



A Multicenter, Retrospective Study of Early Weightbearing for Modified Lapidus Arthrodesis



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ABSTRACT

The modified Lapidus arthrodesis is a long-established surgical technique for management of hallux valgus that provides reproducible results and quality patient outcomes. The data from 367 consecutive patients undergoing unilateral modified Lapidus arthrodesis from January 1, 2007 to December 31, 2008 at participating centers were retrospectively evaluated. The included patients were categorized into early weightbearing (≤ 21 days) and delayed weightbearing (> 21 days) groups. A total of 24 nonunions (6.5%) were identified, with 13 (7.1%) in the early weightbearing group and 11 (6.0%) in the delayed weightbearing group. To date, the present study is the largest multicenter investigation to evaluate early weightbearing after modified Lapidus arthrodesis and the only large study to directly compare early and delayed weightbearing. The findings of the present study have shown that early weightbearing for modified Lapidus arthrodesis does not increase the risk of nonunion when evaluating various fixation constructs.

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The modified Lapidus arthrodesis is a long established surgical technique for the management of hallux valgus that provides reproducible results and quality patient outcomes (1–26). Since originally described by Albrecht (1) in 1911 and popularized by Lapidus beginning in 1934, several investigators have proposed modified techniques and/or fixation constructs in an effort to decrease the incidence of complications, including nonunion for first tarsometatarsal arthrodesis (1–8,10–21,23–26). Historically, this procedure required extensive periods of non-weightbearing to limit

the risk of nonunion or other complications, such as first metatarsal elevation (1,2,5,8–11,13,15,18,19,21,22,25,26). However, the risks associated with prolonged non-weightbearing are also obvious and warrant consideration to achieve optimal patient outcomes (eg, deep vein thrombosis, disuse osteopenia, generalized deconditioning). With the advent of improved fixation modalities, foot and ankle surgeons have challenged the need for prolonged non-weightbearing after modified Lapidus arthrodesis (3,4,6,7,11,12,14,16,17,24). These modern fixation constructs might allow for early weightbearing without an increased risk of nonunion. This has been studied in several relatively small cohorts or when using a single fixation construct (3,4,6,7,11,12,14,16,17,24). To provide further insight to this concept, we performed a large multicenter retrospective study using various fixation constructs.

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Patients and Methods

After institutional review board approval for all study sites, the data from consecutive patients undergoing unilateral modified Lapidus arthrodesis from January 1, 2007 to December 31, 2008 at participating centers were retrospectively evaluated. Potentially eligible patients were identified by searching each center's electronic records using Current Procedure Terminology code 28297 (CPT[®], American Medical Association, Chicago, IL). The included patients were categorized into the early weightbearing (≤ 21 days) and delayed weightbearing (> 21 days) groups. The exclusion criteria were revision first tarsometatarsal surgery, osteomyelitis, and hardware removal before fusion. Data were collected for 367 patients who had met the inclusion criteria (183 early weightbearing, 184 delayed weightbearing), including patient age, gender, body mass index (BMI), the presence of diabetes, nicotine use, days to weightbearing, joint preparation technique, fixation construct, use of bone grafting, postoperative immobilization, and radiographic union. Incomplete demographic data collection was present for 27 (7.36%) patients; accordingly, our reported results reflect this for the pertinent items, with reported results for 340 (92.64%) patients when appropriate.

The demographic and clinical characteristics were analyzed using frequencies and percentages for the categorical data and the mean \pm standard deviation or median and range for continuous data. Patients who experienced union were compared with patients who experienced nonunion using chi-square tests for BMI, joint preparation, augmented fusion (ie, autograft/orthobiologics versus none), device, and early versus prolonged weightbearing. Age and the interval to weightbearing between these 2 groups were compared using a Wilcoxon rank sum test because of the non-normal distribution. Fisher's exact chi-square test was used to compare gender, nicotine use, and diabetes owing to the small cell counts. Statistical significance was set at $p \leq .05$. This analysis was repeated to compare patients with early weightbearing with patients with a delay to weightbearing.

Results

A total of 24 nonunions (6.5%) were identified, with 13 (7.1%) in the early weightbearing group and 11 (6.0%) in the delayed weightbearing group ($p = .663$). Regardless of the time to weightbearing, 97.8% of patients with planar resection experienced union but only 91.5% of patients with curettage experienced union ($p = .040$). A screw and nonlocking plate (3 of 11) was significantly inferior statistically to a screw and locking plate construct (3 of 101) regarding union ($p = .024$), and a 3-compression screw construct (12 of 115) was significantly inferior statistically to a screw and locking plate construct (3 of 101) regarding union ($p = .031$; [Tables 1 and 2](#)). The patients who experienced union versus nonunion had no differences in gender ($p = .901$), age ($p = .595$), BMI [$\chi^2(1) = 0.13$, $p = .724$], nicotine use ($p = .190$), or diabetes ($p = .993$; [Table 2](#)). Also, no difference was found between the early weightbearing and delayed weightbearing groups in age ($p = .066$), BMI [$\chi^2(1) = 0.46$, $p = .498$], nicotine use [$\chi^2(1) = 1.84$, $p = .176$], or diabetes [$\chi^2(1) = 1.71$, $p = .191$; [Table 3](#)].

