

KELLER BUNIONECTOMY

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The Keller bunionectomy was first described by Davies-Colley in 1887. It was popularized by Keller in 1904 and has since retained his name. Indications for the Keller bunionectomy include elderly patients with high intermetatarsal angles with poor bone stock, limited gait requirements, circulatory compromise, severe first metatarsophalangeal joint (MTPJ), DJD, infection, and/or osteomyelitis of the first MTPJ, metabolic diseases such as gout, and reconstruction of the first MTPJ after surgical intervention.

The surgical technique as described by pioneers simply involved a dorsal medial incision over the first MTPJ. The first metatarsal head was remodeled and one-half to one-third of the proximal phalanx was resected. The wound was then closed in layers. Certain morbidities were found to result from these interventions, which included hallux extensus, degenerative joint disease of the first MTPJ, lesser metatarsalgia, a propulsive gait, dorsal hallux irritation from the shoe, hallux frontal plane rotation pathologies, a shortened hallux, and of course, cosmetic problems that have resulted in patients, particularly women not wanting to wear open-toed shoes (Figures 1A, 1B). Reasons for morbidity include too much osseous resection, improper muscle-tendon balance of the first MTPJ, no soft tissue interface placed between the proximal phalanx and the first metatarsal head resulting in DJD, and the inability to maintain appropriate position for healing of the surgical site. Improvements in techniques and indications have led to the metamorphosis of the Keller, which include EHL tendon lengthening, capsular interposition, Kirschner-wire (K-wire) stabilization, decreasing the amount of osseous resection from the proximal phalanx, stabilization of the long and short flexors to the base of the proximal phalanx, angling the type of osseous resection, and insertion of 2 K-wires.

One often wonders what the procedure will do for the patient. It will do the following: decrease pain, improve range of motion, increase or decrease lesser metatarsalgia, decrease intermetatarsal angle, decrease hallux abductus angle and/or valgus rotation, decrease heloma molle formation (kissing cousin) between digits 1 and 2, decrease second digit and MTPJ pathology, increase the gait pattern, allow for a greater variety of shoe gear, and of course, improve the lifestyle of the patient.

In 1962, Thomas presented a study which compared

arthroplasty of the first MTPJ via standard operation with a modified arthroplasty which consisted of a K-wire insertion of the MTPJ. Results revealed very similar results which included patients being pleased and/or satisfied in 96% of the cases, and dissatisfied in 4% of the cases, using either technique. So the question is, are patients happier and functionally better having K-wires inserted into the MTPJ versus not using K-wires? Thomas summarizes his study as “the use of a distractor (K-wire) can be expected to produce an improved end result and aid post-operative wound healing.” Sherman et al in 1984, reviewed 51 Keller procedures in 35 patients. The average age of the patients was 53 years and all were women. They compared group A, in which no K-wire was used nor purse-stringing of the capsule was performed, compared with group B where K-wires were inserted for 3 weeks in addition to capsular purse-stringing techniques. Subjective results were slightly better in the A group where no K-wires were used. The satisfaction rate between the 2 groups was not significant. They then measured the gap created after each surgical procedure and found that in Group A, the

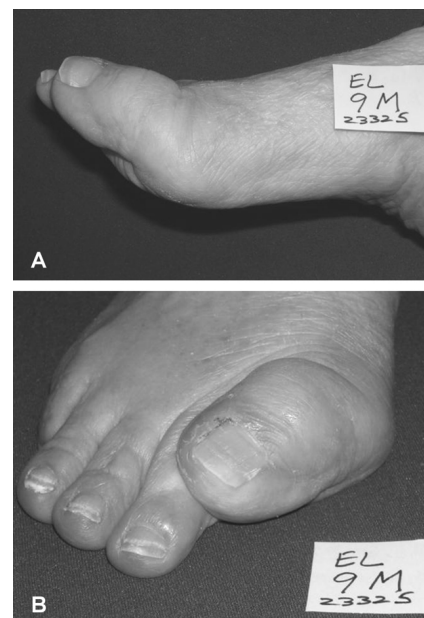


Figure 1A. Hallux extensus of the first MTPJ. Patient had discomfort over the interphalangeal joint dorsally and the hallux impinged the second digit. B. Hallux extensus of the first MTPJ.

distance was 3-mm compared with 2.6-mm in Group B. Patients in Group B had the Kirshner wire retrograded back through the interphalangeal joint into the metatarsal head and these cases were found to have more pain of the interphalangeal joint.

Flexor power was also studied and they found that flexor power was reduced in the patients with the wired procedure by 30% and that patients who did not have the wire placed in the foot had a reduction of 8%. The amount of proximal phalangeal joint resection in Group A was 42% and in Group B was 32%. Reize et al in 2007, performed a retrospective study of 118 feet with hallux valgus and hallux rigidus following Keller bunionectomies. Results revealed that patients with hallux valgus and K-wire transfixation were the most satisfied patients. Patients with hallux rigidus were very satisfied with the postoperative distraction.

