

15

Reverdin Procedure and Its Modifications

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The Reverdin osteotomy was first described for use in the hallux abducto valgus deformity by J.L. Reverdin in 1881. It was originally described as a procedure in which, after removal of a medial eminence, a wedge-shaped portion of bone was resected proximal to the articular surface of the head of the first metatarsal. This procedure results in correction of the proximal articular set angle as well as reduction of the prominent bunion deformity.¹ Since Reverdin's original description, several modifications have been made to the original procedure. All the modifications are designed to effect structural correction of the hallux abducto valgus deformity occurring at the first metatarsal head level.

The Reverdin procedure is indicated for a mild to moderate hallux abducto valgus deformity in which the primary pathology is a lateral shift of the articular facet of the first metatarsal head. Physical examination will reveal a stable metatarsocuneiform joint that may shift into metarsus primus varus as the valgus deviation of the hallux occurs. The resulting first metatarsophalangeal joint reveals a hallux valgus deformity with an enlarged medial eminence, an adapted joint, and lateral deviation of the articular cartilage in response to the new angle of function of the hallux. A congruous to slightly deviated freely movable joint with pain-free range of motion should be present on examination² (Fig. 15-1). Additional indications include an increased hallux abductus angle with an increased proximal articular set angle (PASA). A valgus rotation or sagittal plane deformity of the first metatarsal head

may also be present. Additional radiographic criteria for performing the Reverdin procedure include adequate bone density and a normal metatarsus primus adductus angle, because no transposition of the capital fragment will occur. A normal to increased metatarsal protrusion distance should be present, as each of the osteotomy cuts will remove a 1-mm portion of bone. This shortening must be taken into account when determining the size of bone wedge to be resected.³

The Reverdin procedure is ideally performed on patients less than 60 to 70 years of age *depending on bone structure and quality*. The procedure may be performed on older patients if adequate bone stock is present and their activity level warrants doing the procedure. The age of the patient is also important because the first metatarsal sesamoid articulation of the younger patient adapts more quickly and completely to the new position of the head of the metatarsal and the sesamoid. This may reduce further degeneration of the metatarsal sesamoid articulation if present."⁴ Pre-operative templates should be made to ascertain the amount of correction desired. This allows for a more accurate evaluation of the results and decreases the chance of error.⁵ An alternate method is to create a distal osteotomy parallel to the articular surface of the first metatarsal head and a proximal cut perpendicular to the long axis of the first metatarsal shaft.⁶

A standard approach to the first metatarsophalangeal joint is utilized with a dorsolateral skin incision and a linear or inverted L-shaped capsulotomy to expose the joint. The first metatarsal head is freed from the



Fig. 15-1. Radiograph of bunion deformity with an increased proximal articular set angle and an adapted joint.

surrounding capsular and ligamentous structures and delivered medially through the wound site. The medial eminence is then resected. Release of the conjoined adductor tendon and a lateral capsulotomy are performed along with a tenotomy of the extensor digitorum brevis tendon if contracture is present. A fibular sesamoidectomy may also be performed at this time if significant deviation or degeneration is noted.

A sagittal saw is utilized to make two transverse cuts in the first metatarsal head to allow for removal of a predetermined wedge of bone, leaving the lateral cortex intact. The first osteotomy is created 1 cm proximal to the articular surface of the first metatarsal head. This osteotomy must be parallel to the articular surface to ensure adequate reduction of the PASA. The second osteotomy is performed proximal to the first osteotomy to allow for removal of a predetermined wedge of bone with the base medial and apex lateral. The

lateral cortex is left intact to provide a cortical hinge to stabilize the osteotomy.

The bone wedge is removed and the osteotomy closed, reducing the PASA. The joint is reevaluated to confirm that an adequate wedge has been removed. A significant reduction in the PASA will be noted, with increased joint congruity. This procedure does not require fixation because of the stability provided by the lateral cortex and the retrograde force of the hallux on weight-bearing (Fig. 15-2).

Ambulation is permitted on the first postoperative day in a postoperative shoe as tolerated with crutch assistance. The patient is instructed to avoid prolonged periods of dependency, which can lead to increased edema.