Discussion

To date, the present study is the largest multicenter study evaluating early weightbearing after modified Lapidus arthrodesis and the only large study to directly compare early and delayed weightbearing. Our findings have shown that early weightbearing after modified Lapidus arthrodesis does not increase the risk of nonunion when evaluating various fixation constructs. The fixation construct with the lowest rate of nonunion, regardless of the time to weightbearing, was a locking plate with a compression screw (3.0%). A locking plate and compression screw construct was superior statistically to a compression screw and nonlocking plate. However, when a 2-crossed screw construct was used, the interval to weightbearing was delayed in 81.6% of patients, but with a 3-crossed screw construct, 60.9% of patients were included in the early weightbearing group. In terms of union, 3 crossed screws were inferior (10.4% nonunion) to 2 crossed screws (4.6%). However, it is difficult to determine whether this demonstrated a counterintuitive global inferiority of the 3-screw construct or was a function of selection bias, demonstrating a surgeon's predilection to increase the number of screws when anticipating early postoperative weightbearing. The ultimate suboptimal

Table 1

Patients characteristics (N = 367)

Variable	Value
Demographic characteristic	
Female gender	315 (85.8)
Age at surgery (y)	
Median	51.0
Range	13.0 to 77.0
Body mass index ≥ 30.0 kg/m ²	130 (38.2)
Nicotine user*	49 (14.4)
Diabetes*	24 (7.1)
Clinical characteristic	
Joint preparation*	
Planar resection	92 (27.1)
Curettage	248 (72.9)
Fenestration*	
Drill/Kirschner wire	296 (87.1)
Osteotome	25 (7.4)
Both	19 (5.6)
Graft*	
Autograft	51 (15.0)
Orthobiologics	45 (13.2)
None	244 (71.8)
Fixation type	
Two screws	87 (23.7)
Three screws	115 (31.3)
Screw/nonlocking plate	11 (3.0)
Screw/locking plate	101 (27.5)
Locking plate	1 (0.3)
Fusion rod/screw	23 (6.3)
Fusion rod/plate	27 (7.4)
Screw/Kirschner wire	2 (0.5)
Device	
Controlled ankle motion boot	267 (72.8)
Cast	90 (24.5)
Postoperative shoe	10 (2.7)
Weightbearing	
Time to weightbearing (days)	
Median	22.0
Range	1.0 to 102.0
Early weightbearing (≤ 21 days)	183 (49.9)
Delayed weightbearing (> 21 days)	184 (50.1)
Outcome	
Union	343 (93.5)
Nonunion	24 (6.5)

Data presented as n (%), unless noted otherwise.

* Data not available for 27 patients (n = 340).

stability with nonlocked plate constructs in early weightbearing remains a matter for conjecture. King et al (14) recently studied a 2-crossed screw construct and early weightbearing (partial weightbearing at an average of 12 days, full weightbearing at an average of 34 days) in 136 patients, reporting an impressive (2.2%) nonunion rate. Our study included only 16 patients who could be similarly categorized as having 2 crossed screws and early weightbearing; thus, no additional insight was provided to the identified discrepancy in the results between 2- and 3-crossed screw constructs.

Other noteworthy findings from our data included the statistically significant difference between the planar resection and curettage joint preparation techniques. Our study demonstrated the superiority of planar resection. The explanation for the variability in the results for these joint preparation techniques is unclear—whether true superiority exists for planar resection or simply that curettage is a relatively more surgeon-dependent technique that warrants meticulous attention to ensure appropriate preparation. Our results have shown that at times surgeon attention to joint preparation will be suboptimal, despite being integral to the success of the procedure. Evidence from a systematic review by Donnenwerth et al, (9) which reported a nonunion rate of approximately 5% for modified Lapidus arthrodesis using 2 crossed screws and a curettage joint preparation technique in 599 feet supports the latter.