In repair of hallux abducto valgus in the elderly patient via the Keller procedure a few technique principles and concepts are important to consider. These include the capsular incision and/or flap formation, the amount of osseous resection, resection of the metatarsal head, osteotomy of the first metatarsal head in order to reduce intrametatarsal angle, suturing of the flexor hallucis brevis and/or flexor hallucis longus to the base of the proximal phalanx, use of appropriate soft tissue interposition between the first metatarsal head and base of the proximal phalanx, use of appropriate fixation to maintain alignment for 4-6 weeks, and appropriate closure and bandaging in order to maintain position.

There are various forms and techniques for soft tissue interposition of the first MTPJ. These include capsular imbrication, purse-string/hour glass capsulorrhaphy, U- and V- shaped flaps, etc. (Figure 2). These also include portions of rolled up tendon anchovy (posterior tibial tendon, Achilles tendon, EHB, EHL), etc. More current

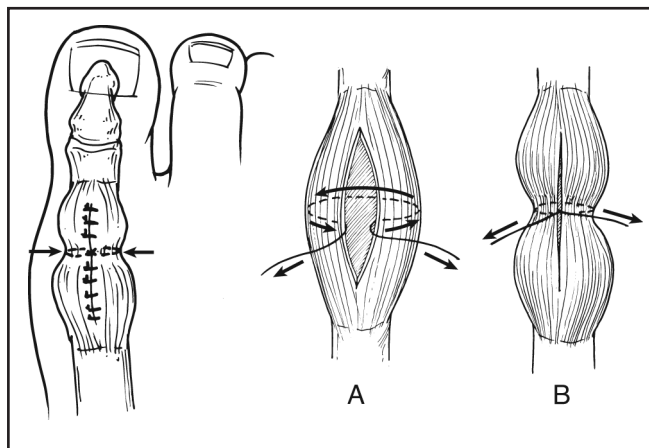


Figure 2A. Diagram demonstrating the hourglass U-flap.

techniques include the use of allografts such as Alloderm, Graft Jacket, Oasis, or Pegasus, etc. Of these, the Pegasus is the thickest and strongest of the allografts and the one that we would strongly consider in these repairs, since it is very thick and difficult to tear. With respect as to whether to maintain the base of the U-shaped flap proximally on the metatarsal neck or distally at the metaphyseal-diaphyseal junction of the proximal phalanx, I recommend maintaining the capsule proximally, since the capsular and periosteal attachments are thicker and less likely to tear on the metatarsal side.

SURGICAL TECHNIQUE

The patient is a 46-year-old man with a moderate to severe hallux abducto valgus deformity with hallux overlapping of the second toe (Figures 3, 4) This patient has very limited gait demands and has a history of hyperuricemia. A dorsal medial incision is placed over the first MTPJ extending from mid-diaphysis of the first metatarsal just short of the interphalangeal joint of the hallux. The incision is deepened through subcutaneous tissue to the level of the capsule. The capsule can be marked to identify the incision that will be placed into it (Figure 5). The capsule is then mobilized off the metatarsal head and base of the proximal phalanx. The base of the proximal phalanx is freed from soft tissue attachments (Figure 6). Osseous resection of osteophytes from the metatarsal head is accomplished followed by resection of approximately 25-30% of the proximal phalanx, enough to allow excellent mobility of the remaining base against the metatarsal head (Figure 7).

Once the osseous segments are resected, a drill hole is placed at the proximal inferior aspect of the proximal phalanx (Figure 8). A 2.0 nonabsorbable suture is placed within the flexor hallucis brevis tendon and/or the flexor hallucis longus tendon and secured in place allowing for flexor stability during gait (Figure 9). A K-wire is then driven through the base of the proximal phalanx exiting the toe and stopped when the proximal end of the K-wire is even with remaining body of the proximal phalanx (Figure 10). The distal aspect of the capsule is then placed over the head of the metatarsal using a horizontal mattress suture, which incorporates the lateral capsule and secured in place (Figures 11, 12).

Once the capsule the interposed between the osseous segments, the hallux is distracted slightly keeping space between the proximal phalanx and the metatarsal head and the K-wire is driven within the body of the metatarsal head (Figure 13). It is important to maintain the position of the hallux approximately 10 degrees extended to the long axis

