Review Article

Ray Resections of the Fingers: Indications, Techniques, and Outcomes

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Abstract

Ray resection, which was pioneered by Bunnell in the 1920s, was initially performed as a salvage procedure for dysfunction of the proximal interphalangeal joint. Successful ray resection with or without an adjacent ray transfer can be useful for treating vascular insufficiency, tumors, infection, trauma, recurrent Dupuytren contracture, and congenital abnormalities of the hand. Indications, techniques, and outcomes vary based on the digit and the number of digits resected. Compared with amputation at the proximal phalangeal level, a single ray resection has better cosmesis and similar function, resulting in improved patient satisfaction. However, a 15% to 30% loss in grip and pinch strength has been reported. Today, ray resection results in good cosmetic and functional outcomes when preservation of a functional digit is unattainable or when the presence of an abnormal, unreconstructable digit interferes with the overall hand function.

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A nonfunctional digit that is limited by pain, stiffness, insufficient or excessive length, or lack of sensation may interfere with daily activities. These functional limitations are usually the result of trauma, malignancy, infection, congenital deformities, vascular insufficiency, or recurrent Dupuytren contractures (Figure 1). Ray resection of the finger is performed to reduce pain and improve function by removing the finger using metacarpal resection. Here, we provide an overview of the current issues concerning ray resection in an effort to guide the orthopaedic surgeon with regard to appropriate patient selection, surgical technique, and postoperative care for optimal outcomes.

General Considerations

The one absolute indication for ray resection is ischemic necrosis involving the metacarpal.[1] Severe dysfunction of the proximal interphalangeal joint and amputations at the level of the proximal phalanx are also classic indications for ray resection.[1-6] Some authors argue that maintenance of the metacarpal head and the transverse arch is important for grip stability and strength[7] and advocate that ray resection should be reserved for extreme cases. Amputations performed distal to the proximal interphalangeal joint function well without ray resection. However, a stiff obstructive finger, regardless of length, may result in decreased function and dexterity of the remainder of the hand and, in some cases, a painful, repeatedly traumatized useless digit.[1,8,9] The advantages of ray resection are gap elimination, removal of a cumbersome or painful digit, and better cosmesis in most cases.[2-6,10-22,23] The disadvantages of the procedure include decreased grip and pinch strength, decreased palm width, and an

Figure 1

Preoperative photograph of the hand demonstrating an infected index finger. The finger was later treated with resection.

Figure 2

A B

Photographs of the dorsal (**A**) and volar (**B**) aspects of the hand demonstrating the markings for a racquet- or V-shaped incision for resection of the little finger.

abnormal finger count.[5,7,17,23] Many authors have described the importance of hand width and grip strength to laborers and have recommended against ray resections in this population,[9,14,23] but others have reported good results even in these patients.[6] The primary contraindication is any psychological barrier to amputation because resection may lead to emotional distress.

The decision to perform a proximal phalangeal ray resection of the index or little finger is difficult for both the patient and the surgeon. In the trauma setting, many resections are performed as a secondary procedure after the patient's condition has stabilized. This allows the patient time to decide whether the function and cosmesis of the injured digit are acceptable, thereby obviating the need for further surgery; if resection is desired, the injured digit serves as a good source of tissue for hand reconstruction.[24] The major disadvantage to secondary resection is that the patient requires more time off work.[2,3,10-12]

