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Joint-Destructive Procedures

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The term *joint-destructive procedure* might suggest that a functioning joint is destroyed by the procedure. It is emphasized here, however, that this type of procedure must be reserved for joints with a hallux valgus deformity accompanied by severe, painful osteoarthritis with erosion of cartilage and limitation of motion, various types of arthritis, and severe infections or damage of other origin of this joint.

To relieve pain and restore reasonable function of the first metatarsophalangeal joint in these cases, there are three possible procedures: resection of articulating parts of bones, resection, and using an implant or arthrodesis. All resection arthroplasties have in common that if the entire metatarsal head is not removed, the medial outgrowth (exostosis) of the metatarsal head is resected. Several combinations have been utilized (Table 21-1).

In 1836, Fricke[1] performed "excision of the bones which form the metatarsodigital joint of the great toe" with great success. As the sesamoids belong to the joint, this implicates that they also were extirpated. In 1853, Hilton[2] removed the "articular extremities" of the metatarsal and first phalanx "including the two sesamoid bones."

Heubach[3] reported in 1897 on results of total joint resection including the sesamoids performed by his chief, Rose, of Berlin, in the years 1884-1897. Heubach himself used the removed joints for a detailed description of the pathomorphology of hallux valgus and for staging hallux valgus into three groups relating to the position of the sesamoids.

Clayton,[4] for his forefoot correction in severe rheumatoid arthritis, employed resection of the metatarsal head and the phalangeal base leaving the sesamoids in situ. Kramer (1826) and Roux (1829) were known by

Heyfelder[5] to have removed the head of the first metatarsal. Hueter[6] did this procedure for an infected first metatarsophalangeal joint, but later (1877) also applied it to hallux valgus without infection.

Mayo in 1908 modified the operation by removing two-thirds of the metatarsal head, "the section also removing two thirds of the anterior portion of the bony hypertrophy on the inner side." Riede[7] in 1886 was the first to publish four successfully operated cases of hallux valgus that he had treated by resection of the base of the phalanx and the exostosis of the head of the first metatarsal. He had seen deplorable results with decapitation of the first metatarsal, and intended his publication to serve as a warning to other surgeons treating hallux valgus. In 1887 Davies-Colley[8] described the same surgical technique for the treatment of hallux rigidus ("hallux flexus").

Keller,[9,10] being also impressed by poor results of the metatarsal head resections, in 1904 and 1912 reported his technique of treating hallux valgus. which is essentially the same as that described by Riedl. Brandes,[11] apparently inspired by Billroth, unfortunately recommended resection of two-thirds of the phalanx, causing several generations of surgeons in German-speaking countries to create short and floppy great toes that were often followed by transfer metatarsalgia.

Although Kelikian[12] in 1965 again tried to put straight the fact that Riedef was the first, in 1886, to publish base resection combined with exostectomy for the treatment of hallux valgus, it remained the convention to call this operation after Keller in English-speaking and after Brandes in German-speaking countries.

Table 21-1. Resection Arthroplasties for Hallux Valgus

Resected Part of Joints	Authors
Metatarsal head	Fricke 1836
Base of phalanx	Hilton 1853
Sesamoids	Rose 1884 (Heubach 1897)
Metatarsal head	Clayton 1960
Base of phalanx	
Metatarsal head	Kramer 1826
	Roux 1829
	Hueter 1871
Metatarsal head, partial	Mayo 1908
Medial prominence of	Riedel 1866
Metatarsal head	Keller 1904
Base of phalanx	Brandes 1927

THE KELLER TYPE OF ARTHROPLASTY

General Discussion of Procedure

The Keller procedure can be defined by Riedel's description[7]: removal of the exostosis from the metatarsal head and of the base of the first phalanx. The numerous variations in respect to details of the operation are discussed and we refer to what has for us proved to lead to acceptable results with this procedure.

