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Salvage of the Failed Keller Resection Arthroplasty

Surgical Technique

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INTRODUCTION

Arthrodesis of the first metatarsophalangeal joint is a reliable technique for salvaging a failed Keller procedure¹. It addresses deformity as well as the

problem of instability, which is the underlying cause of most complications occurring after resection arthroplasty.

Preparation and fixation techniques evolved at our institution during the study period. The following is a description of the technique that we currently recommend (Figs. 1-A and 1-B).

ABSTRACT

BACKGROUND:

A number of typical complications have been associated with Keller resection arthroplasty. Recurrent valgus deformity, cock-up deformity, and a flail toe may be difficult problems for the treating surgeon because options for salvage are limited. In this study, we evaluated arthrodesis of the first metatarsophalangeal joint as a salvage technique following a failed Keller procedure. In addition, the outcomes of motion-preserving procedures were reviewed in a separate series.

METHODS:

Arthrodesis of the first metatarsophalangeal joint was performed in twenty-eight patients (twenty-nine feet, group A), and either a repeat Keller procedure or an isolated soft-tissue release was performed in eighteen patients (twenty-one feet, group B). The patients were evaluated at least twenty-four months postoperatively, with a personal interview and a clinical examination with use of a modification of the hallux metatarsal-interphalangeal scale. Radiographs were also made for the group treated with the arthrodesis.

continued

SURGICAL TECHNIQUE

Preparation

The procedure is performed with use of regional anesthesia (an ankle block with 1% lidocaine and 0.5% bupivacaine). The use of a fluoroscope to monitor alignment and fixation is recommended. The operation should be done without a tourniquet so that bone vitality can be assessed during preparation.

Skin Incision and Approach

A standard dorsal approach is recommended regardless of existing scars. The skin incision starts approximately 4 cm proximal to the metatarsophalangeal joint and extends to the interphalangeal joint.

The tendon of the extensor hallucis longus is usually dissected out and is cut in a z-shaped fashion to facilitate exposure of the metatarsophalangeal joint. In cases of a cock-up great-toe deformity, it will be necessary to lengthen this tendon anyway.