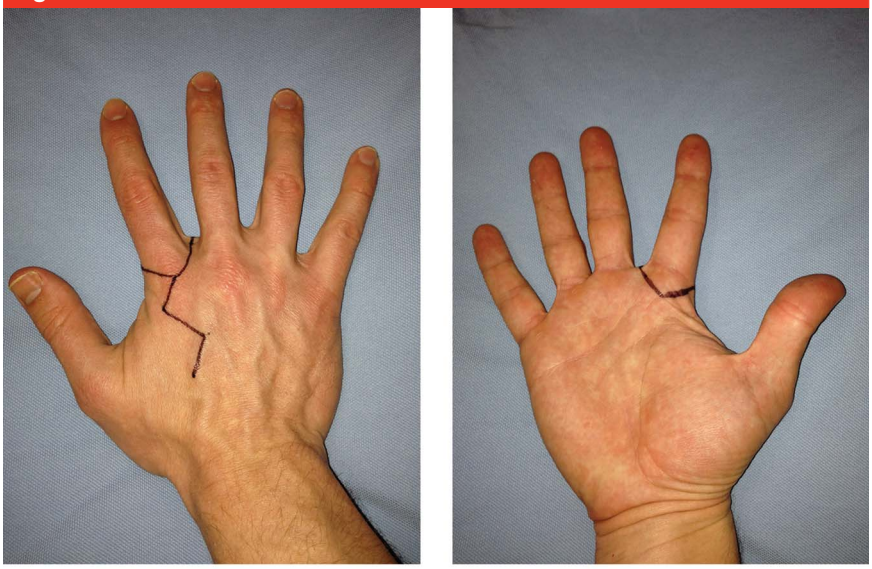
Resections are classified as thumb, border, or central, and each category is treated differently. Incisions for ray resections vary, but recreating the web space is paramount.[11,14] Also, avoiding placement of the incision on the ulnar border of the palm prevents a painful scar on a weight-bearing portion of the hand. Because the thumb allows for opposition and is crucial to overall hand function, indications for ray resection of this digit are typically limited, and surgical reconstruction is preferred. Surgical reconstruction of the thumb is beyond the scope of this article.

A racquet or V-shaped incision can be used for the border digits (Figures 2 and 3). A web space–preserving incision pioneered by Plasschaert and Hage[25] may be used for a central ray resection, with good results reported (Figure 4). Most authors agree with extending the proximal aspect of the incision using a Brunner zig-zag incision to prevent the development of contractures.[11,15,25] Resection of the central digits is unique in that it may result in difficulty with small objects falling through the persistent gap[3,6,8,11,14-16,18-26] (Figure 5). Thus, central digits are treated with resection and soft-tissue imbrication, bony transposition, carpal wedge resections, or total metacarpal resections to close palmar gaps (Figure 6). Border resections are performed without transposition. Following single ray resection of the fingers, grip and pinch strength can be expected to be 70% to 85% of the strength of the uninvolved hand.[1,2,4,7-11,14-16,18-22,24] Patients are generally satisfied with the outcomes of ray resection, given the improved dexterity and good functional and cosmetic outcomes.

Preoperative Evaluation

A detailed history and physical examination is performed, taking into account patient age, hand dominance, occupation, medical comorbidities, patient concerns about outcome and amputations, any functional limitations, prior surgeries, and any history of injury to or pathology of the hand. The focused physical examination includes inspection for any wounds or scars;