The dressings are changed at weekly intervals with suture removal at 10 to 14 days. The dressings serve to splint the toe in the corrected position to maintain reduction of the hallux abductus deformity. Postoperative radiographs are taken at 2 and 4 weeks to evaluate alignment and healing of the osteotomy site. Physical therapy, consisting of active and passive range-of-motion exercises, is utilized starting at 1 week postoperatively to increase the range of motion and to prevent fibrosis of the joint.

The postoperative shoe is worn for approximately 3 to 4 weeks, at which time the patient is allowed to wear shoes having a wide roomy forefoot. Once the swelling has decreased postoperatively, the patient is casted for orthoses to reduce any abnormal pronatory forces.

The greatest advantage to performing the Reverdin procedure is reduction of the PASA, allowing realignment of the joint. The osteotomy is stable because of its distal placement along with compression from weight-bearing forces. Rapid healing occurs because the osteotomy is placed in metaphyseal bone. Additionally, the procedure may be performed in the presence of uncontrollable pronatory forces and thus allows for increased joint range of motion from shortening of the metatarsal. The shortening results in a decrease in cubic content of the joint that provides increased range of motion. This procedure can also be performed on children before epiphyseal closure because the placement of the osteotomy is distal to the epiphysis.

The disadvantages and complications to performing the Reverdin procedure may include under- or over-