The joint capsule and the soft-tissue coverage

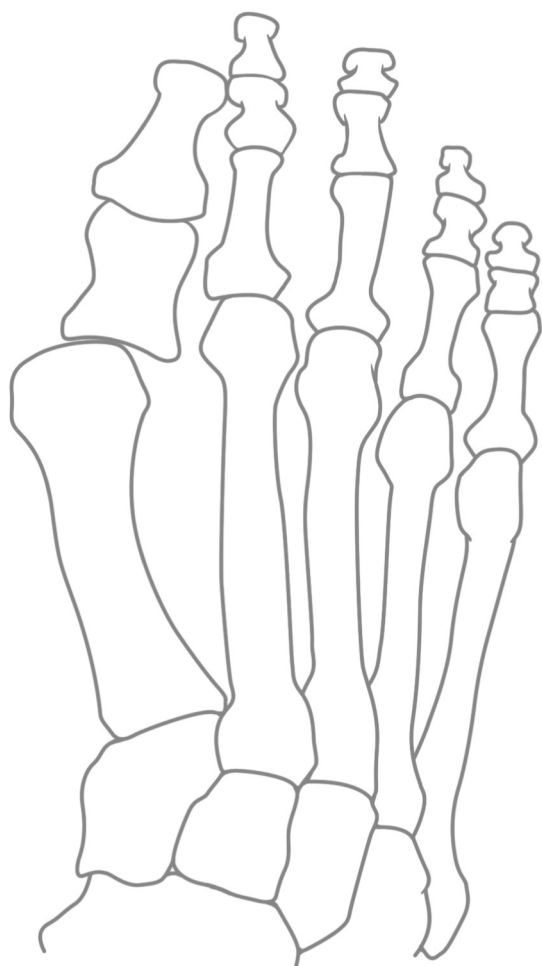


FIG. 1-A

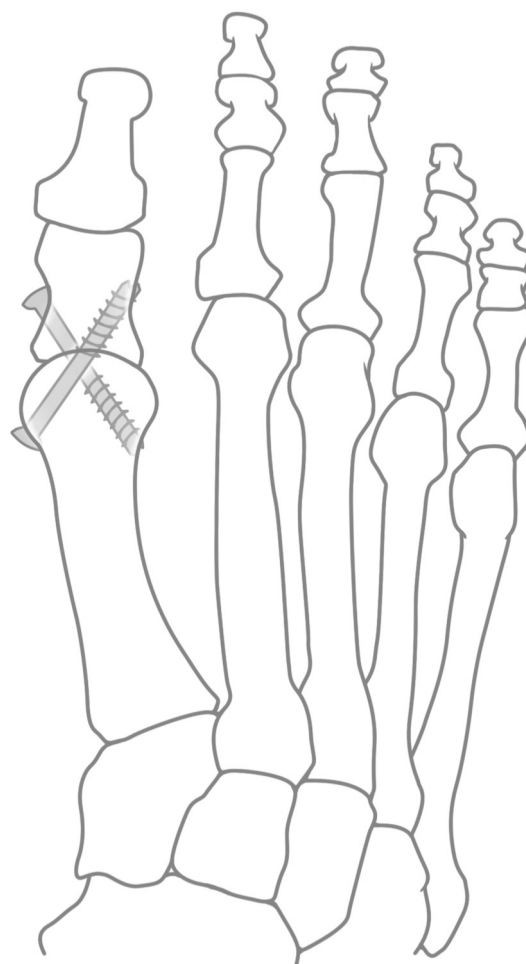


FIG. 1-B

Fig. 1-A An anteroposterior view of a foot, showing recurrent valgus deformity after a Keller procedure. **Fig. 1-B** Correct screw placement for fusion of the metatarsophalangeal joint.

of the metatarsal and phalanx are incised longitudinally straight down to the bone and then are opened as an envelope. A subperiosteal preparation is mandatory to ensure sufficient release of the lateral soft tissues and adhesions. Only the plantar aspect is left intact, to preserve the blood supply to both bones. After inspection of the articular surfaces, osteophytes and debris

ABSTRACT | continued

RESULTS:

In group A, the average duration of follow-up was thirty-six months and fusion was achieved in twenty-six of the twenty-nine feet. Satisfaction was excellent or good in twenty-three cases, and the postoperative score according to the modified hallux metatarsal-interphalangeal scale averaged 76 points (maximum, 90 points). A repeat arthrodesis was necessary in five feet because of malposition or pseudarthrosis. In group B, the average duration of follow-up was seventy-four months. Satisfaction was excellent or good in only six

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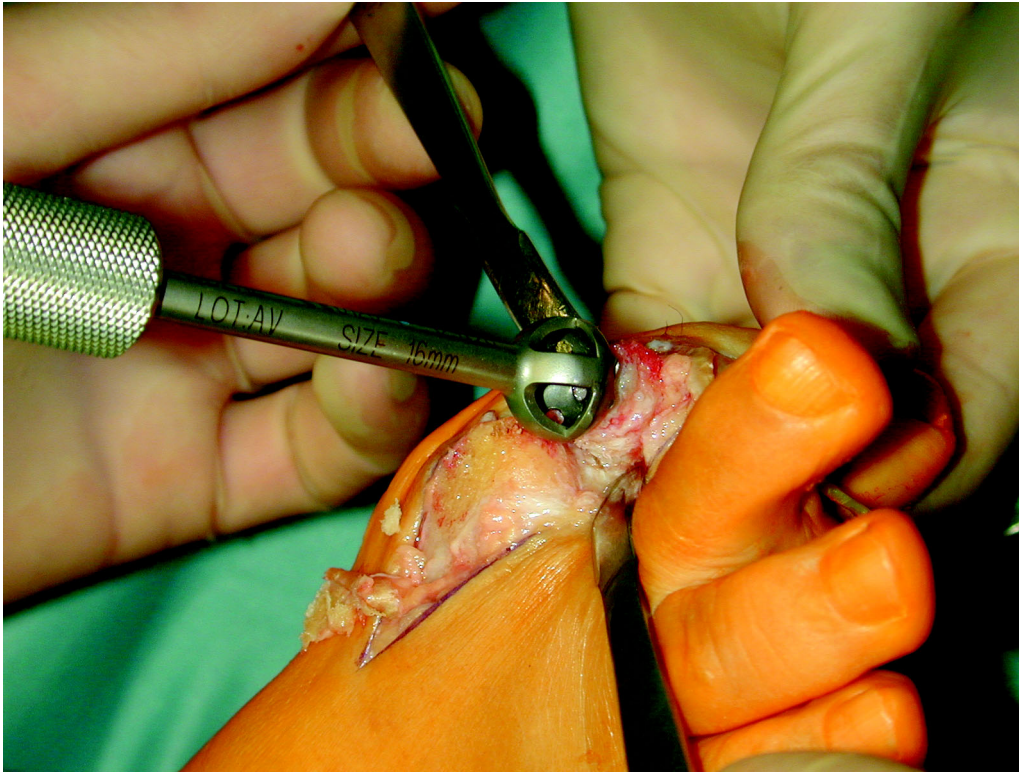


FIG. 2-A

Figs. 2-A and 2-B
Preparation of the metatarsal and the phalangeal joint surfaces with a special power-driven reamer (Hallu-Reamer; Newdeal, Plano, Texas).