Keller[9] recommended a medial skin incision, which has the advantage that the important digital nerves and vessels are avoided and that the scar is scarcely visible.[13] We have observed no problems with pressure caused by shoes.

If a bursa is present, it is not resected; the incision is deepened through it.

The capsule is incised longitudinally at its medial aspect. If reconstruction of the capsuloligamentous apparatus is planned, the sesamoids are mobilized.[13,14] The lateral capsule is also cut in a longitudinal direction[14] to facilitate the cerclage fibreux, which serves to reduce the intermetatarsal angle. Care must be taken to preserve the posteromedial insertion of the capsule just behind the exostosis rather plantarly.[15] At this portion of the capsule the nutrient artery of the metatarsal head penetrates the capsule. If this vessel is cut, the metatarsal head is at risk for osteonecrosis.[15]

Although several authors have contended that the intermetatarsal angle is reduced by removal of the base of the phalanx,[16-18] it was noticed that an intermetatarsal angle less than 10° usually was not achieved.

Bonney and MacNab,[19] in analyzing a series of operations to correct hallux valgus, concluded that the most important of two main causes of poor ("indifferent") results was failure to correct "metatarsus primus varus," which in this case apparently means the intermetatarsal angle. In my experience[18] the average reduction of the intermetatarsal angle was from 14° to 11.8° in the simple procedure, while in the group with cerclage fibreux the average intermetatarsal angle was altered from 16.6° to 9.3° at follow-up in an average of 8.5 years. Although as Jahss indicates.[20] the value of this procedure was doubted by Kelikian, Jahss[20] emphasizes that the cerclage holds with his experience of 10 years of follow-up.

With a mobile first ray, intermetatarsal angles up to 25° can be treated with this method. We therefore made it an indispensable step in the procedure. If there is doubt of reductibility, radiographs are done with an elastic bandage around the forefoot to see whether the forefoot narrows sufficiently. If the deformity is rigid, which is very rare, an osteotomy of the Trethowan type is performed.[21]

The disarticulation of the base of the phalanx should be achieved by sharp dissection with a knife. If a sharp elevator is used to free the phalanx laterally, a piece of bone may break off that must be removed. However, Bonney and MacNab[19] in their study on operative results after Keller procedures found fragments of bone left behind to have little influence on the results, "provided this untidiness is not carried too far."

Contrary to Keller and followers we do not resect the phalanx subperiosteally but remove the base with the periosteum adhering to it; this prevents neosteogenesis, which may be expected from a tissue with osteogenetic potency.

Because some controversy is apparent from the literature regarding the size of the resected part of the phalanx, several opinions may be of interest. Riedl[7] did not give any details as to the amount of resection of the base of the phalanx, nor did Keller.[89] In his second publication in 1912, Keller[10] advised that enough of the "phalangeal head" is removed to enable the distal portion to be placed in an overcorrected position medially without impinging on the first metatarsal. Brandes[11] strictly insisted on resection of two-thirds of the phalanx. Gilmore and Bush[22] removed one-third to one-half of the proximal phalanx. Cleve-

land and Winant[23] postulated removal of at least one-half of the phalanx to prevent the postoperative development of hallux rigidus.

Kelikian recommended resection of at least half the phalanx. He attributed proliferative new bone formation to resection through the cancellous base. Bonney and MacNab[19] in their critical survey of operative results concluded that the optimal length of the resected piece was one-third to one-half of the proximal phalanx.

Wrighton[24] considered the most common technical error to be resection of more than one-third of the phalanx, producing a short, rotated, and floppy toe and a relative projection of the second toe that leads to a hammer deformity. Giannestras[25] recommended removing 1 cm, or not more than 1.5 cm, to avoid an obvious overshortening of the hallux. He also emphasized that the cut should be perpendicular to the long axis of the phalanx. The incidence of the development of a floppy toe appeared to rise significantly when more than one-third of the phalanx was removed. Lelievre[13] postulated that as "metatarsus varus has been reduced" (by cerclage fibreux) the hallux should be as long as the second toe, calculating that in the following weeks there will be, by shaping of the base of the stump of the phalanx, a reduction in length of 2-3 mm. Thus, an ideal proportion will be gained. He also demands a "joint play" of 10 mm at distraction and thinks that in most cases these conditions are realized by resecting the base at the metadiaphyseal border. Mann[26] resects the proximal part of the phalanx at the metaphyseal flare, which compares well with Lelievre's prescription. As much as one-half of the phalanx may be removed.