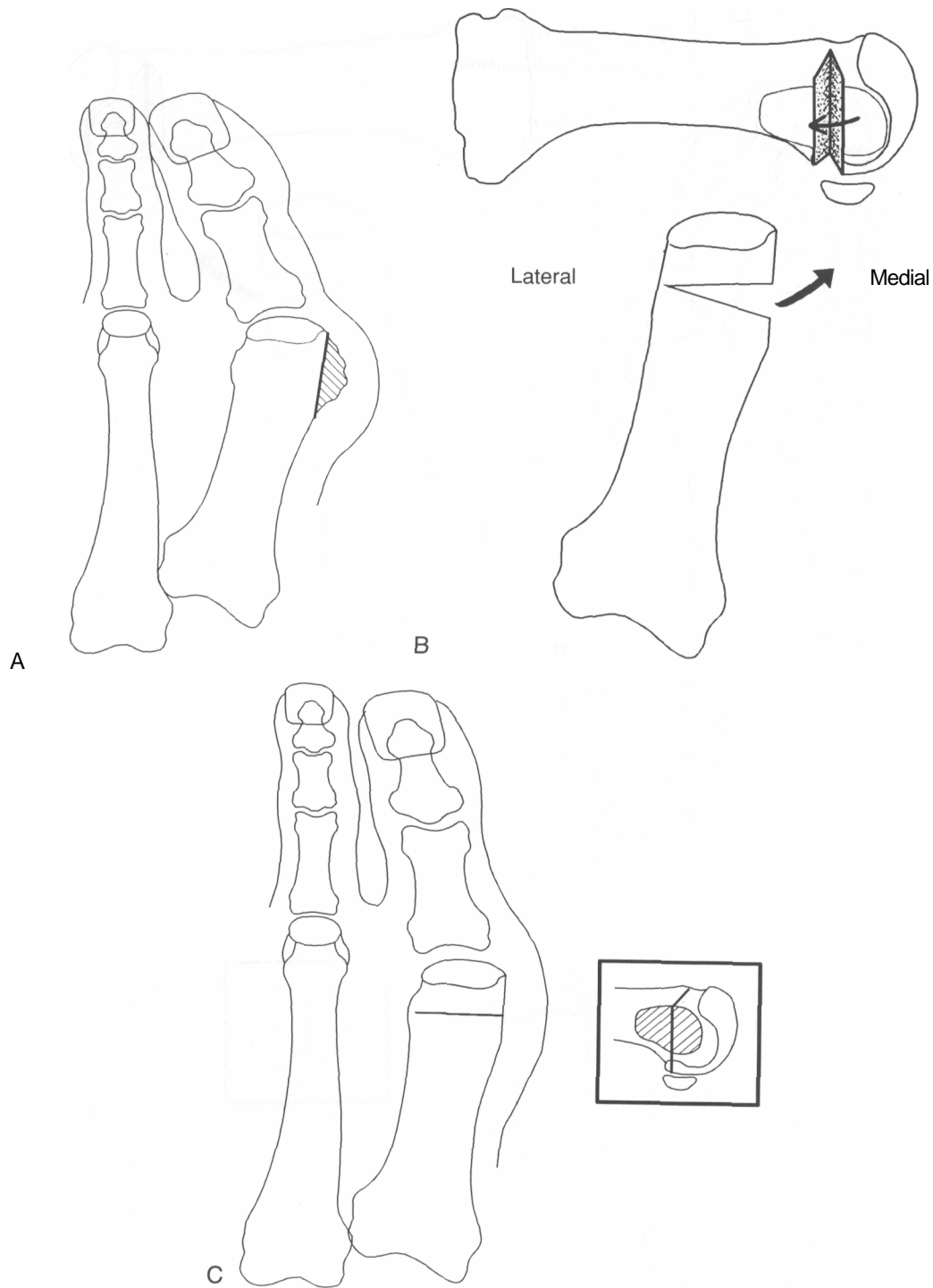


Fig. 15-2. Reverdin procedure. (A) Portion of the medial eminence to be resected. (B) Demonstration of bone wedge removal to allow for PASA correction. (C) Completed osteotomy with reduction of the hallux and realignment of the first metatarsophalangeal joint.