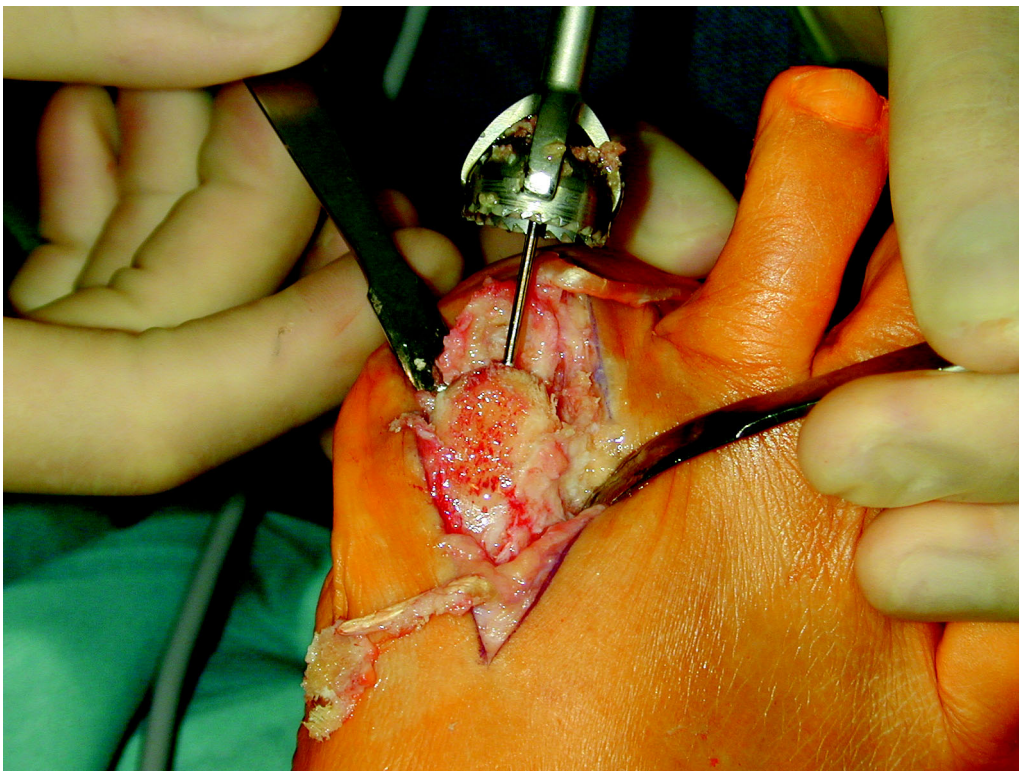


FIG. 2-B

are removed with a rongeur. Special attention should be paid to the plantar aspect of the joint to avoid laceration of the flexor hallucis longus tendon.

Preparation of the Joint Surfaces

In the next step, any remaining cartilage and sclerotic bone is removed to create bleeding cancellous bone surfaces. Compared with flat cuts or a conical preparation, a ball-and-socket preparation has the advantage of minimizing bone loss, and it creates the ability to alter the position of the toe after the preparation has been performed. This

ABSTRACT | continued

cases, and the patient was dissatisfied in eleven cases. The score according to the modified hallux metatarsal-interphalangeal scale averaged 48 points. Valgus deviation and cock-up deformity had recurred in the majority of the feet at the time of follow-up.

CONCLUSIONS:

Although it is more technically demanding, we recommend arthrodesis for salvage following a failed Keller procedure since it may be associated with a higher rate of patient satisfaction and better clinical results.

ball-and-socket preparation can be carried out with a small spherical reamer, chisels, or a rongeur. The potential disadvantage of this method, especially

when it is done by hand, is the inaccuracy in attaining a spherical surface, resulting in a reduced area of bone contact. Special power-driven reamers (Hallu-

