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Early Weightbearing of the Lapidus Bunionectomy: Is it Feasible?

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The Lapidus procedure is no longer considered a strict nonweightbearing bunionectomy.1–12 Rigid internal fixation has provided stability of the fusion construct, allowing surgeons to mobilize patients sooner than traditionally thought.2,3 Studies have emerged demonstrating that early weightbearing programs achieve fusion rates equivalent or better than nonweightbearing protocols.1,4–9 The orthopedic industry has also recognized this shift and produced specialized plating systems to provide additional and alternative fixation options.

WHAT IS A LAPIDUS BUNIONECTOMY EARLY WEIGHTBEARING PROGRAM?

Early weightbearing refers to allowing patients to place weight on their operative extremity before boney consolidation of the fusion (a process that takes 6–8 weeks).

Disclosures: The author is a consultant to Orthofix, Inc., and receives royalties for the Orthofix Contours Lapidus Plating System.
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There are no rigid guidelines for the amount of weight allowance and at what point after the index operation patients can begin this process.

**Time to Initiate Early Weightbearing Protocol**

Some recommend a period of nonweightbearing for 2 weeks after the surgery to allow for soft tissue healing. Others allow immediate weightbearing as tolerated. Nonetheless, each surgeon has their own protocols based on their experiences and comfort level. As surgeons continue to use early weightbearing programs and have satisfactory results, protocols continue to advance.

**Type of Extrinsic Protection**

The fusion site still needs to be supported extrinsically during the postoperative healing process. Surgeons have used weightbearing short leg casts, removable walking boots, and postoperative shoes. A cast provides the most amount of protection. A removable boot allows for patients to specifically exercise the foot and ankle. A postoperative shoe provides the least extrinsic support, and surgeons should be confident that the internal fixation is stable enough to support the loads of weightbearing when choosing this method.

**Amount of Weight Allowance**

The amount of weight that a patient can place postoperatively is also not clearly delineated. Some advocate gradual increases in weightbearing pressure over the course of 6 weeks, whereas others allow immediate weightbearing. Proper patient selection and fixation method are probably the most critical factors when selecting patients suitable for a postoperative weightbearing program after Lapidus bunionectomy.

**THE STIGMA OF NONUNION WITH POSTOPERATIVE WEIGHTBEARING**

Early experience with the Lapidus procedure resulted in a nonunion rate up to 25%, and this was a major deterrent to surgeons performing the Lapidus procedure. Postoperative weightbearing was inappropriately blamed as the cause of the nonunions, and it was not until experience with the Lapidus that poor inadequate nonrigid fixation was demonstrated to be the cause of the high nonunions seen in the early part of the century.

Dr Paul Lapidus also experienced this high nonunion rate (in the 1930s) because the fixation method of choice was suture. Screw fixation was introduced in the 1970s and surgeons started performing the procedure with more regularity in the 1980s. Screw fixation provided stability of the fusion, allowing for more reliable and acceptable fusion rates (Figs. 1 and 2).

Experience and better fixation methods have brought the nonunion rate to 3% to 12% of cases, a more palatable number for surgeons. Recent studies have suggested that the nonunion rate is even lower in 0% to 5.3% of cases. Nonunions exists even in the best hands and for the most part should not be considered a complication, but rather an expected outcome in a low percentage of cases.

There are patient and surgeon factors that can contribute to nonunion occurrence. Surgeons should be mindful of the technical aspects of the procedure and chose a stable fixation method to decrease the possibility of nonunion. Nonetheless, some patients are predisposed to bone healing difficulties because of genetic factors, medical comorbidities, and habits (ie, smoking) (Fig. 3). Furthermore, nonunions may be asymptomatic (not painful) and should be considered a radiographic finding.
Although early weightbearing seems like a new concept, it is not. Lapidus’s postoperative protocol was weightbearing in postoperative shoe with a medial plate. Fixation options were limited at that time to support early weightbearing. However, because rigid internal fixation was introduced in the late 1980s for Lapidus arthrodesis there have been numerous studies demonstrating that early weightbearing is an acceptable postoperative protocol. Between 1987 and 1992, only four studies regarding early weightbearing were produced. There was a lag of 17 years before the next wave of publications emerged and surgeons became comfortable with the procedure and improved techniques. Between 1992 and the present, seven publications demonstrate a variety of postoperative early weightbearing protocols with satisfactory results.