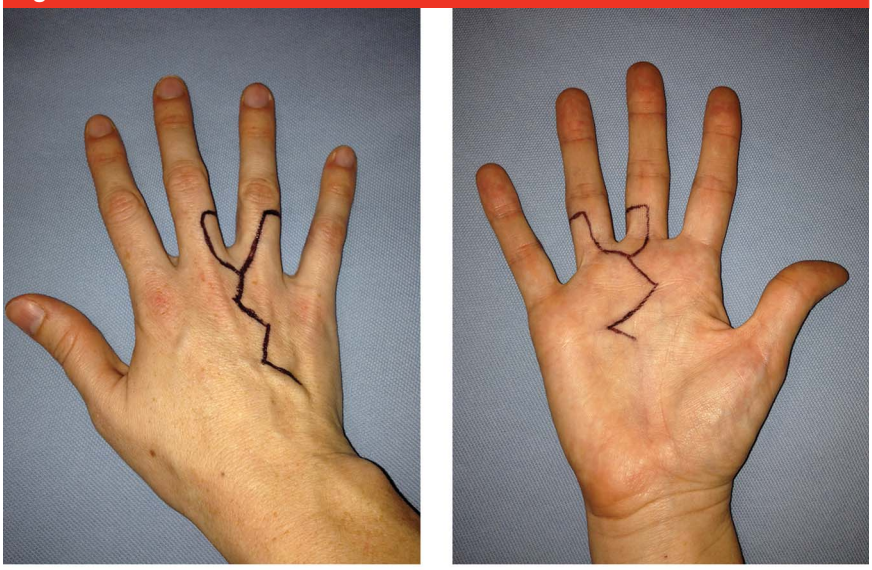
Figure 3



A B

Photographs of the dorsal (**A**) and volar (**B**) aspects of the hand demonstrating the markings for a racquet- or V-shaped incision for resection of the index finger.

Figure 4



A B

Photographs of the dorsal (**A**) and volar (**B**) aspects of the hand demonstrating the markings for an incision described by Plasschaert and Hage[25] for resection of the long finger.

palpation of any fluctuance or masses; and detailed sensory, range-of-motion (ROM), and motor examinations. A thorough vascular examination is conducted, as well, including assessment of pulses; an Allen test for radial, ulnar, and digital arteries; and a Doppler evaluation of digital vessels. Radiography of the affected hand is also indicated. Additional studies, such as MRI, ultrasonography, and arteriography, may be used to evaluate masses or vascular insufficiency.

Indications

Indications for border ray resection are trauma that involves the index and little fingers, malignancy confined to one of the border metacarpals, infection, congenital deformities, vascular insufficiency, and recurrent Dupuytren contracture involving the border digits.[1-7,10,12,13,23] Although the indications for central ray resection are similar to those for border ray resection, having a dysfunctional central finger is arguably more problematic for the patient because it is harder to "avoid" the obstructive central digit in day-to-day activities.[2,3,8-11,14-23,25-28]

Ray Resection of the Index and Little Fingers

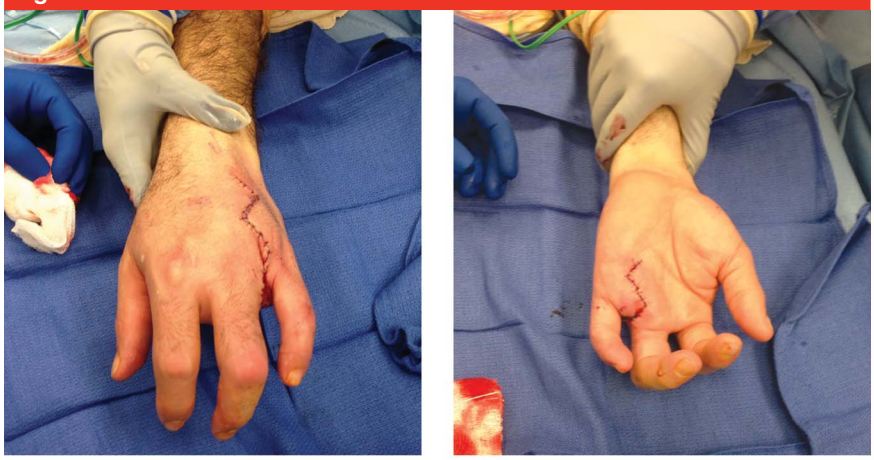
Surgical Techniques

For resection of the index finger, a skin incision should be used that allows for wound closure without tension or excess integument while preventing contractures.[1,7,23,29] The digital neurovascular bundles and branches of the superficial radial nerve are identified. The digital arteries and veins are ligated and cut, and the nerves are isolated and transected sharply. The extensor tendons of the index finger (ie, extensor digitorum communis, extensor indicis proprius) are isolated. The tendons are transected, and the cut ends are allowed to retract proximally after division of the junctura tendinea. The index finger metacarpal is then exposed in a subperiosteal fashion. In resections of the border fingers, the metacarpal is partially removed with an osteotomy; the bone is cut obliquely 2 cm

Figure 5

Preoperative photograph of the hand demonstrating a palmar gap resulting from amputation of the ring finger.

