operative MRI evaluation for avascular necrosis. *J. Foot Surg.* 31:469-477, 1992.
14. Grace, D. L. Metatarsal osteotomies: which operation? *J. Foot Surg.* 26:46-50, 1987.
15. Duke, H. Buried Kirschner wire fixation of the Austin osteotomy-bunionectomy: A preliminary report. *J. Foot Surg.* 25:197-203, 1986.
16. Wu, K. K. Wu's bunionectomy: A clinical analysis of 150 personal cases. *J. Foot Surg.* 31:288-297, 1992.
17. Mancuso, J. E., Abramow, S. P., Bloom, W. B., Carloscia, M. P., Landsman, M. J. Smooth Kirschner (K) wire fixation of distal metaphyseal osteotomy bunionectomies: A 10-year retrospective survey. *J. Foot Surg.* 31:276-284, 1992.
18. Meisenhelder, D., Harkless, L., Patterson, J. Avascular necrosis after first metatarsal head osteotomies. *J. Foot Surg.* 23:429-435, 1984.

19. Horne, G., Tanzer, T., Fort, J. Chevron osteotomy for the treatment of hallux valgus. *Clin. Orthop.* 183:32-36, 1984.
20. Geldwert, J. J., McGrath, J., Rock, G. C., Mancuso, J. E. Wilson bunionectomy with internal fixation: A ten-year experience. *J. Foot Surg.* 30:574-579, 1991.
21. Leventen, E. The Chevron procedure. *Orthop.* 13:973-978, 1990.
22. Johnson, K. A., Cofield, R. H., Morrey, B. F. Chevron osteotomy for hallux valgus. *Clin. Orthop.* 142:44-47, 1978.
23. Hattrup, S. J., Johnson, K. A. Chevron osteotomy: analysis of factors in patients' dissatisfaction. *Foot Ankle.* 5:327-332, 1985.
24. McGlamry, E. D., Banks, A. S. Reverdin hallux valgus correction. In *Reconstructive Surgery of the Foot and Leg. Update '92*, pp. 227-230, edited by J. A. Ruch, The Podiatry Institute, Tucker, GA, 1992.
25. Williams, W. W., Barrett, D. S., Copeland, S. A. Avascular necrosis following Chevron distal metatarsal osteotomy: A significant risk? *J. Foot Surg.* 28:414-416, 1989.