Fig. 1. Screw fixation of the Lapidus bunionectomy with two-crossed screws. (A, C) Preoperative weightbearing radiographs. (B, D) Postoperative weightbearing radiographs at 2 weeks after index operation. The first metatarsal is placed parallel to the second metatarsal, and the first metatarsal is relocated back over the sesamoids.

Fig. 2. Lapidus bunionectomy using two screws across the first tarsometatarsal (TMT) joint. A temporary screw into the intermediate cuneiform provides additional stability to the construct during the healing process. (A, C) Preoperative weightbearing radiographs. (B, D) Postoperative weightbearing radiographs demonstrating healed fusion. (From Blitz NM. The versatility of the Lapidus arthrodesis. Clin Podiatr Med Surg 2009;26:427–41.)
Sangeorzan and Hansen\textsuperscript{10} retrospectively reviewed Lapidus procedures with crossed screw fixation and an early weightbearing program in 40 feet. Their protocol involved immediate toe touch weightbearing in a short leg cast for 2 weeks. Patients were then allowed “weight of leg ambulation” for an additional 2 weeks in the cast, then full weightbearing for an additional 4 weeks until radiographic evidence of union was identified. Radiographic union was achieved in 92%. Three patients underwent revision for nonunion. Using the same postoperative early weightbearing protocol discussed previously, Clark and coworkers\textsuperscript{11} evaluated the Lapidus arthrodesis in an adolescent population (average age of 18) in 32 feet. Fusion rate was 100%.

Bednarz and Manoli\textsuperscript{26} performed a consecutive review of 31 feet after Lapidus arthrodeses with screw fixation. A 100% union rate was seen in their early weightbearing protocol. Patients were nonweightbearing for 2 weeks followed by protected weightbearing for 2 to 6 weeks.

Myerson and colleagues\textsuperscript{12} evaluated 67 feet after a first metatarsocuneiform joint fusion. Twenty-one feet were placed in a short leg cast and crutches until comfortable weightbearing was tolerated. The remaining 46 feet were ambulating in a postoperative shoe with or without crutches for a duration of 6 to 8 weeks. There were seven radiographic nonunions (9.5%) and only one patient underwent a revision fusion.

Sorensen and coworkers\textsuperscript{8} retrospectively reviewed locking plate fixation and early weightbearing. Fusion rate was 100%, and the average time to radiographic fusion was 6.95 weeks with an average time to ambulation of 2 weeks.

Kazzaz and Singh\textsuperscript{7} allowed postoperative weightbearing in a postoperative shoe in 27 feet and achieved a successful fusion in 6 to 24 weeks, in a retrospective review.

Fig. 3. Bilateral nonunion of the first TMT in a nonsmoker. This patient’s surgeries were performed 8 months apart and the same technique and fixation construct were used. In some cases, patients are simply prone to nonunion.
The authors attributed the success to modern techniques of minimal bone resection, meticulous bone surface preparation, and rigid internal fixation.

Saxena and coworkers\(^9\) performed a retrospective comparison of outcomes of Lapidus following cross screw fixation versus locking plate with screw fixation in 40 patients. The locking plate group was allowed full weightbearing at 4 weeks, whereas the screw fixation group was allowed at 6 weeks. There were no differences in postoperative complications between the two groups, and the locking plate Lapidus allowed for earlier weightbearing.

Basile and colleagues\(^6\) retrospectively reviewed immediate weightbearing after modified Lapidus arthrodesis when two screws and a neutralization K-wire fixation were performed in 41 patients. They compared an early weightbearing protocol (immediate partial weightbearing in a removable boot) with a nonweightbearing protocol (short leg cast for 6 weeks postoperatively). No nonunions were identified and the authors suggested that a “third point of fixation may enable immediate protected weight bearing, by minimizing load placed on the crossed lag screw construct, in patients undergoing modified Lapidus arthrodesis.”

In a multicenter review of 80 feet, Blitz and colleagues\(^1\) retrospectively reviewed an early weightbearing protocol with screw fixation (two to three screws). All patients were allowed protected weightbearing after the first postoperative visit. All 80 feet proceeded to successful union (100% union), and the mean time to union was 44.5 days. Patients began protected weightbearing at a mean 14.8 days postoperative.