Figure 6



A B

Postoperative photograph of the dorsal (**A**) and volar (**B**) aspects of the hand demonstrating the gap closure after a central digit resection with soft-tissue imbrication.

from the base from proximal to distal and radial to ulnar[7,9] (Figure 7). The insertions of the flexor carpi radialis and extensor carpi radialis longus must be protected during the osteotomy.[1,7,26] Although an osteotomy of the base of the metacarpal is preferred to preserve ligamentous and tendinous insertions at the base,[2] in the rare case of malignancy or when a soft-tissue defect is present, removal of the entire metacarpal may be beneficial.

When disarticulation is used, the insertions of the wrist extensors or flexors are subperiosteally dissected, transferred, tenodesed, or allowed to scar in place; the remaining attachments prevent retraction.[8,15,19] Additionally, protection of the radial artery as it wraps around the base of the second metacarpal is important.[12] Volarly, the flexor tendons of the index finger (ie, the flexor digitorum profundus and flexor digitorum superficialis) are transected proximal to the lumbrical muscles to allow for retraction without causing intrinsic tightness. Transection proximally also allows the tendons to retract proximal to the carpal tunnel to decrease carpal tunnel congestion and scarring.[23]

Historically, the insertion of the first dorsal interosseous muscle was transferred to the proximal phalanx of the long finger to prevent scissoring and ulnar translation of the remaining lesser digits.[1,7] This transfer has fallen out of favor, given the lack of benefits and because the muscle was often transferred to the extensor hood, causing intrinsic overpull.[28] The extensor indicis proprius and flexor digitorum superficialis of the index finger have also been transferred to the long finger in an attempt to improve the independent function of the long finger, but results have been discouraging given the lack of functional benefit and increased number of rotational deformities reported.[7,8,23,24] Tendon transfers done in conjunction with ray resection are of historical interest only and should not be performed.

Preservation of the radial digital neurovascular bundle to the long finger is important to prevent decreased perfusion and sensation, which could interfere with key pinch maneuvers.[29] To prevent neuroma and hyperesthesia, surgeons have used suture ligature, proximal transection, intraneural alcohol, buried nerve ends, silicone caps, avoidance of excessive mobilization, and end-to end repair of nerves [2,7,11,23,30] (Figure 8). However, no technique has been shown to reduce neuroma formation. Transected radial and ulnar digital nerves can be repaired by suturing the nerves together end to end. Gorkisch et al[30] performed this technique using an interposed autograft from one of the injured digital nerves to prevent the partially regenerated axon ends from resting beneath the anastomosis.

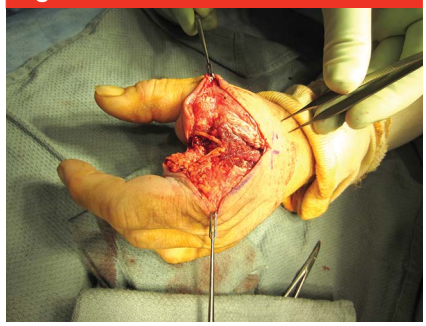
Compared with resection of the index finger, some technical differences exist when the procedure in the little finger is performed. The metacarpal of the little finger is cut from proximal to distal and ulnar to radial to prevent an ulnar spike, and the flexor and extensor tendons and the ulnar artery and nerve are protected[9,13] (Figure 9). The osteotomies are performed in this fashion to prevent bony prominence over the radial or ulnar border of the palm in index and small finger resections, respectively. Historically, the abductor digiti quinti insertion has been transferred to the proximal

Figure 7

A B

A, Intraoperative photograph of the hand demonstrating index finger resection with removal of the metacarpal in a retrograde fashion after subperiosteal exposure of the metacarpal. **B,** Photograph of a Sawbones model (Pacific Research Laboratories) of the hand demonstrating resection of the index finger.

Figure 8



Intraoperative photograph of the hand demonstrating the digital nerves buried in the interossei.