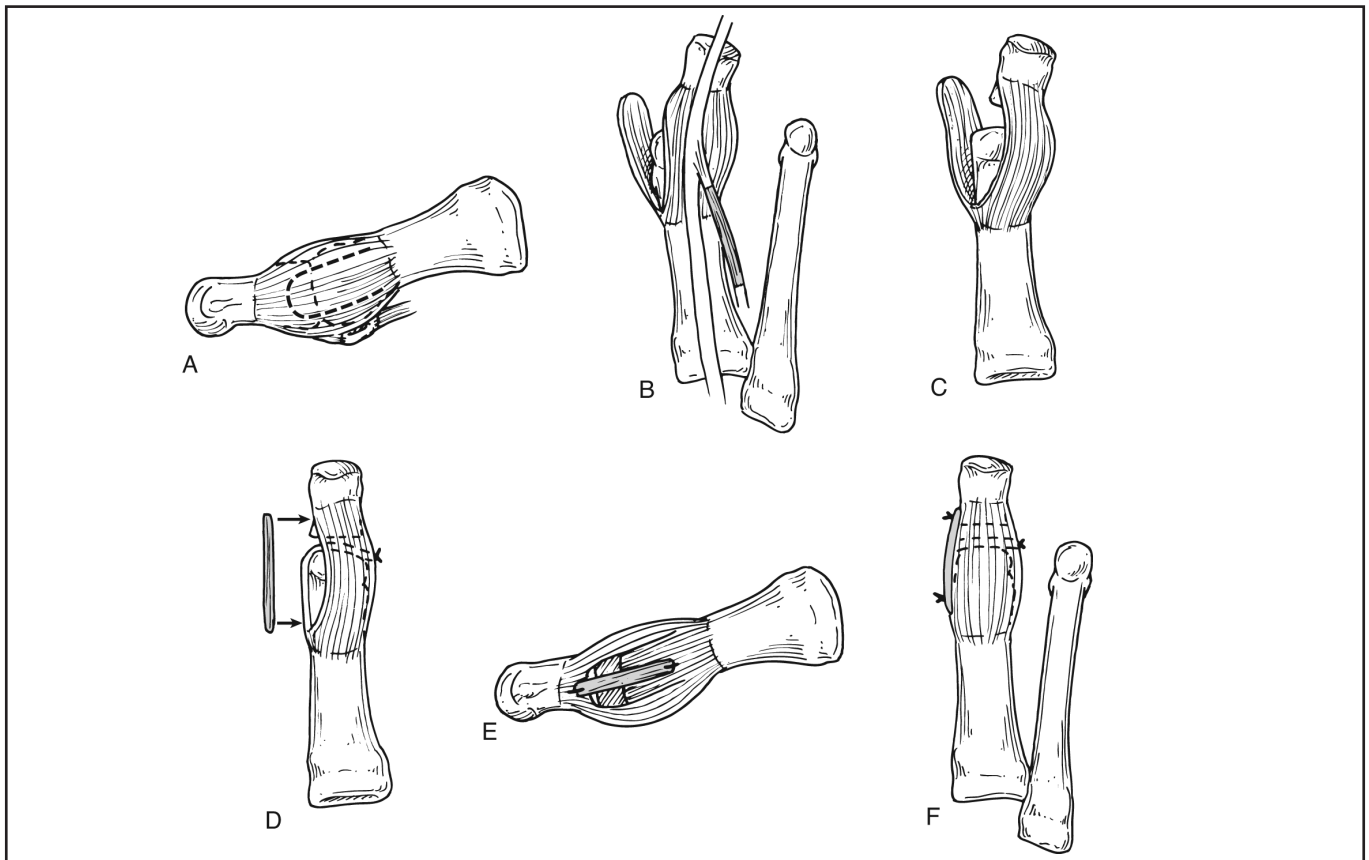


Figure 2B. Proximally based U-flap.