The amount of resection done by Imhoff et al.[27] depends on the valgus angle. At less than 40°, they resect one-third; at angles greater than 40° they resect one-half as recommended by Reiter.[28]

In our experience resection at the metaphyseal flare[13,26] is usually sufficient; this represents approximately one-third of the total length of the phalanx. The plane of resection is perpendicular to the long axis of the bone, as is recommended by most authors.

An oscillating saw is used. Bone-cutting forceps carry the risk of crushing the bone, and the phalanx is at risk for damage, especially in the elderly osteopenic patient.

Replantation of the base of the phalanx was advo-cated by Regnauld.[29] To make the operation as reconstructive as possible, we began using Regnauld's replantation of the base of the proximal phalanx to provide for cartilaginous joint surfaces. At an early follow-up of 22 operations, we found one replant dislocated; another was partly resorbed, and in one case the replanted base was broken. Because at that time we had found this step of the operation technically difficult, we have discontinued doing it.

The exostosis of the metatarsal head is removed flush with the medial contour of the shaft,[12] which is in agreement with most writers. Keller[10] in his second publication in 1912 recommended making the cut obliquely upward and outward along the length of the metatarsal, extending from the inner sesamoid below to a line above that is well past the middle of the bone. All other outgrowth of bone around the metatarsal head is also removed.

In contrast to other authors,[12] the sesamoids are preserved even if severe osteoarthrosis is present. Osteophytes are removed from the medial sesamoid if they protrude too far medially. Pain stemming from a metatarsosesamoidal osteoarthrosis is extremely rare. Removal of the sesamoid can add to the biomechanical disadvantages of the procedure.

We have occasionally added interposition of a distally pedunculated capsuloperiosteal flap, doubled with a resorbable suture and sewn over the resection surface of the phalanx using the lateral periosteum or a drill hole in the bone to anchor it. We have not obtained sufficient results to determine whether this improves mobility. Lelievre[13] has abandoned interposition of a capsular flap. He described early development of a fibrous cartilage that gradually develops into chondroid metaplasia. We also saw this macroscopically when correcting recurrent hallux valgus after Keller-type operations.

In considering tenopexy, at an early follow-up of Keller procedures to which fibrous cerclage was added, metatarsalgia had developed at the second and sometimes third metatarsal in 5 of 21 feet.[14] Transfer metatarsalgia is attributed to weakened ground pressure of the great toe. According to Ellis,[30] in normal function of the foot the posture of the great toe is flat and straight on the ground. He explained that the proximal phalanx is pressed to the ground by the short flexors as a presupposition for the long flexor to act as a pressor on the distal phalanx. If the proximal
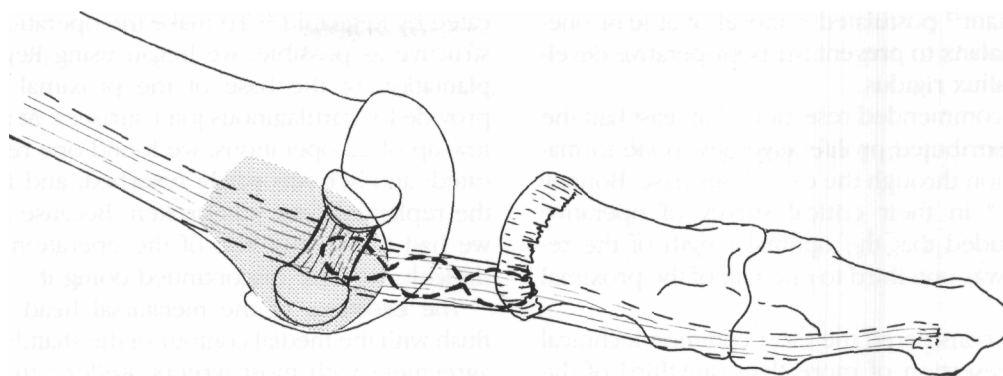
Fig. 21-1. Tenopexy according to Viladot. A Bunnel-type suture connects the long flexor tendon with the intersesamoid ligament.