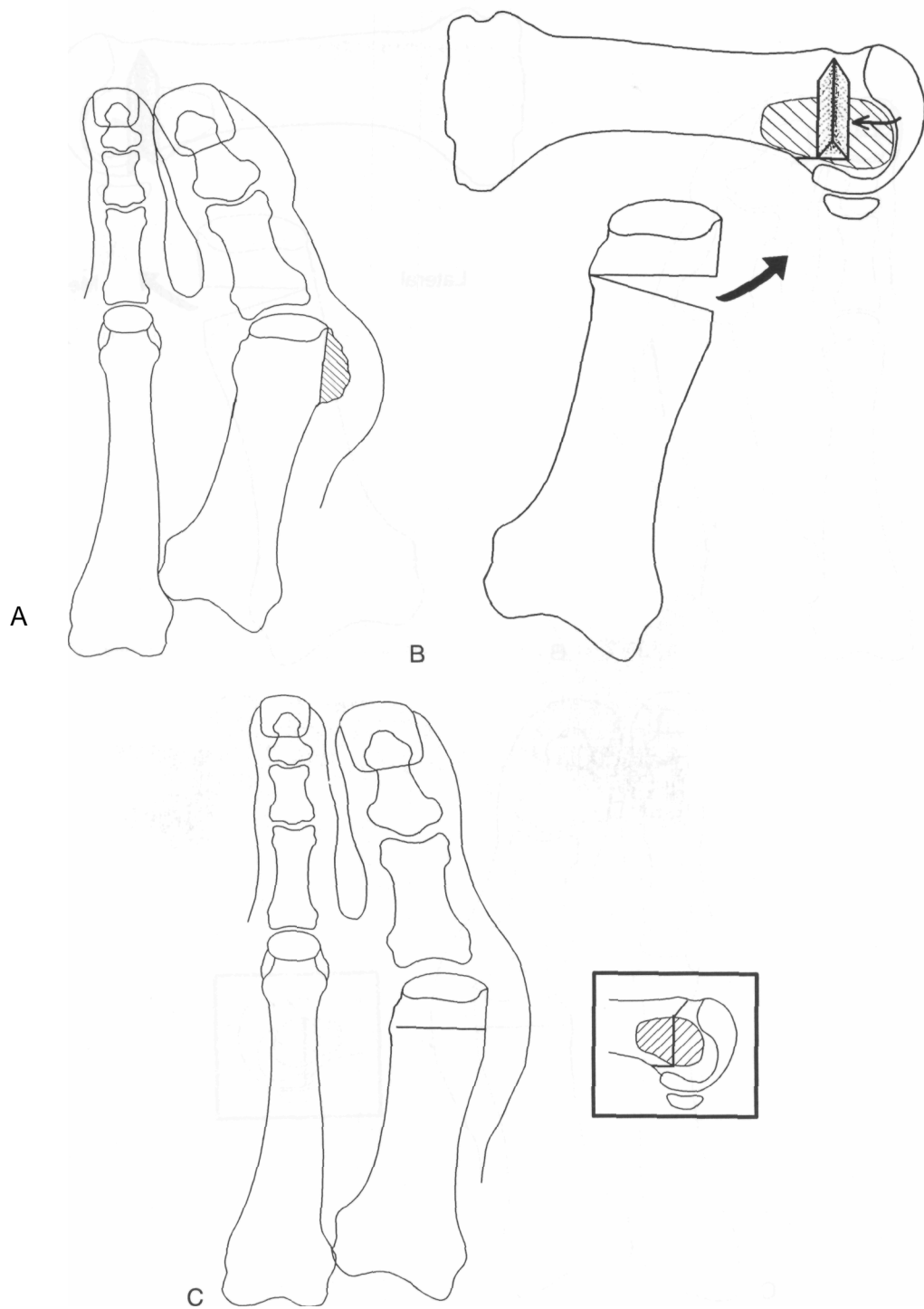


Fig. 15-3. Reverdin-Green procedure. (A) Portion of the medial eminence to be resected. (B) Wedge resection and plantar transverse Green osteotomy. (C) First metatarsal after reduction of the osteotomy.

correction caused by inadequate or overaggressive wedge resection, limitus from joint incongruity created by the correction, hallux varus deformity, and disruption of the metatarsal sesamoid articulation resulting in joint limitus and arthritis. As no transposition of the capital fragment occurs, reduction of the intermetatarsal angle or of sagittal plane deformities cannot be addressed. Dislocation of the osteotomy may occur if the lateral cortex is fractured or osteotomized. Nonunion and aseptic necrosis rarely occur, because the osteotomies are created in highly vascular metaphyseal bone while maintaining the lateral cortex and soft tissue structures.

The Reverdin-Green procedure was described by D.R. Green in 1977. The original Reverdin procedure is modified by performing an additional osteotomy designed to prevent disruption of the first metatarsal sesamoid articulation.⁴ This osteotomy is created parallel to the plantar weight-bearing surface of the first metatarsal, 1 cm proximal to the articular surface and superior to the plantar aspect of the first metatarsal head. The osteotomy is a through-and-through cut

made from medial to lateral, exiting proximally through the metatarsal neck. The subsequent cuts are made as described for the original Reverdin procedure, extending plantarly to the level of the initial osteotomy (Fig. 15-3).

The indications for the Reverdin-Green procedure are the same as those for the Reverdin procedure. The advantages are as listed for the Reverdin procedure with the additional advantage of preventing the disruption of the metatarsal sesamoid articulation. The disadvantages include the potential for adherence of the flexor plate to the plantar metatarsal neck in the region of the plantar osteotomy, which may result in a limitus deformity. Postoperative care is identical to that listed for the Reverdin procedure.

The Reverdin—Laird procedure, developed by P. Laird in 1977, is a modification of the Reverdin-Green procedure that involves transecting the lateral cortex with the dorsal cuts, allowing lateral transposition of the capital fragment. This procedure allows for reduction of an increased intermetatarsal angle in addition to reduction of the PASA.⁴