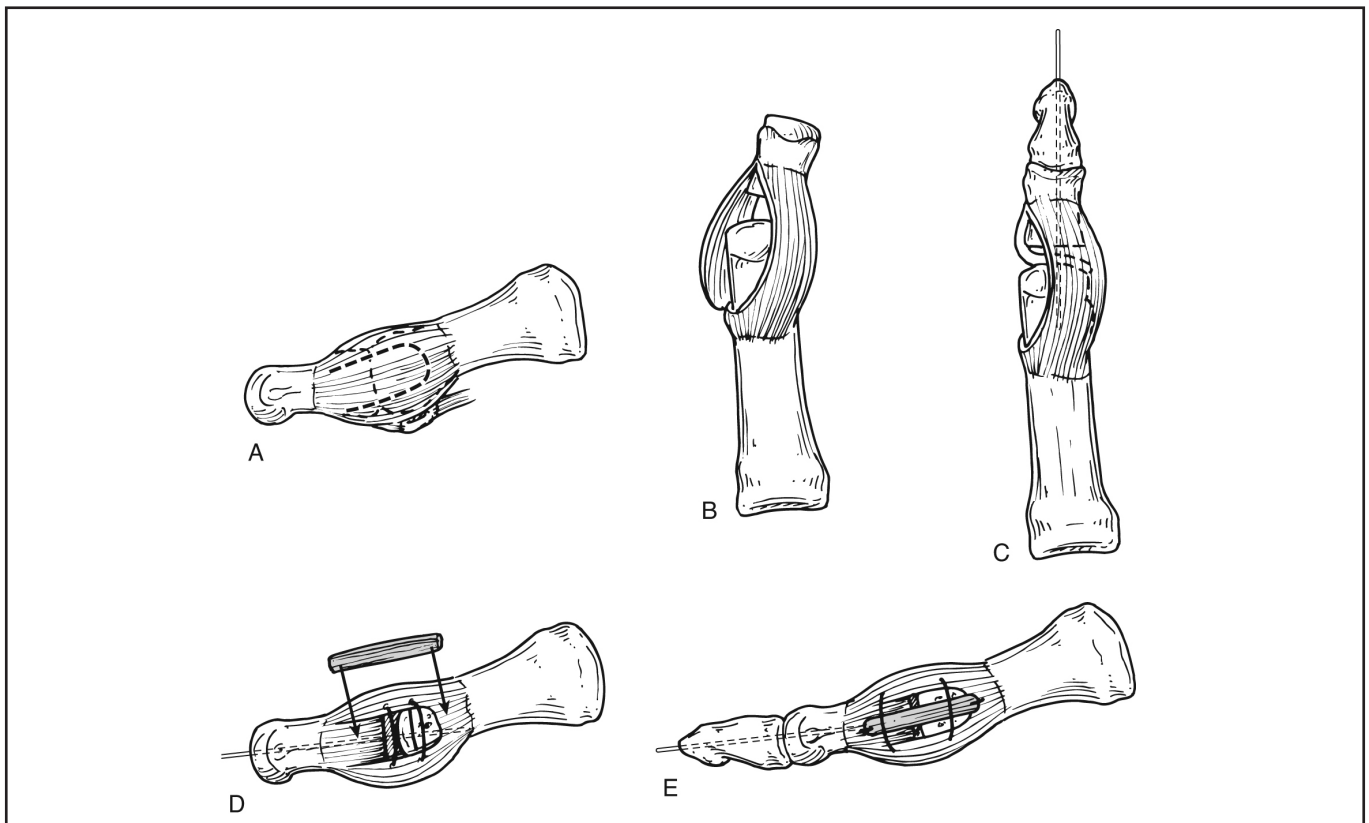


Figure 2C. Distally placed U-flaps.

of the first metatarsal head. If the K-wire is in line with the long axis of the first metatarsal it may be difficult for the patient to ambulate and, in fact, may bend the wires. This is more of a problem in a cavus type foot as with a cavus foot the angle of declination of the first metatarsal is higher and therefore the position of the hallux will have to be more extended at the MTPJ. I prefer to use 2 K-wires to maintain position, one to hold the length and the second wire to reduce the possibility of frontal plane rotation and shortening of the proximal phalanx-metatarsal head interface (Figure 14).

The wound is then closed in layers. The K-wires are left in place for approximately 6 weeks at which time they are removed and the patient is encouraged to return to more standard shoe gear (Figure 15). Patients who have K-wires holding alignment may bathe after 2 weeks and apply their own dressings. Some patients are hesitant to

do this and therefore we leave the dressing on during the time we expect the K-wire to stay in place. Once post-operative radiographs are taken and found to be adequate the K-wires can be removed (Figure 16).

I picked eleven patients between 1997 and 2007 who had the Keller procedure. The demographic findings are as follows: 11 patients, 10 women, 1 man (total 13 feet.) Average age 70.75 years (range 61-79 years). Mean is 71.5 years. Follow-up period was 20 months (range 3 months to 5 years). Two patients had bilateral procedures done. Two patients had hallux limitus/rigidus, 1 patient had hallux varus, 3 patients had osteoporosis, 3 patients had gout, 1 patient had a failed total implant, 1 patient had a take-down first MTPJ arthrodesis, 1 patient had a Keller with pan metatarsal head resection, and 1 patient had Charcot with severe first intermetatarsal angle.



Figure 3. Preoperative view of HAV with severe increase in the first IM angle and lateral deviation of the hallux. Preoperative view.

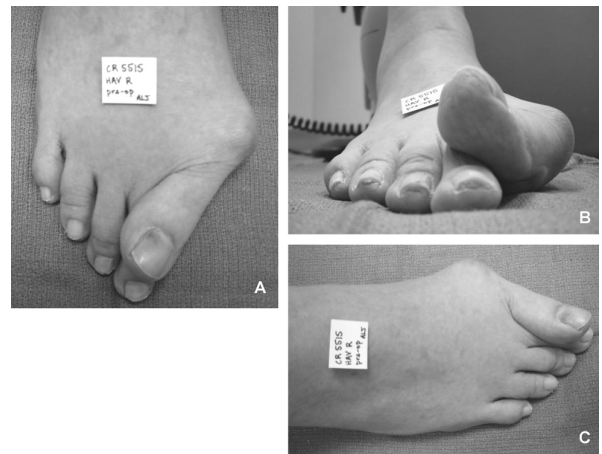


Figure 4. Clinical view of patient described in Figure 3.