phalanx is not stable, the long flexor causes knuckling at the interphalangeal joint.

When the base of the phalanx is removed in a Keller-type procedure, the insertion of the short flexors is severed and the proximal phalanx is left unstable. To compensate for this, several techniques have been developed that aim at reuniting the plantar plate with the stump of the phalanx either directly or via the long flexor tendon. Regnauld[29] places a resorbable suture from between the sesamoids and across the tendon sheath of the long flexor through the capsuloperiosteal tissue of the phalanx. He also describes Viladot's technique of suturing the intersesamoid ligament to the tendon of the flexor hallucis longus muscle (Fig. 21-1) and Buruturan's method of connecting the intersesamoid ligament to the base of the phalanx by using a drill hole. Regnauld[15] advises against including the long flexor tendon in the suture because of the risk of creating a permanent flexion at the interphalangeal joint, thus producing a mallet toe. Lelievre[13] does not believe that such procedures reduce the frequency of metatarsalgia.

We use Vilatot's technique; in our experience, the sesamoids retract proximally but cock-up deformities seem to be prevented. Lengthening of the extensor longus tendon is usually not necessary, a reason why we continue to add tenopexies in Keller procedures.

The repair of the capsuloligamentous apparatus is done by reconstructing the medial metatarsosesamoidal ligament. This is accomplished with resorbable material of size 1, usually Vicryl (see Fig. 21-1).

Any type of postoperative immobilization of the toe is deemed unnecessary if rehabilitation begins on the day of the operation, or preferably on the preceding day, by instructing the patients about their contribution to the success of the procedure. Although it is recommended by some authors,[12,22,25,31-33] Sherman et al.[33] did not recognize any advantage in Kirschner wire (K-wire) distraction and suspected that degenerative changes in the interphalangeal joint and a subjectively worse result might be the outcome. Use of an external staple creates two portals for possible infection instead of just one for the K-wire.[34]

Bonney and Macnab[19] found when comparing results with and without immobilization in a plaster that incorporated the great toe for 2 weeks that there was no difference in the objective functional results. Although the authors are of the opinion that mobility of the new joint does not depend on what is termed early mobilization, on the other hand the results suggest that immobilization is not necessary.

With respect to metatarsalgia, there was no significant difference in the results of Rogers and Joplin,[35] who "followed Keller's technique" without fixation and those of Bryan[35] who used K-wires and external staples. In 1976 we discontinued distraction with a suture through the pulp of the toe and did not see any disadvantage as to the functional results.

We never resect any skin even if a surplus of skin results after removal of the bunion. The baggy appearance of this skin disappears within 6 weeks postoperatively. Postoperative treatment is continued for 6 weeks using elastic adhesive tape. Movement of the

toe is encouraged on the day of operation, and ambulation with sandals or larger tennis shoes as soon as the patient tolerates it.

OBJECTIVE OF THE PROCEDURE

The goal of this procedure is to eliminate pain caused by the exostosis, and by osteoarthritis, and to restore function of the whole foot as completely as possible. This can be achieved by taking into account all pathologic anatomic alterations accompanying the deformity. The procedure thus must include removal of the exostosis, correction of malposition of the first metatarsal in a transverse and sagittal plane, reposition of the metatarsal head onto the sesamoidal apparatus by lateral release, medial reconstruction of the capsuloligamentous structures, and restoration of muscular balance as much as possible.[36]

PATIENT SELECTION AND INDICATION

The opinion that a joint with good mobility must be treated by a joint-preserving procedure regardless of the patient's age is gaining support.[37] As in all planned surgery, circulatory problems must be evaluated; if necessary, advice of an angiologist should be sought.