Table 2
Patient comparison stratified by union

Variable	Union (n = 343)	Nonunion (n = 24)
Demographic characteristic		
Female gender	295 (86.0)	20 (83.3)
Age at surgery (y)		
Median	51.0	51.0
Range	13.0 to 76.0	26.0 to 77.0
Body mass index ≥ 30.0 kg/m ²	122 (38.5)	8 (34.8)
Nicotine user*	43 (13.6)	6 (26.1)
Diabetes*	22 (6.9)	2 (8.7)
Clinical characteristic		
Joint preparation*		
Planar resection	90 (28.4)	2 (8.7)
Curettage	227 (71.6)	21 (91.3)
Fenestration*		
Drill/Kirschner wire	275 (86.8)	21 (91.3)
Osteotome	24 (7.6)	1 (4.4)
Both	18 (5.7)	1 (4.4)
Augmented fusion*		
86 (27.1)	10 (43.5)	
Fixation type		
Two screws	83 (24.2)	4 (16.7)
Three screws	103 (30.0)	12 (50.0)
Screw/nonlocking plate	8 (2.3)	3 (12.5)
Screw/locking plate	98 (28.6)	3 (12.5)
Locking plate	1 (0.3)	0 (0)
Fusion rod/screw	23 (6.7)	0 (0)
Fusion rod/plate	26 (7.6)	1 (4.2)
Screw/Kirschner wire	1 (0.3)	1 (4.2)
Device		
Controlled ankle motion boot	249 (72.6)	18 (75.0)
Cast	85 (24.8)	5 (20.8)
Postoperative shoe	9 (2.6)	1 (4.2)
Weightbearing		
Time to weightbearing (days)		
Median	22.0	16.5
Range	5.0 to 88.0	1.0 to 102.0
Early weightbearing (≤ 21 days)	170 (49.6)	13 (54.2)
Delayed weightbearing (> 21 days)	173 (50.4)	11 (45.8)

Data presented as n (%), unless otherwise noted.

* Data not available for 27 patients (n = 340).

Several recent studies have reported promising data in favor of fixation to the plantar (ie, tension side) surface for modified Lapidus arthrodesis (6,7,16,20,23). However, our study did not include this technique for comparison. Gutteck et al (11) recently reported the superiority of the plantar-based locking plate construct compared with a dorsomedial locked plating system in a relatively small series. Cottom and Vora (7) reported a series of 88 cases using a plantar interfragmentary screw and a medial locking plate with early weightbearing for modified Lapidus arthrodesis that resulted in only 2 nonunions.

Our study had some limitations. First, our study had the inherent weaknesses of the variability associated with both multicenter and retrospective studies. Additionally, a selection bias might have been present because much of the procedural selection criteria and determination of fixation construct were surgeon dependent and without uniform consistency in our retrospective design. Also, the confirmation of radiographic union was verified by each center individually, because patient identifiable data were not shared among the centers or study investigators. Thus, the associated radiographic interpretation could have varied among the reporting surgeons. Despite our series being the largest to date to evaluate this procedure, the large number of various fixation constructs precluded our ability to perform an isolated analysis of any individual construct between the early and delayed weightbearing groups.

In conclusion, our large multicenter study has demonstrated that early weightbearing for modified Lapidus arthrodesis provides an acceptable incidence of nonunion (7.1%), consistent with the available data, regardless of the time to weightbearing (2% to 12%) and

Table 3
Patient comparison stratified by weightbearing groups

Variable	Early Weightbearing (<21 days; n = 183)	Delayed Weightbearing (≥ 21 days; n = 184)
Demographic characteristic		
Female gender	164 (89.6)	151 (82.1)
Age at surgery (y)		
Median	53.0	49.0
Range	13.0 to 77.0	13.0 to 76.0
Body mass index ≥ 30.0 kg/m ²	73 (39.9)	57 (36.3)
Nicotine user*	22 (12.0)	27 (17.2)
Diabetes*	16 (8.7)	8 (5.1)
Clinical characteristic		
Joint preparation*		
Planar resection	38 (20.8)	54 (34.4)
Curettage	145 (79.2)	103 (65.6)
Fenestration*		
Drill/Kirschner wire	174 (95.1)	122 (77.7)
Osteotome	0 (0.0)	25 (15.9)
Both	9 (4.9)	10 (6.4)
Augmented fusion*		
47 (27.7)	49 (31.2)	
Fixation type		
Two screws	16 (8.7)	71 (38.6)
Three screws	70 (38.3)	45 (24.5)
Screw/nonlocking plate	6 (3.3)	5 (2.7)
Screw/locking plate	47 (25.7)	54 (29.4)
Locking plate	0 (0.0)	1 (0.5)
Fusion rod/screw	17 (9.3)	6 (3.3)
Fusion rod/plate	27 (14.8)	0 (0.0)
Screw/Kirschner wire	0 (0.0)	2 (1.1)
Device		
Controlled ankle motion boot	148 (80.9)	119 (64.7)
Cast	35 (19.1)	55 (29.9)
Postoperative shoe	0 (0.0)	10 (5.4)
Outcome		
Union	170 (92.9)	173 (94.0)
Nonunion	13 (7.1)	11 (6.0)

Data presented as n (%), unless otherwise noted.

* Data not available for 27 patients (n = 340).

comparable to that of our similar delayed weightbearing cohort (6.0%). Further randomized, controlled prospective study directly comparing large series of various single constructs head-to-head (ie, 2 crossed screws, compression screw with locking plate) is warranted for both early and delayed weightbearing groups.

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