DeVries and colleagues\(^5\) performed a retrospective comparison of screw fixation versus plate fixation in 143 Lapidus tarsometatarsal (TMT) joint arthrodesis. Time to full weightbearing and union rate demonstrated statistically significant improvement (\(P<.001\)) when locking plates were used. Locking plate and early weightbearing demonstrated a 98.5% union rate.

Menke and colleagues\(^4\) retrospectively reviewed an early weightbearing program in 21 Lapidus fusions with locking plate combined with a single interpositional screw. Successful fusion was achieved in 90.5% and the mean time to weightbearing was 4.7 weeks.

**WHICH PATIENTS ARE CANDIDATES FOR AN EARLY WEIGHTBEARING PROGRAM?**

There are no exact guidelines that indicate which patients should be enrolled in an early weightbearing program. Surgeons should evaluate patients on a case-by-case basis, based on age and activity; general health status; medical comorbidities; medications; weight (body mass index); and smoking use.

Age and medical comorbidities play an important role in a patient’s ability to obtain a solid union. Patients who have medical comorbidities that might affect bone healing are poor candidates. Age is not particularly a contraindication for early weightbearing so long as the patient does not have osteoporosis, which may make interfere with obtaining rigid fixation.

Obese patients can transmit excess weight onto their fusion leading to fixation failure, and increasing the chances for nonunion. Similarly, patients with peripheral neuropathy can transmit high loads to the fusion site. Smokers are well known to develop nonunions and surgeons should carefully consider early weightbearing protocols if patients cannot cease smoking.

**TECHNICAL PEARLS WHEN PERFORMING A LAPIDUS BUNIONECTOMY**

A curvilinear incision is most commonly used. The incision is placed dorsomedially over the first ray. The medial dorsal cuneiform nerve should specially be identified, mobilized, and protected throughout the case (Fig. 4).
A concomitant McBride procedure should be performed before the midfoot fusion. Medial eminence resection and an adductor release are performed by method of choice dictated by the surgeon. However, it is important to preserve the plantar medial sagittal groove of the first metatarsal head because it limits medial and varus migration of the tibial sesamoid.

Access to the first TMT joint is achieved by a linear capsulotomy, located dorsal medially on the joint (Fig. 5). The author prefers the curettage method of resecting the joint, followed by perforation of the subchondral plate.

The final position of the first ray requires that the surgeon balance the metatarsal position in all three planes: transverse, sagittal, and coronal. The intermetatarsal angle should be as close to zero degrees as possible. In the sagittal plane, the first metatarsal is translated inferiorly (or plantarflexed) to accommodate the shortening that occurs when the joint is resected. The author prefers inferior translation to plantarflexion. In the coronal plane, the position should be neutral with the sesamoids relocated beneath the metatarsal head. The position of the first ray is stabilized with a K-wire before definitive fixation. Fixation can be with screws or specialized plating systems.

**CAUSES OF IATROGENIC LAPIDUS NONUNION**

Iatrogenic nonunion is the result of two factors: poor technique or poor fixation. Although the risk of nonunion will never cease to exist, surgeons should attempt to limit iatrogenic causes.

Preparation of the joint surface varies from surgeon to surgeon, and there is not a single way to do this, except that adequate resection of the articular cartilage must occur. The medial cuneiform and the first metatarsal base must be meticulously resected...
denuded of cartilage and the subchondral plate perforated to allow for bleeding bone at the interface of the fusion. Two techniques for joint preparation are “curettage resection” or “saw resection.” Studies have not been performed to evaluate the effectiveness of one technique over another in terms of fusion rate.

The curettage resection involves using osteotomes or curettes to denude the cartilage, but leaves the subchondral plate intact. The subchondral plate offers some stability of the fusion site.27 With the saw resection the entire joint and portions of the subchondral plate are resected with an oscillating saw. Thermal necrosis of the bone may occur and copious irrigation is encouraged to decrease this occurrence.

Perforation of the subchondral plate is necessary for osseous ingrowth that leads to fusion. Techniques include drilling, burring, fish scaling, and picking. When perforating the plate with a drill (or K-wire) it is important to limit thermal necrosis of bone by copious irrigation (Fig. 6). A bone pick may also be used without the risk of heat generation (Fig. 7).

Poor fixation refers to nonrigid internal fixation. According to Arbeitsgemeinschaft für Osteosynthesefragen (AO) principles, at least two points of fixation should be used. Kirschner wires do not offer compression and are not suitable for Lapidus fusion as the only method of fixation. When screws are used, at least two screws should be used. In some situations adding a third screw from the base of the first metatarsal to the second metatarsal or intermediate cuneiform provides additional stability to the construct. Surgeons should attempt to achieve compression across the fusion site.