The indication for a Keller-type procedure will usually be established with a painful osteoarthritic joint, dorsiflexion less than 30°, and a hallux valgus angle of more than 40°.[12] Candidates for a simple Keller procedure will be patients with nonhealing ulceration at the site of the exostosis. ulcerations and joint destructions initiated by sensory neuropathies, and septic arthritis with destruction of joint surfaces.

In the rheumatoid foot, treatment of the lesser metatarsophalangeal joints, mutilated and dislocated as they are, will usually be metatarsal head resection. To achieve good functional alignment some part of the metatarsal head will also have to be removed,[13] or an arthrodesis of the first metatarsophalangeal joint can provide for even better stabilization of the foot.

PREOPERATIVE MEASURES

An ankle block is set with 1% Xylocaine after ruling out all contraindications. A tourniquet is put on just above the ankle joint and inflated to a pressure of twice the patient's systolic pressure of the arm. In patients with diabetes or with even slight circulatory problems, a tourniquet is not used.

THE OPERATION

A medial longitudinal skin incision is made from the crease of flexion of the interphalangeal joint to just proximal to the exostosis. The joint is exposed subcutaneously by blunt dissection using scissors. The capsule is incised longitudinally 5 mm plantar to the insertion of the medial metatarsosesamoid ligament at the epicondyle of the metatarsal head.

With a knife, using a hook inserted into the proximal joint surface of the phalanx, the base is shelled out separating the abductor hallucis, the adductor hallucis, the flexor brevis, and the extensor brevis tendon from its insertion into the base. The periosteum is left intact. The base is grasped with a small reposition forceps, and while rinsing thoroughly with saline the base of the phalanx is removed with an oscillating saw perpendicular to the longitudinal axis of the bone and just proximal to the site where the reposition forceps gripped, at the proximal metaphyseal flare of the phalanx.

Exostectomy is performed flush with the medial contour of the metatarsal shaft. An osteotome or an oscillating saw is used to remove the exostosis. To prevent intrusion into the shaft, an indentation is made perpendicular to the axis with a smaller osteotome just proximal to the exostosis. The osteotomy may incline 10° to the sagittal plane from dorsolateral to plantar-medial. If present, osteophytes are removed from the dorsal and lateral circumference also.

Adhesions of the sesamoid apparatus to the metatarsal head are separated by a blunt periosteal elevator.[12] The lateral metatarsosesamoidal ligament and capsule is dissected using a Smillie meniscotome. The deep transverse metatarsal ligament is left intact.

Tenopexy of the flexor hallucis longus tendon to the intersesamoid ligament is now added. The tendon sheath is opened longitudinally with a knife from the intersesamoid ligament to the resection plane of the phalanx. With a Bunnel-type suture starting just at the resection plane of the phalanx, the flexor hallucis tendon is fixed to the intersesamoid ligament (see Fig. 21-1). The capsule is sutured with resorbable material. Medial reefing is possible by resection or plication.

With the toe in neutral position and under longitudinal traction of the toe, a U-type mattress suture (Regnauld, personal communication) is set with a resorbable 1-0 thread, usually Vicryl. The needle penetrates the capsule dorsally at the border to the periosteum from outside in, is directed through the plantar lip of the capsule just dorsal to the medial sesamoid at its proximal end, then back through the capsule from outside in at the distal end of the sesamoid and from