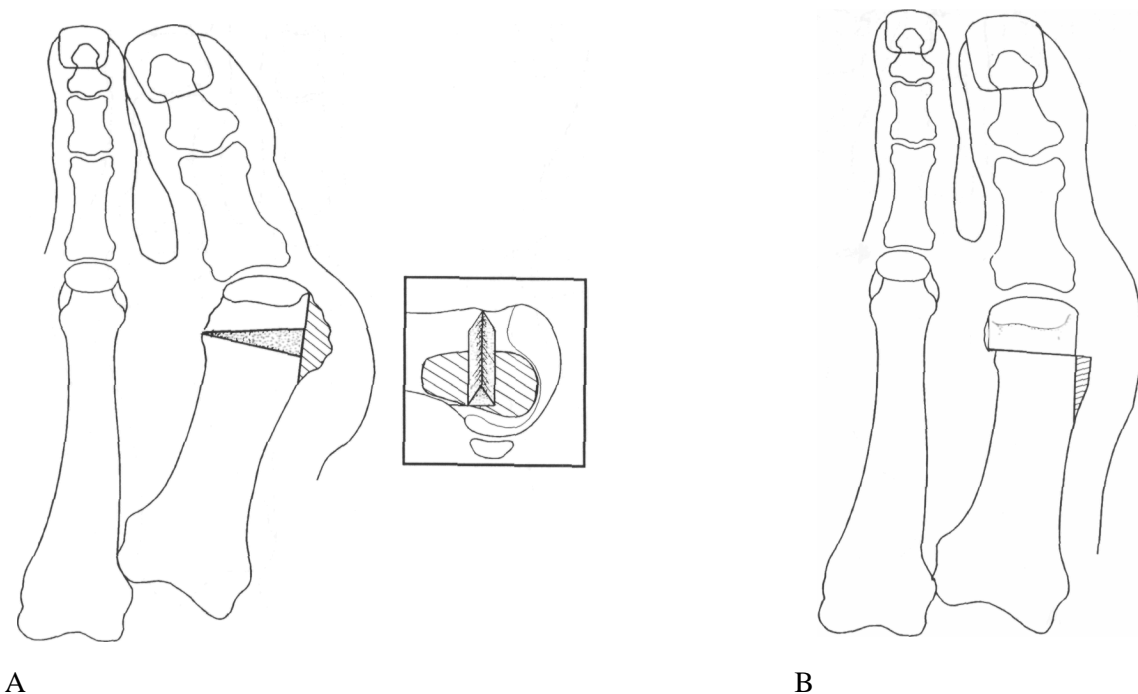


Fig. 15-4. Reverdin-Laird procedure. (A) Demonstration of eminence resection and wedge removal. The inset shows plantar Green osteotomy. (B) Transposed capital fragment before fixation. The remainder of the prominent metatarsal shaft is resected.

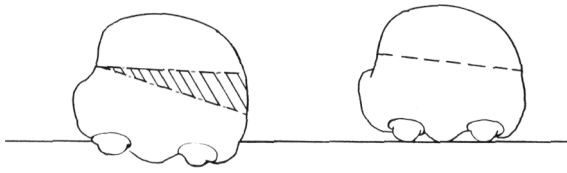


Fig. 15-5. Modification for correction of hallux valgus rotation. Wedge removal medially allows for reduction of valgus rotation. (Adapted from Laird et al.,⁷)

The indications for the Reverdin-Laird procedure include the previously listed indications for the Reverdin procedure. An additional indication is an increased intermetatarsal angle, which may be addressed through transposition of the capital fragment.

The Reverdin-Laird procedure involves exposure and soft tissue releases identical to those performed for the Reverdin procedure. The medial eminence is resected and the plantar osteotomy cut is created from medial to lateral. The dorsal osteotomy cuts are cre-

ated initially, leaving the lateral cortex intact. This prevents both excessive bone resection and the creation of a U-shaped apex to the osteotomy from excessive resection of the lateral cortex. The wedge of bone is removed, and the lateral cortex is osteotomized. The capital fragment is then transposed laterally to allow for the desired amount of correction of the intermetatarsal (IM) angle. The osteotomy site is approximated, and fixation is achieved based on the surgeon's preference (Fig. 15-4).

The advantages of the Reverdin-Laird procedure include a reduction of the IM angle in addition to preventing disruption of the plantar metatarsal sesamoid articulation. The disadvantages include decreased stability from transposition of the capital fragment and increased difficulty in performing the procedure. Fixation is also required for this procedure as disruption of the lateral cortex is necessary to allow transposition of the capital fragment. Postoperative care is identical to that described for the Reverdin procedure.