Fig. 5. Access to the first TMT joint. (A) A dorsal medial linear capsulotomy is made directly over the first TMT joint, and medial to the extensor hallucis longus tendon. (B, C) The medial capsule/periosteum is sharply reflected. (D) The lateral capsule is reflected distal to the joint. (E) Blunt dissection is performed laterally to avoid transecting any interspace vasculature. (F) The first TMT joint is fully exposed and ready for articular cartilage resection.
Fig. 6. Perforation of the subchondral plate. (A) Drilling of the subchondral plate allows for osseous ingrowth. (B) Fat globules (arrow) within the irrigation fluid indicate that the subchondral plate was appropriately perforated.

Fig. 7. Additional perforation of the subchondral plate. (A, B) Scoring of the subchondral plate with a bone pick is another way to promote perforation of the subchondral without generating heat. The technique calls for pulling of the bone pick in an upward fashion, creating ridges into the plate. (C) Close-up view illustrates how the subchondral plate should look when the joint preparation is complete.
Compression staples have been used and offer advantages versus simple bone staples. Plating system may be used in isolation or in conjunction with screws.

**TO PLATE OR NOT TO PLATE THE LAPIDUS?**

Successful clinical fusion can be achieved with screws or plates, but the ideal fixation method has yet to be determined.\(^{28,29}\) Plating systems have evolved from simple tubular plates to specialty plates dedicated for the Lapidus.

First experience with plates involved linear tubular plates, which were mainly used as a bailout option when screws failed intraoperatively (Fig. 8). Although the linear

**Fig. 8.** Tubular plating for Lapidus. In this example, a 1.3 tubular plating system was used for Lapidus arthrodesis. Because of the limited screw options into the medial cuneiform (and the linear orientation), the screws were placed into the intermediate cuneiform for additional fixation. Similarly, a screw was placed into the second metatarsal for similar stability reasons. An isolated screw (not incorporated to the plate) traverses the fusion site. (Courtesy of Dr Lawrence DiDomenico, Youngstown, OH.)

**Fig. 9.** Distraction Lapidus procedure for arthritic first TMT joint using a T-plate. (A, C) Preoperative weightbearing radiographs. Arthritic first TMT joint with long second metatarsal. (B, D) Postoperative healed weightbearing radiographs. In this case, a T-plate and screw that is not incorporated into the plate is used in the “belt and suspenders” fashion. This plate is not anatomic and bent to attempt to decrease its profile. (From Blitz NM. The versatility of the Lapidus arthrodesis. Clin Podiatr Med Surg 2009;26:427–41.)
plates offered some stability, they did not fit the area properly (especially at the medial cuneiform) and the plate could overhang into the naviculocuneiform joint. These plates needed significant bending to achieve an adequate fit but invariably fit poorly. An advantage of linear plates is the long lever arm onto the metatarsal that provides resistance to the cantilever forces that act to distract the fusion site. General T-shaped plates were also tried but did not match the shape of the medial cuneiform, and the screw position was subsequently less than ideal for the medial cuneiform (Fig. 9). Because the T-plate has so much bulk on the medial cuneiform side, these plates invaded the anatomic insertion and course of the tibialis anterior insertion. Some surgeons used concomitant screws to provide this extra stability in a “belt and suspenders” approach.

The first generation of dedicated TMT plating systems provided a four-hole construct with two screws on both sides of the joint (Fig. 10). Some plates have step offs to achieve

![Fig. 10. Four-hole plating system for Lapidus arthrodesis. In this case the plate was used as a buttress plate, in conjunction with an isolated screw traversing the first TMT. (Courtesy of Dr Armol Saxena, Palo Alto, CA.)](image1)