inside out through the dorsal origin of the capsule paralleling the thread that is already inserted (Fig. 21-2A). The forefoot is now compressed transversely and the suture is tied under tension, thus repositioning the metatarsal head on the sesamoid apparatus (Fig. 21-2B). The surplus rims of the capsule are now resected and by side-to-side sutures with the same material the capsuloligamentous apparatus, especially the medial metatarsosesamoid ligament, is reconstructed (Fig. 21-
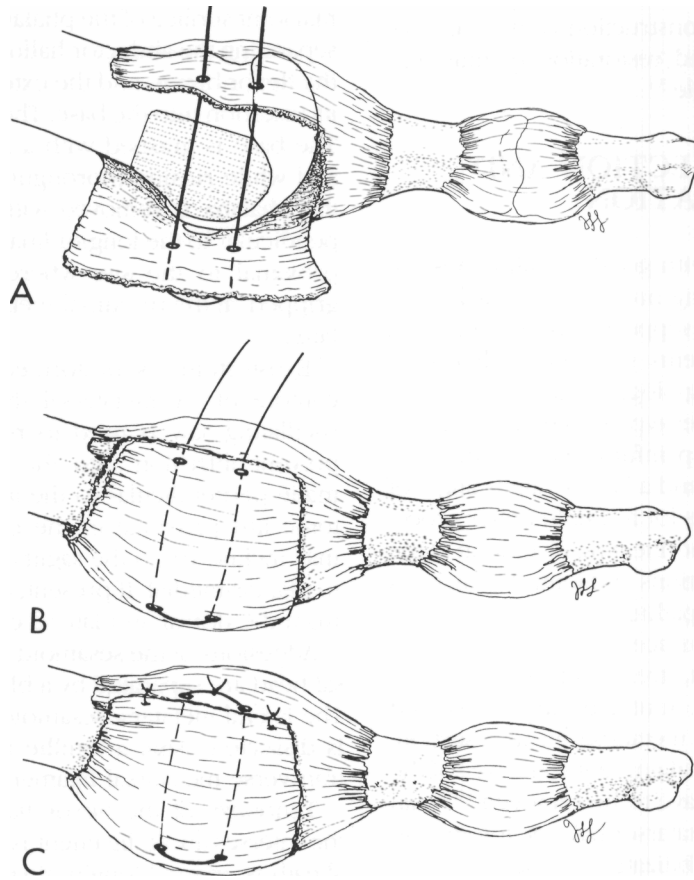

Fig. 21-2. (A) Reconstruction of the capsuloligamentous apparatus. After resection of the base of the phalanx and the exostosis, freeing the sesamoid bones from the metatarsal head and a lateral capsulotomy a U-type suture connects the dorsal rim of the capsule with the plantar part, passing through it close to the medial sesamoid bone. (B) By pulling at the threads of the suture, the sesamoids are replaced on the metatarsal head. (C) With the U-type suture tied, the surplus of capsuloligamentous tissue is resected and the suture completed by simple knots.
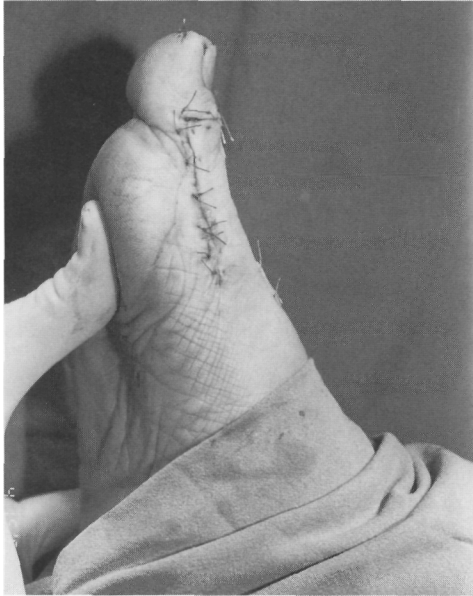
Fig. 21-3. Push-up test at the end of the operation. The head of the first metatarsal is supported from below with the ankle joint in a neutral position. If there is extension in the metatarsophalangeal joint, usually with buckling at the interphalangeal joint, the long extensor tendon will have to be lengthened.