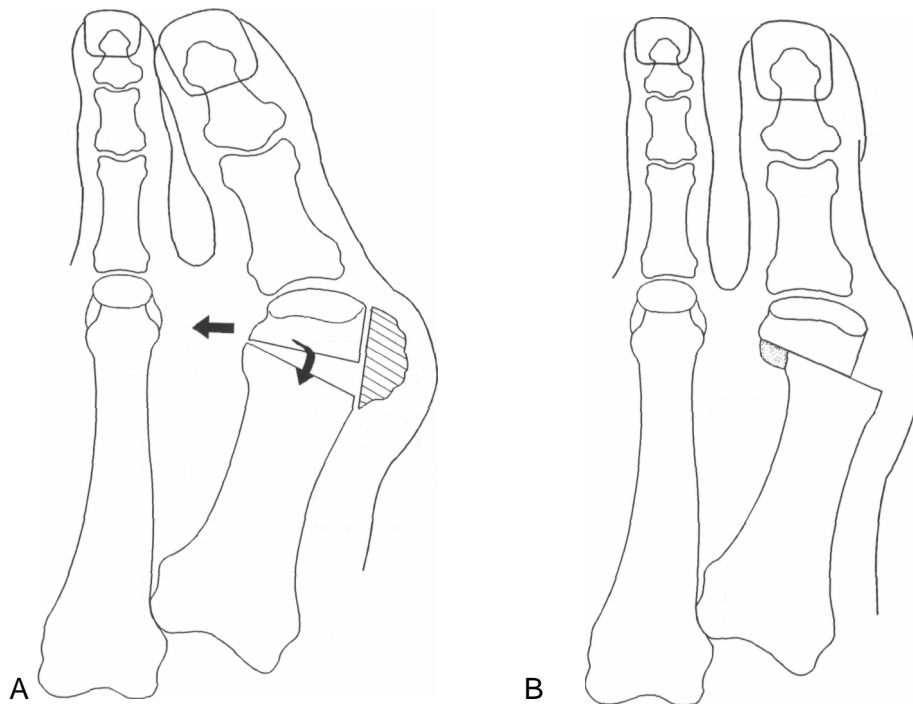


Fig. 15-6. (A & B) Modification to reduce shortening of the first metatarsal. The dorsal osteotomies created to remove the bone wedge are angulated to decrease shortening of the first metatarsal on lateral transposition of the capital fragment. (Adapted from Laird et al.,⁷)



Fig. 15-7. Preoperative radiograph demonstrating increased proximal articular set angle before Reverdin-Laird procedure.

In 1988, Laird introduced two modifications to the Reverdin-Laird procedure. The first involves correction of a valgus rotation of the first metatarsal head; the second procedure is designed to decrease shortening of the first metatarsal when performing the Reverdin-Laird procedure.⁷ Both modifications require the same postoperative management as for the previously mentioned procedures.

The modification for correcting hallux valgus rotation involves a modification of the plantar osteotomy cut. A second plantar osteotomy is created dorsal to the first osteotomy cut. The osteotomy is created from



Fig. 15-8. Postoperative radiograph demonstrating Reverdin-Laird procedure with Herbert screw fixation. The dorsal osteotomy was angulated to decrease shortening of the first metatarsal.

dorsomedial to plantar-lateral with the base medial and apex lateral. The wedge of bone is removed and the capital fragment is reapproximated onto the metatarsal shaft. Fixation is used to maintain correction (Fig. 15-5).

The modification to decrease shortening of the first metatarsal is indicated in instances in which a negative metatarsal protrusion distance is present. This procedure involves a modification of the dorsal osteotomy cuts. The dorsal cuts are created from proximal-medial to distal-lateral. This allows distal transposition of the capital fragment when it is shifted laterally (Figs. 15-6 to 15-8). This modification is not recommended