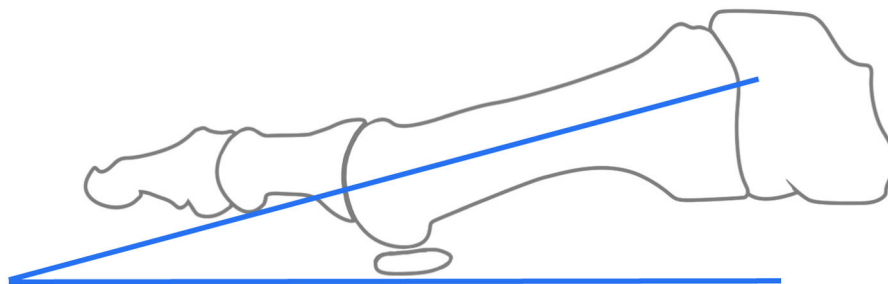


FIG. 3-A

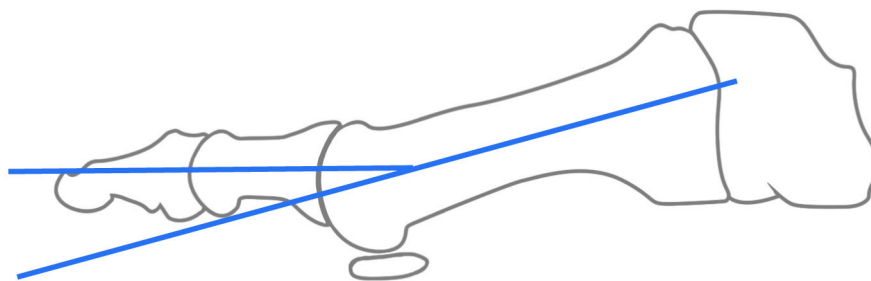


FIG. 3-B

The metatarsal inclination angle should be measured preoperatively on a weight-bearing lateral radiograph to adequately position the phalanx relative to the metatarsal.

CRITICAL CONCEPTS**INDICATIONS:****Revision Surgery**

- Instability of the metatarsophalangeal joint (cock-up deformity, floppy toe)
- Recurrent valgus deformity

Primary Surgery

- Severe arthritis of the metatarsophalangeal joint

CONTRAINDICATIONS:

- Infection
- Neurological disease
- Severe vascular disease

continued

Reamer; Newdeal, Plano, Texas) can facilitate this step (Figs. 2-A and 2-B).

To expose the phalangeal joint surface, the toe is brought into maximum plantar flexion. A 1.6-mm Kirschner wire is placed into the center of the phalanx as a guide for the reamer set. An adequately sized convex reamer is then used to remove the sclerotic bone down to cancellous bleeding bone. The preparation of the surface of the metatarsal head follows, performed in the same manner as the concave counterpart.

Position

The position of the fusion is crucial. A hallux valgus angle of 15° is recommended, but the correct position has to be determined for the individual patient. Both impingement on the second toe (caused by excessive abduction)

and irritation of the medial aspect of the hallux by the shoe (caused by insufficient abduction) must be avoided. Positioning in the sagittal plane can be referenced to the first metatarsal or the plantar plane of the foot (Figs. 3-A through 3-D). The correct position is achieved when

the tip of the toe is able to exert pressure on the ground while the patient is standing. Insufficient dorsal extension must be avoided to prevent overloading of the toe and the interphalangeal joint during walking. As it is difficult to simulate the weight-bearing situation in the operating room,

**FIG. 3-C****FIG. 3-D**

The tip of the great toe should be able to exert pressure on the ground during weight-bearing.



FIG. 4-A



FIG. 4-B

Fusion of the metatarsophalangeal joint with two crossed 3.0-mm cancellous screws.

the use of the metatarsal as an osseous reference point may be helpful. In general, a range of 15° to 20° is recommended for the dorsal angle between the metatarsal and the phalanx, but the metatarsal inclination angle of the individual patient has to be considered. The inclination of the first metatarsal can be measured on a preoperative weight-bearing lateral radiograph to help position the fusion in the sagittal plane. The rotation of the toe should always be neutral.