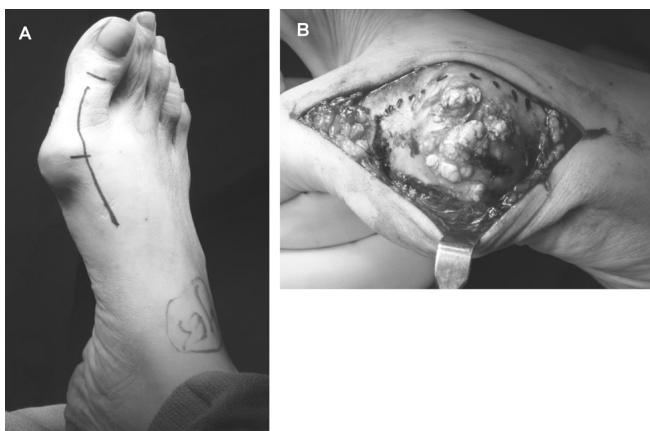


Figure 5A. Planned dorsal medial incision. B. Planned capsulotomy is marked.

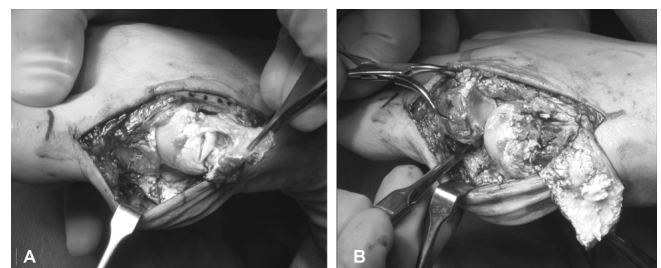


Figure 6A. Capsule mobilized off the metatarsal head and base of the proximal phalanx. Note gouty tophi within the capsule and joint. B. Capsule mobilized.

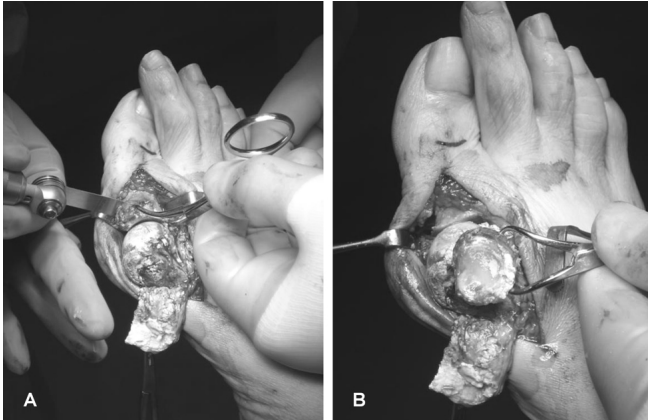


Figure 7A. Base of the proximal phalanx is resected. B. Resection of proximal phalanx base.

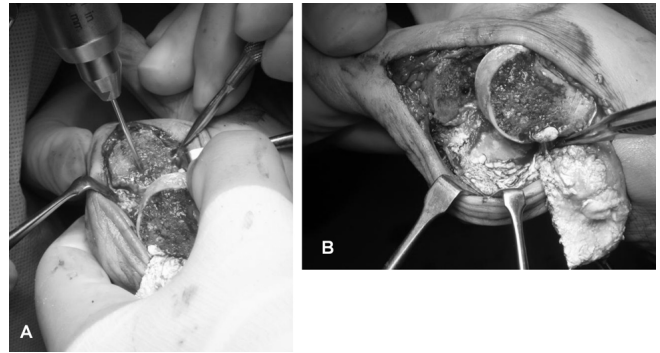


Figure 8A. Drill hole placed on inferior proximal aspect of the remaining proximal phalanx for reattachment of the flexor tendon. B. Placement of drill hole.

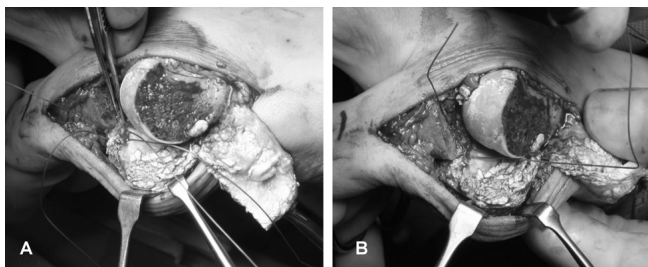


Figure 9. Suturing of short flexor tendon to base of the proximal phalanx using 2.0 nonabsorbable suture.

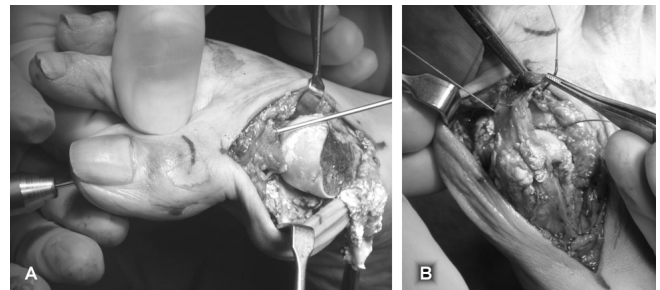


Figure 10. K-wire is retrograded from proximal to distal through the hallux.