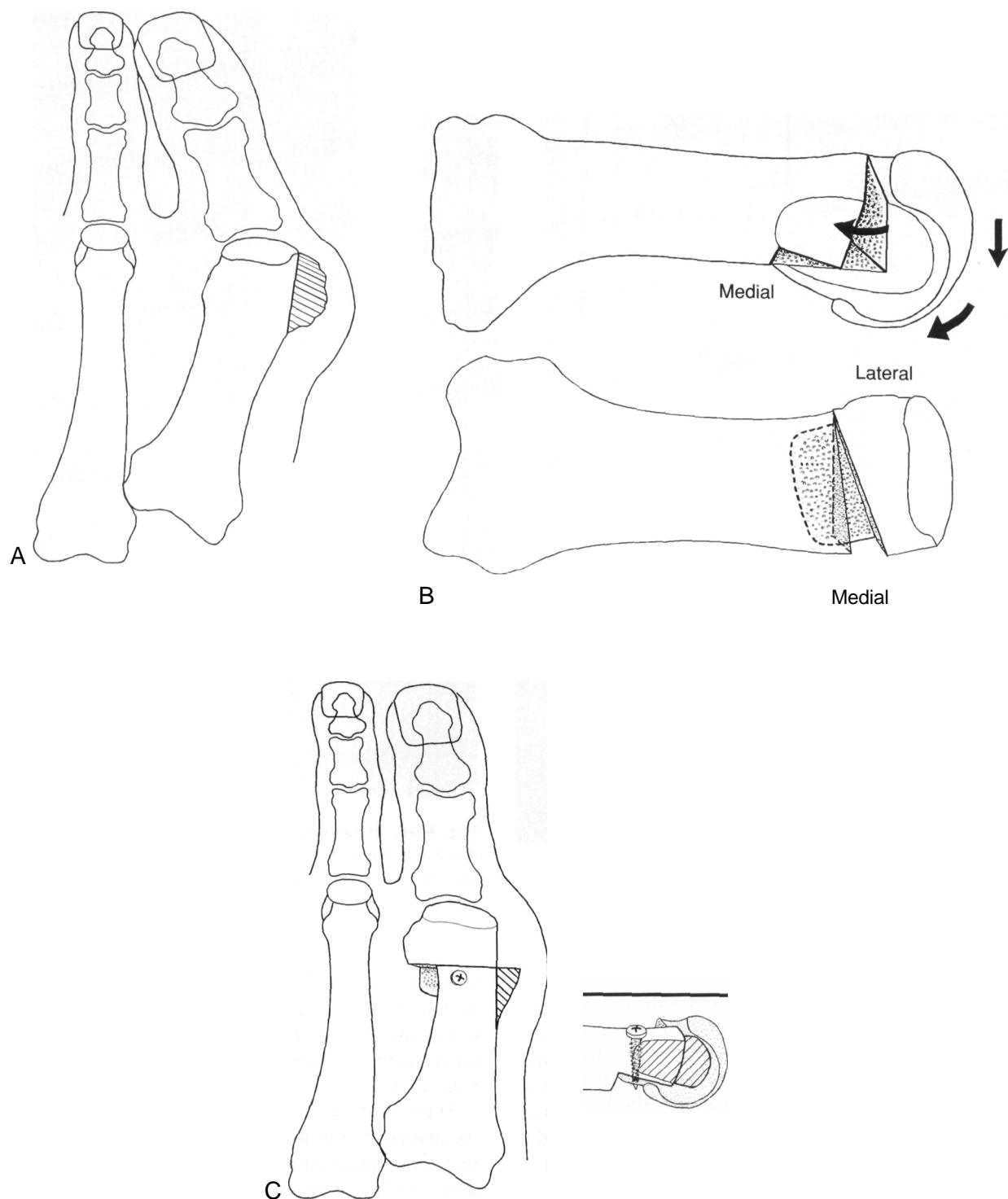


Fig. 15-9. Reverdin-Todd. (A) Portion of the medial eminence to be resected. (B) Bone wedge resections allowing for plantar displacement of the capital fragment and PASA correction. (C) Osteotomy after lateral transposition of the capital fragment and screw fixation.

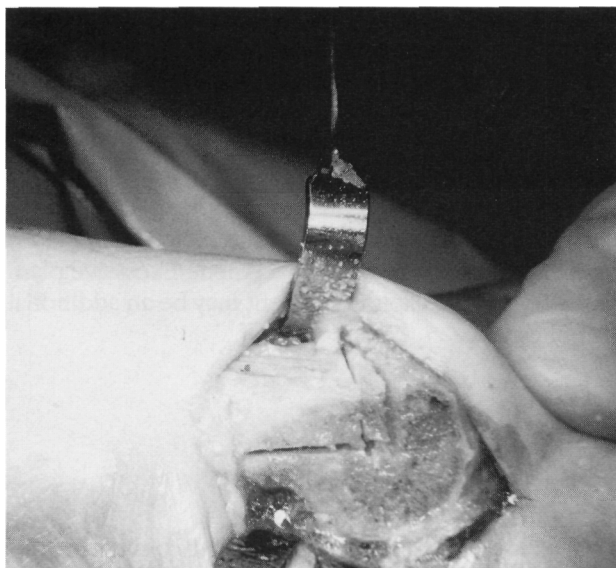


Fig. 15-10. Reverdin-Todd osteotomy. The procedure was modified with minimal angulation of the dorsal proximal cut because significant plantarflexion of the capital fragment was not necessary.

Fig. 15-11. Reverdin-Todd osteotomy before transposition of the capital fragment demonstrating dorsal and plantar wedge resections.