CRITICAL CONCEPTS | continued

PITFALLS:

- Despite the presence of other scars, a dorsal approach should be used. This allows one to expose the metatarsophalangeal joint adequately and to avoid injury to the medial dorsal cutaneous nerve, which may be difficult to identify in the scar tissue.
- Positioning is the most important factor. A slight deviation from the correct position in any of the three planes can lead to symptoms requiring additional revision. The anatomical position of the foot during surgery differs from the situation during normal weight-bearing, especially with regard to the intermetatarsal angle and the first metatarsal inclination angle. We

continued

CRITICAL CONCEPTS | continued

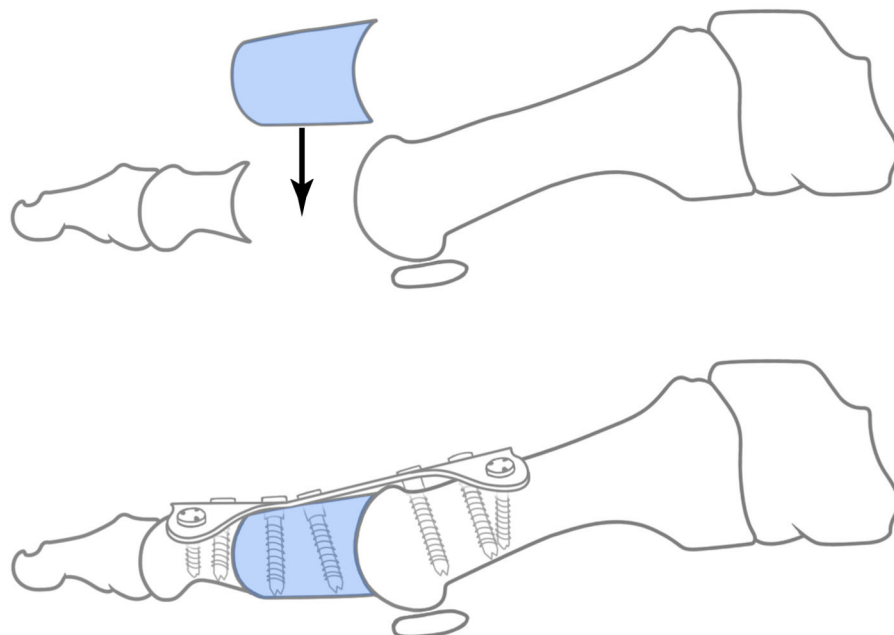
recommend that, to best simulate the situation during gait, the surgeon press the cover of an instrument tray against the sole of the foot very firmly.

- In cases of severe metatarsus primus varus, a metatarsal osteotomy should be considered. While some reduction of the first-second intermetatarsal angle by the arthrodesis alone has been reported², the exact amount and therefore the final result cannot be predicted. In our series, we did not observe any reduction in the intermetatarsal angle.
- In cases of excessive shortening of the first ray, a bone-block interposition arthrodesis may be necessary, although it is associated with increased nonunion rates and wound complications³. In such cases, we use an autogenous tricortical graft from the iliac crest, which is prepared with the spherical reamer on both ends. The two resulting cup-shaped surfaces are inserted between the metatarsal and the phalanx, which both have been prepared as described above. An anatomically preshaped plate (Hallu-Plate; Newdeal) is used for fixation (Figs. 5-A, 5-B, and 5-C). If additional stability is required, a 3.0-mm cancellous screw can be inserted.

continued

Fixation

The method of fixation depends on the size and quality of the residual phalanx. Usually, two crossed 3.0-mm cancellous screws (Synthes, Paoli, Pennsylvania) are used. The guide-wires for the screws are inserted through medial skin incisions under fluoroscopic control. The first is driven from the medial aspect of the first metatarsal head, with the screw aimed at the lateral cortex of the proximal phalanx. To avoid contact between the screws, neither should be placed exactly in the center of the dorsoplantar diameter of the bone; one should be shifted slightly dorsally and the other, slightly plantarly. The second screw is inserted from the me-

**FIG. 5-A**

Bone-block interposition arthrodesis. The bone surfaces of the iliac graft are cup-shaped.



FIG. 5-B



FIG. 5-C

Lateral (Fig. 5-B) and anteroposterior (Fig. 5-C) radiographs after bone-block interposition arthrodesis.

dial aspect of the proximal phalanx and aimed at the lateral aspect of the metatarsal (Figs. 4-A and 4-B).

Mobilization

Depending on the intraoperative stability of the fusion and the anticipated compliance by the patient, the patient either wears a stiff-soled shoe and is allowed weight-bearing to tolerance on the heel or wears a below-the-

knee walking cast until there is radiographic evidence of fusion. Normal shoe wear is possible after seven to ten weeks.

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CRITICAL CONCEPTS | continued

AUTHOR UPDATE:

There have been no major changes in the procedure, except that a different type of fixation is used in special cases. If the amount of residual bone does not allow the insertion of crossed screws, or in patients treated with bone-block interposition arthrodesis, definitive alignment is maintained with an anatomically preshaped plate and screws (Hallu-Plate; Newdeal).

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