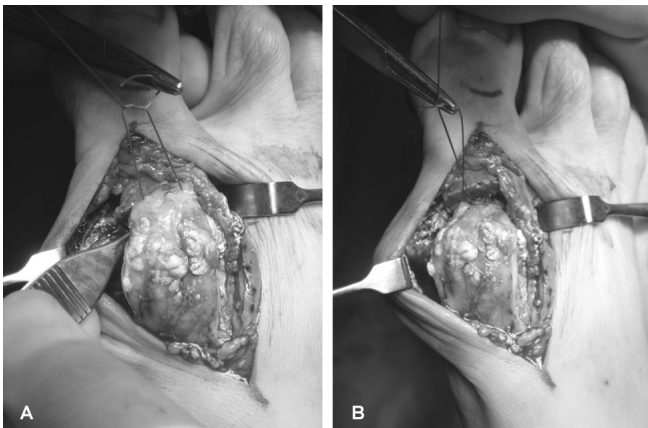


Figure 11. Capsule is then used to cover the metatarsal head and held in place using a horizontal mattress suture.

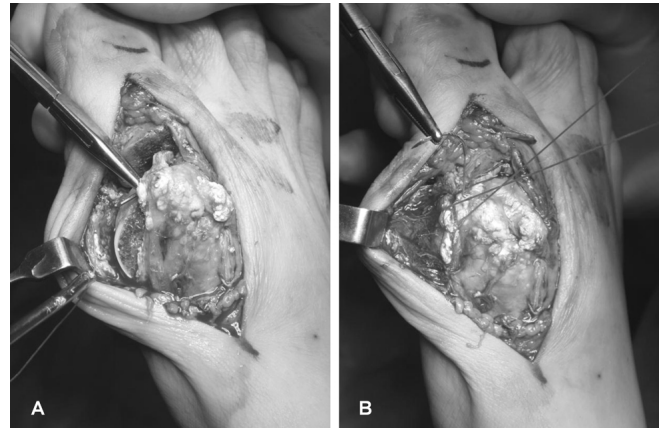


Figure 12. Inferior portion of capsule is repaired.

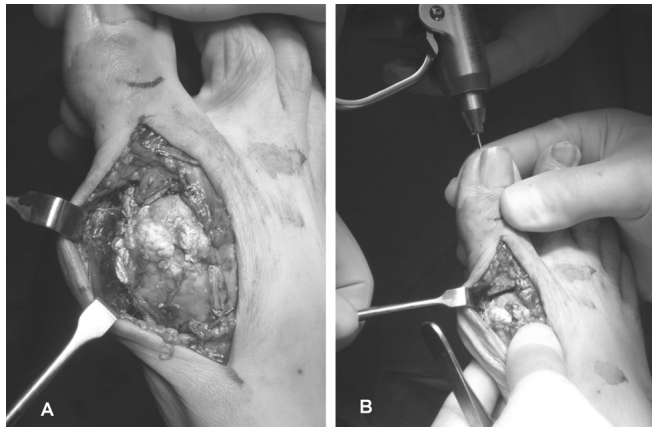


Figure 13. While the hallux is distracted to maintain distance between proximal phalanx and metatarsal head, the K-wire is then retrograded into the first metatarsal head.



Figure 14. K-wires are placed in 2 planes to avoid telescoping and frontal plane deviation during the healing process.



Figure 15. Radiographs reveal K-wires in position at 4 weeks

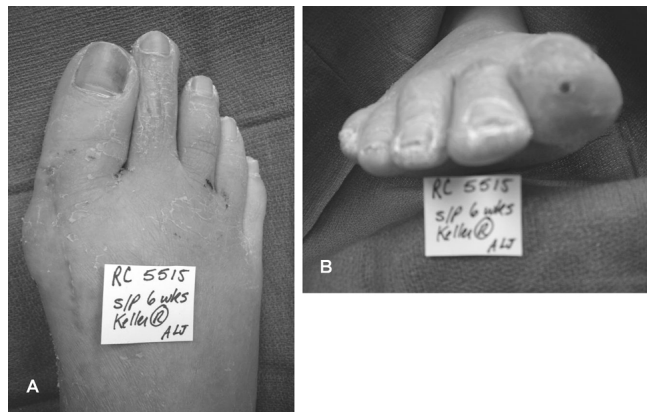


Figure 16A. Clinical presentation 6 weeks after surgery and 2 weeks after K-wires were removed. B. Clinical presentation.

CASE PRESENTATIONS

Case 1.

A 72-year-old female with significant osteoporosis, and painful hallux abducto valgus demonstrates a very high intermetatarsal angle (Figure 17). Note that at 5 years postoperative the intermetatarsal angle has maintained its reduction, and the base of the proximal phalanx still continues to show a gap between the base of the proximal phalanx and the metatarsal head. Some mild loss of the lesser second metatarsal alignment is noted. This patient has been extremely happy since her procedure (Figure 18).