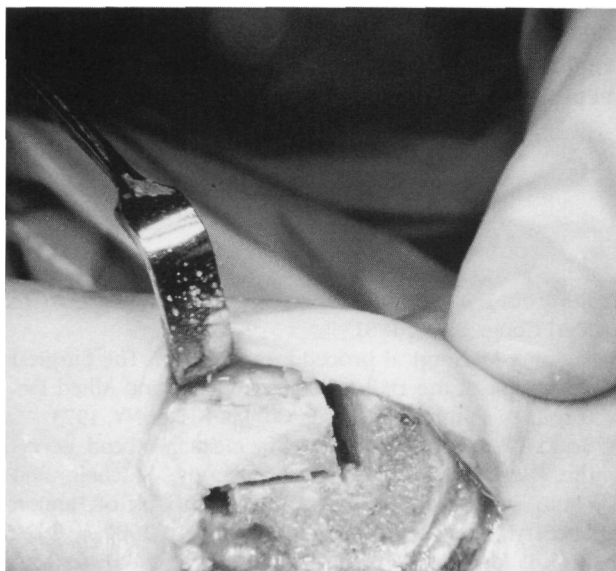


Fig. 15-12. Postoperative radiograph shows osteotomy after screw fixation.

for lengthening a metatarsal as the contracture of soft tissue structures would tend to limit lateral displacement of the capital fragment and may result in increased joint limitation. Advantages, disadvantages, and complications are the same as those listed for the Reverdin-Laird procedure.

The Reverdin-Todd procedure was developed by W.F. Todd at the California College of Podiatric Medicine in 1978. It is a modification of the Reverdin-Laird procedure that allows for correction of a sagittal plane deformity.⁴ The indications for the Reverdin-Todd

procedure include a dorsiflexed metatarsal, adequate bone stock to allow screw fixation, and an increased intermetatarsal angle. Adequate metatarsal width for transposition of the capital fragment is also necessary to allow for reduction of the IM angle and to permit screw fixation.

The Reverdin-Todd procedure involves lengthening the skin incision proximally to expose the distal one-third of the metatarsal shaft. The medial eminence is resected, and appropriate soft tissue releases and fibular sesamoidectomy are performed. The initial plantar osteotomy is made through the medial and lateral cortices, transecting the plantar one-third of the shaft of the metatarsal and extending proximally to the distal one-third of the metatarsal shaft. The dorsal osteotomy is made perpendicular to the plantar cut. The dorsal proximal cut is then made, angulated from dorsal-distal to plantar-proximal an appropriate amount to remove a predetermined wedge of bone to allow for plantar flexion of the capital fragment.

After removal of the bone wedge, the lateral cortex is transected. A second plantar osteotomy is created, dorsal to the first plantar cut, and angulated to the same degree as the amount of plantarflexion created by the proximal dorsal cut. The cut is made through both cortices with the base proximal and the apex located distally. The capital fragment is then transposed the predetermined amount and approximated to the shaft of the metatarsal. The position is maintained utilizing a bone clamp or K-wire, and screw fixation is achieved utilizing standard AO technique and one or two 2.0-mm screws. Additional eminence resection is then performed, and the wound site is closed in the appropriate fashion (Figs. 15-9 to 15-12).

An additional modification to decrease a valgus rotation of the capital fragment can be achieved by angulating the plantar osteotomies to allow resection of a wedge of bone with the base medially and apex laterally. The key steps to performing this procedure involve appropriate preoperative determination of the size of bone wedges to be resected and proper execution and angulation of the osteotomies to prevent errors in angulation or overcorrection. Postoperative care is the same as that described for the Reverdin procedure. Ambulation with crutch assistance is allowed as tolerated by the patient.

The advantages of the Reverdin-Todd procedure

are that it allows correction of a sagittal plane deformity, unlike the other modifications. It also allows internal screw fixation. The disadvantages and complications may include an increased difficulty of the procedure due to the angulation of the osteotomies, delayed healing from extension of the osteotomy into diaphyseal bone, weakening of the first metatarsal by a decrease in dorsal to plantar width, and an increased potential for fracture or displacement. Excessive plantar flexion of the capital fragment may be an additional complication.

SUMMARY

The Reverdin procedure and its most commonly performed modifications have been described. The variety of modifications reveal the versatility of the procedure as well as its many indications. The distal placement of the Reverdin osteotomy makes it a stable

procedure that heals rapidly. Additionally, it is technically easier to perform than other procedures indicated for these criteria, such as the bicorrectional Austin osteotomy. The Reverdin procedure and its modifications should be considered in the surgical treatment of hallux abducto valgus deformities with angulational or rotational components to the first metatarsal head.

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