2C). The most distal suture connects the periosteum of the phalanx with the capsule and the tendon of the abductor hallucis muscle.

In the case of a rigid first metatarsal fixed in abduction, an opening wedge osteotomy at the base of the first metatarsal is made as described by Trethowan[20,38] A push-up test is performed at the end of the operation (Fig. 21-3). After having performed the operation in the manner described here, there is usually no dorsiflexion in the metatarsophalangeal joint. If there is, the extensor hallucis longus tendon must be lengthened.

KEY POINTS OF THE PROCEDURE

To reestablish function of the forefoot, the first ray must be stabilized. It has been shown that after head resections of the lesser metatarsals the results were

fair if the first ray was stable but poor when it was unstable.[39]

This stabilization is achieved by reducing the intermetatarsal angle by reconstructing the medial metatarsal ligament and by strengthening the ground pressure of the first toe, which can be accomplished by trying to maintain the function of the short flexors. Care must also be taken of the lesser toes in respect to the expected excess length of the second and sometimes also the third toe, hammer toes, and dislocations at lesser metatarsophalangeal joints. The whole foot must always be addressed.[13]

POTENTIAL INTRAOPERATIVE DIFFICULTIES

Although the Keller operation is considered to be a simple procedure for the treatment of hallux valgus, there are some steps that can cause difficulties for the less experienced. The flexor hallucis longus tendon follows the plantar contour of the first phalanx, which is concave in a plantar direction. If the structures cannot be clearly visualized and the knife does not follow the osseus contour closely, the flexor tendon is at risk to be dissected. This would have to be repaired immediately.

In rather stiff joints, the ablation of the lateral collateral ligament and the adductor tendon can be difficult. A smaller scalpel and patience are often helpful. Care must also be taken to preserve the digital nerves because lesions can create painful neuromas. If the capsular reconstruction is inadequate, the intermetatarsal angle will not be reduced to normal and recurrence of the deformity must be expected.

If the tenopexy of the flexor hallucis longus is situated too far proximally, the flexor longus tendon will aid in pulling the sesamoids proximally and waste much of its power to this purpose.

CRITERIA FOR ACCEPTABLE RESULTS

A pain-free joint that appears straight with a minimum passive dorsiflexion of 30°, an eliminated exostosis, and the absence of metatarsalgia will usually satisfy the patient. The intermetatarsal angle is expected to be

smaller than 10° and the hallux valgus angle less than 20°. The metatarsal head should be relocated on the sesamoid apparatus, and the sesamoids should not retract proximally.

COMPLICATIONS

Early postoperative complications are rare. If infection occurs, it can usually be cured by antibiotics in an early stage. If empyema develops in the nearthrosis, the wound should be opened and debrided and a drainage applied. A complication that often develops insidiously is hallux varus (Fig. 21-4). If the intermetatarsal angle is reduced to less than 5° or even becomes negative, the patient must be considered at risk to develop hallux varus. The technique of application of

Fig. 21-5. Four years after a Keller operation without cercalge fibreux. Intermetatarsal angle is 21°; the phalanx is dislocated into the intermetatarsal space; the metatarsal head protrudes medially.

Fig. 21-4. Severe hallux varus of 20° after Keller's operation in a 49-year-old woman, 4 years after surgery.

the dressings must be modified; the elastic adhesive bandage should be looser and a sling pulling the toe medially must be avoided.

Sequelae following too little or too much resection are more frequent. In the first case, either hallux rigidus, or, especially if the metatarsal angle is not addressed, an early recurrence will develop with the phalanx subluxing into the intermetatarsal space (Fig. 21-5). If too much is resected a thick, short, and weak toe will result (Fig. 21-6), sometimes followed by march fractures of one or more metatarsals (Fig. 21-7).