Case 2.

Case 2 is a 68-year-old female who also has significant osteoporosis, painful hallux abducto valgus with a very high intermetatarsal angle (Figure 19). The patient underwent a Juvara closing base wedge osteotomy, with a Reverdin adductory metatarsal head osteotomy with appropriate



Figure 17 A. Case 1 preoperative radiograph demonstrates severe HAV with significant osteoporosis and extension of the proximal phalanx with hallux IPJ flexion. B. Case 1 preoperative radiograph. C. Case 1 immediate postoperative radiograph demonstrates appropriate correction and osseous dissection. D. Case 1 immediate postoperative radiograph.



Figure 18. Case 1 at five years postoperative. First metatarsal alignment is excellent, note mild medial deviation of the second MTPJ.

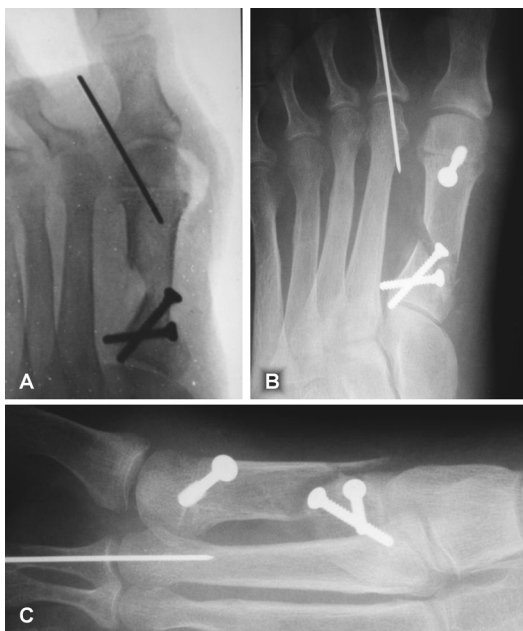


Figure 20A. Case 2 intraoperative radiograph demonstrates Juvara osteotomy to correct the high intermetatarsal angle and a Reverdin osteotomy correcting elevated PASA. B. Patient arrived in office 1 week postoperative, walking on her cast. Note fracture of Juvara osteotomy. C. Postoperative view at 1 week.

fixation to correct for elevated PASA. Perioperatively the patient was given a choice of a Keller bunionectomy versus the double osteotomy procedure. She stated she would not bear weight on the extremity as she preferred the double osteotomy procedure. Unfortunately on postoperative day 1, the patient stepped on her foot and a week later actually walked into the office with her cast on (Figure 20). The patient was taken back to surgery for repair of the fractured hinge on the closing base wedge osteotomy, which healed appropriately but in slight abduction of the first metatarsal head with mild to moderate hallux adductus (Figure 21). The patient continued to have symptoms and 1 year later,



Figure 19A. Case 2 preoperative radiograph demonstrate high intermetatarsal angle, significant osteoporosis, and lateral deviation of the hallux. B. Preoperative view. C. Preoperative view.

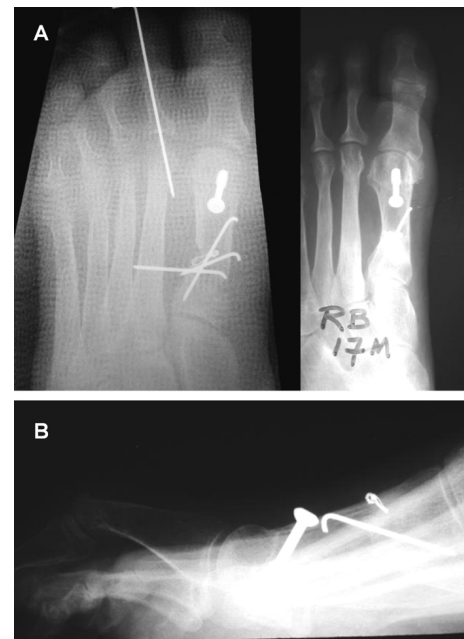


Figure 21A. Case 2 reconstruction of fracture site using multiple K-wire techniques and nonweightbearing postoperatively, until osseous consolidation.

underwent a Keller bunionectomy for repair of her pathology (Figure 22). This case shows how a patient who is elderly who is not necessarily capable of caring for herself, can compromise a surgical correction. It is for this reason that the Keller bunionectomy is a much preferred procedure in patients like this who have a very high degree

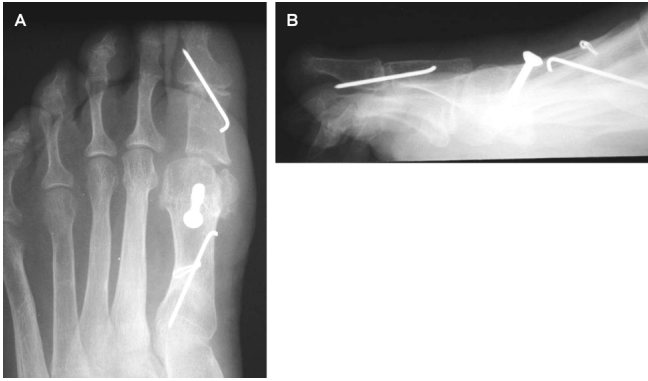


Figure 22. Case 2. Postoperative symptomatic hallux adductus treated with Keller bunionectomy.