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![Fig. 11. Third-generation Lapidus plate. A contoured Lapidus plate for fixation of the first TMT joint (Contours Lapidus Plating System; Orthofix Inc, McKinney, TX, USA). (A, C) Preoperative weightbearing radiographs. (B, D) Weightbearing radiographs demonstrating healed fusion in anatomic position. Plating system provides three-screw hole options in the medial cuneiform, and three-screw hole options in the first metatarsal. The compression slot screw is removed intraoperatively after the compression is achieved. (Courtesy of Dr Neal Blitz, Bronx, NY.)](image2)
Fig. 12. Unique design features of the Contours Lapidus Plating System. (A) Trapezoidal periarticular screw arrangement to resist tensile loads. (B) Targeted locking screws are optimally placed to engage the plantar aspect of the metatarsal to resist the cantilever distracting forces. Cortical screw threads engage the plantar cortical bone (*highlighted area*). (C) The tibialis anterior tendon inserts on the plantarmedial aspect of the first TMT (*highlighted green area*). The plate does not interfere with the tendinous insertion. (D) The plate is contoured for the first TMT anatomy. A notch of the plate (*blue arrow*) is molded for the medial cuneiform, and incorporating the final position of the fusion site with the metatarsal inferiorly translated. (*Courtesy of Dr Neal Blitz, Bronx, NY.*)

Fig. 13. Intraoperative picture demonstrating the Contoured Plating System matching the anatomy of the first TMT joint. Corresponding intraoperative fluoroscan demonstrating screw placement. One can see how this plate is contoured to the geography of the medial cuneiform and the first metatarsal base. (*Courtesy of Dr Neal Blitz, Bronx, NY.*)
Fig. 14. Intraoperative technique for application of Contoured Plating System. (A) The fusion site is properly positioned. Two K-wires maintain the position, and it is important the K-wires are not placed on the dorsomedial surface because this is where the plate is placed. The first K-wire (blue #1) traverses the fusion site, and is placed from dorsal and lateral on the first metatarsal to plantar medial in the medial cuneiform. The second K-wire (yellow #2) is placed from the plantar medial base of the first metatarsal into the intermediate cuneiform. (B) The contoured plate is placed on the dorsal medial surface of the fusion site. A notch on the plate (green arrowhead) corresponds with geographic anatomy of the medial cuneiform, allowing for proper plate placement. The third K-wires (red #3) placed hold the plate steady. (C) The first screw to be placed is into the medial cuneiform. This secures the proximal aspect of the plate, allowing for the compression screw to be placed in the compression slot. (D) A screw is placed in the compression hole (purple arrow), allowing for compression to occur at the fusion site. Take note that the K-wire (#2) was removed before placing the compression screw to allow for uniform compression across the first TMT. (E) Image demonstrating all screws placed into the contoured locking plate. The compression screw is removed because it is no longer necessary after the remaining holes are filled with locking screws. (Courtesy of Dr Neal Blitz, Bronx, NY.)
a better fit, and understanding the final metatarsal position is not congruent with the medial cuneiform. Locking plates offered a more stable construct. One disadvantage of a periarticular plating system, however, is that the cantilever forces are not specifically addressed within the structure of the plate and compression of the fusion site.

The second generation involved more anatomically geared locking plating systems that had a T-shape to match the limited fixation options available at the cuneiform and provide a longer metatarsal arm for a compression slot. Some surgeons use a screw not incorporated into the plate, most probably because of previous plate generation habits. One plate system offers a transfixation screw incorporated into the plate, but requires the undersurface of bone to be bored out potentially limiting the amount of bone available for fusion. These plates are also flat, and require bending to match the shape of the fusion site.

The third-generation Lapidus plating system incorporates features of previous generations, but is specially designed (contoured) for the anatomy of the fusion site (Figs. 11–13). The Contours Lapidus Plating System is anatomic for the first TMT; fits between the tibialis anterior insertion (inferiorly) and the extensor tendons (superiorly); and is contoured specifically for the underlying geography of the medial cuneiform and metatarsal. The medial cuneiform surface is maximized for screw options. This particular plating system design incorporates periarticular locking screws in a trapezoidal fashion, and a long metatarsal component to resist the cantilever forces. Compression is achieved with a dedicated compression hole (Fig. 14). Lastly, the plate design and screw position and angles incorporate the final position (shortening and inferior translation) of the fusion site. Plating systems can be used for isolated Lapidus bunionectomy or as part of a larger reconstructive foot surgery (Fig. 15).

**SUMMARY**

The Lapidus procedure should no longer be considered a strict nonweightbearing bunionectomy. In the past few years, several studies have emerged demonstrating that early weightbearing after a Lapidus fusion is indeed possible with satisfactory fusion rates. This is mainly because of improved fixation techniques available today that have allowed for better stabilization of the fusion site. Surgeons should still properly indicate patients for early weightbearing protocols.
REFERENCES