SPECIFIC PREOPERATIVE CRITERIA

The Keller procedure, consisting of resection of the base of the phalanx and the exostosis, should be restricted to cases in which the most simple intervention is desirable to reduce the risk of complications, espe-

Fig. 21-6. Left foot. Excessive resection of base of phalanx in an index minus foot.

cially in patients with circulatory problems, and to such emergency situations as septic arthritis and non-healing ulcers over the joint caused by chronically ulcerating bursitis or by various types of neuropathies, often accompanied by osteoarticular alterations. In an otherwise healthy foot, the expanded procedure addressing the specific situation created by removal of the base of the phalanx should be executed.

SPECIFIC BIOMECHANICAL CONSIDERATIONS

In a simple Keller procedure the most serious disadvantage that becomes biomechanically relevant is the loss of insertion of the short flexors to the base of the phalanx. These muscles provide for ground pressure of the first ray, enabling the long flexor to develop full power at push-off of the great toe.

If the short flexors are absent, the toe will buckle at the interphalangeal joint, leading to a mallet deformity (Fig. 21-8). The long extensor overpowering the flex-

ion forces will lead to hyperextension in the neoarthros and to recurrence of lateral deviation of the toe because the abductor hallucis tendon is also detached from the base of the phalanx. The aforementioned complementary procedures should therefore be added.

If the intermetatarsal angle is not reduced to less than 10° the bowstring mechanism, especially of the long extensor, will lead to recurrence. Bonney and Macnab[19] found in their series that a main cause of indifferent results is "the failure to maintain correction of the metatarsus primus varus."

POSTOPERATIVE CARE

Postoperative care begins on the day before the operation by instructing the patient about his rehabilitation program. At the end of the operation, a compression dressing with crepe-rubber is applied with an adhesive type of gauze bandage. While still in the operating room, the patient is asked to move his toes. Even after

Fig. 21-7. (A) March fractures after Keller's operation in a 54-year-old woman. Pain arising in the forefoot 4 months after surgery ceased after 8 weeks. Pain recurred in the forefoot 6 months later. Radiograph showed large callus at second metatarsal and new fracture of third. (B) Two years after fracture of third metatarsal, march fractures have healed and the calluses are smoothed out.

the effect of the local anaesthetic has faded, small movements of the toes are possible without causing too much pain. Pain is reduced by analgesics.

As soon after surgery as the patients are able, they are asked to dorsiflex and plantar-flex their ankle joints as if pressing on a pedal and to bend and stretch hip and knee joints in a bicycling type of movement to promote circulation in the foot and the leg as a prophylaxis to the sequelae of venous stasis and for improvement of metabolism at the site of operation. They will have to try active movement of dorsi- and plantar flexion in the metatarsophalangeal joint, eventually supported by their hands.

Swelling is also avoided by administration of certain drugs, such as Reparil, starting on the day before the operation. Dressings are changed on the second post-

operative day if soaked through on the day following the operation. The second dressing is fixed by an adhesive bandage that compresses the forefoot moderately. Patients are encouraged to get out of bed on the day following the operation and use a wheeled chair to reach the lavatory. On the fourth day they usually walk using special shoes with a soft upper part and a wooden rocker-bottom sole, using crutches.

Low-dose heparin anticoagulation is started 2 hours before the operation and is maintained until the patient leaves the hospital, usually on the tenth day after operation, or at least until he has gained full mobilization. After a week the crutches are usually no longer needed. The sutures are removed on the tenth day after operation. The adhesive bandage is worn for 6 weeks and is changed weekly because it stretches out.

Fig. 21-8. Buckling of the interphalangeal joint 12 years after Keller's operation.

After 6 weeks, in addition to exercises to promote mobility actively and passively using the hands, resisted movement in the direction of flexion is started. This rehabilitation program should be continued for at least 3 months. It would be desirable for the patient to continue an exercise program for the feet throughout life. Postoperative care is at least as important as a meticulously performed operation to make the best out of an otherwise regrettable condition.[13] If the deformity can be attributed to pronatory forces during the propulsion phase of gait, orthoses are prescribed to prevent recurrence of hallux valgus and to prevent or treat metatarsalgia.

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