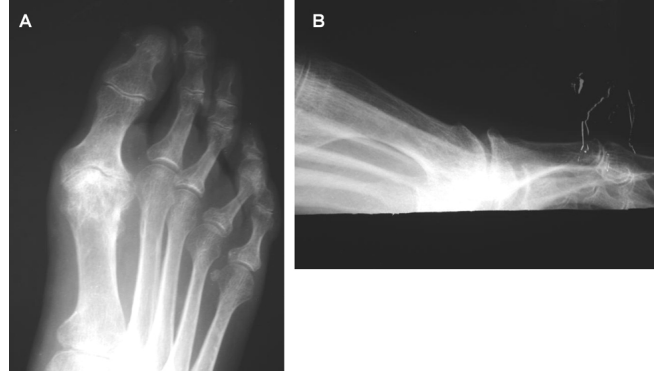


Figure 23. Case 3 preoperative view right foot showing severe DJD first MTPJ.

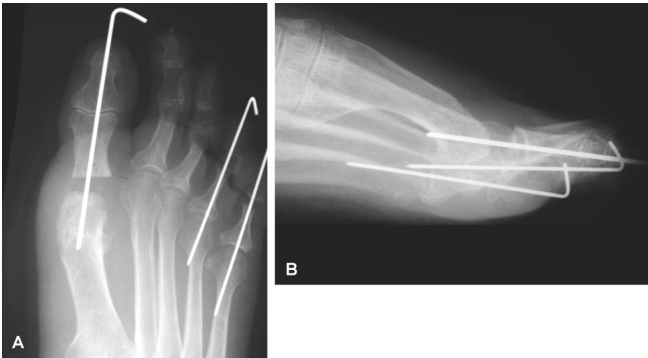


Figure 24. Case 3 at 1 week postoperative. Radiograph demonstrates appropriate correction. Note that the K-wire enters the inferior proximal aspect of first metatarsal head. It is important to engage a cortex in an effort to reduce distal migration of the K-wire during ambulation.

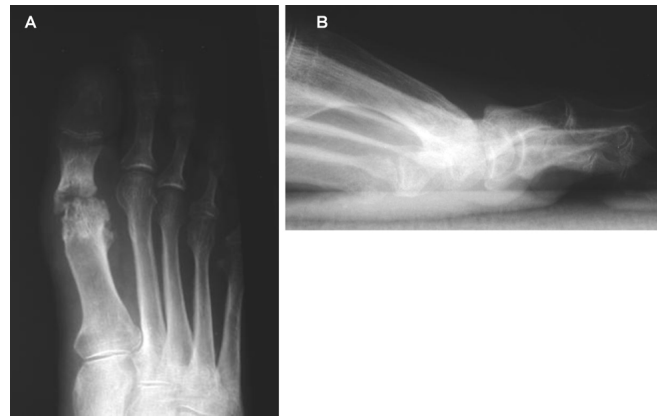


Figure 25. Case 3. Postoperative 1 year view reveals excellent alignment and maintenance of correction.

of bunion deformity, high intermetatarsal angle, and significant osteoporosis.

Case 3 is a 65-year-old woman with a history of chronic pain of the first MTPJ. A diagnosis of hallux rigidus was made (Figure 23). The patient underwent Keller bunionectomy with removal of osteophytes of the metatarsal head, capsular interposition, and K-wire fixation (Figure 24). The patient was weightbearing in the surgical shoe for 6 weeks after which time the K-wire was removed. One year postoperatively the patient was still functioning extremely well with her intervention and went on to have surgical repair of the contralateral foot (Figure 25).

In summary, the Keller bunionectomy is generally indicated for the elderly patient usually older than 65 years of age, with moderate to severe hallux abductovalgus and/or hallux limitus/rigidus, a high intermetatarsal

angle, and significant osteoporosis. Other indications for the Keller bunionectomy include trauma, infection/osteomyelitis, metabolic disease and reconstruction for failed bunion procedures of the first MTPJ.

Key points to keep in mind when performing the Keller bunionectomy include, appropriate osseous resection, regain flexor stability of the proximal phalanx by resuturing the short or long flexor to the base of the proximal phalanx, soft tissue interposition using autogenous and/or allogeneic technique to avoid degenerative joint disease of the first MTPJ, fixation generally using two K-wires to decrease telescoping of the correction and also to reduce the possibility of valgus or varus rotation. Patients are usually ambulatory during the entire postoperative procedure.

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