Figure 9

Photograph of a Sawbones model (Pacific Research Laboratories) of the hand demonstrating resection of the little finger.

phalanx of the ring finger to allow abduction of the ring finger and prevent scissoring of the fingers in flexion.[6,29] Tendon transfers of the interossei, flexor digitorum profundus, flexor digitorum superficialis, and hypothenar muscles have no clinical benefit and may lead to further dysfunction of the hand; therefore, these transfers are of historical interest only and should not be performed in routine ray resections.[1,6-8,23,26,28]

Postoperative Care and Rehabilitation

The patient's finger is immobilized in a bulky soft dressing or protective splint, with the hand placed in the intrinsic-plus position. A drain may be placed at the discretion of the surgeon. The splint is removed 2 to 7 days postoperatively, and a wound check is performed. Active ROM is encouraged to decrease postoperative stiffness. In border ray resection, the patient may be allowed to progress to unrestricted motion after the wound has healed.[1,5,7,13,23]

Outcomes

Karle et al[4] compared the outcomes of ray resection (58 patients) and proximal phalanx amputation (12 patients) of the index finger. The authors found that patients treated with ray resection were more satisfied with the cosmetic result and had less pain than did the patients treated with proximal phalanx amputation. However, patients in the resection group also had lower Disabilities of Arm, Shoulder, and Hand scores (Part B), decreased ROM, decreased sensation, and slightly weaker grip and pinch strength.

In a study of 14 ray resections of border digits (8 index, 6 little), Melikyan et al[10] reported a 19% ($P > 0.05$) decrease in grip strength in the index finger group and a 16% ($P > 0.05$) decrease in grip strength in the little finger group compared with the grip strength of the contralateral hand. Three-point pinch was also decreased by 15% in the index finger group and by 24% in the little finger group. Palm width is also a concern because decreased palm width may lead to difficulty with grasp. Melikyan et al[10] reported that little finger resections were associated with a 6% decrease in palm width, whereas index finger resections had a 3% decrease.

Several studies have reported a decrease of 15% to 30% in three-point pinch and grip strength compared with the unaffected hand.[2,4,7,10] In a study of hand strength and complications following resection of the index finger in 41 patients, Murray et al[7] reported a 50% loss of pronation strength and a 20% decrease in supination strength with index finger resections. With regard to the function of the affected hand compared with that of the contralateral hand, patients who underwent border ray resection performed well on the Purdue Pegboard and Minnesota Rate of Manipulation tests. Functional outcomes following resection of the index finger are favorable because of the transfer of tasks to the long finger.[1,2,7,10] Most patients are able to return to the same occupation and leisure activities at an average of 10 weeks

postoperatively.[10] Although some studies have demonstrated good pain relief following the procedure,[4] Murray et al[7] found that 59% of patients had hyperesthesia and cold intolerance and 37% had limited function. Before the resection, 34 patients had pain, and only 3 were pain free postoperatively. Most of the hypersensitivity was in the first web space and involved the superficial radial nerve, despite the cut ends being buried in the interossei. Some authors have advocated the use of end-to-end nerve repair after amputation to reduce neuroma formation in this highly sensitive area.[1,11,30] Gorkisch et al[30] resected 20 index fingers and performed end-to-end repair of the sensory nerves, resulting in one neuroma caused by repair failure. Even with weakness in grip and pinch strength and the high incidence of hypersensitivity and cold intolerance, patients are typically satisfied with the outcomes after ray resection.[1,2,4-7,10,23]

Ray Resections of the Long and Ring Fingers

Surgical Techniques

Ray resection of the long or ring finger may be performed with or without bony transposition of the adjacent index or little finger metacarpals. The bony transposition can be performed via metacarpal osteotomy, carpometacarpal disarticulation, or intercarpal osteotomy.[10,11,14-16,18] Although resection with deep transverse intercarpal ligament repair is an option, advocates argue that transposition allows better control of rotation, angulation, gap closure, and digit length.[8,9,11,14,16,18,21,26,27] The disadvantages of transposition include the risk of implant infection and prominence, malunion, nonunion, wide web space, stump protrusion, and extensor tendon adherence.[8,11] Proponents of soft-tissue imbrication report good functional results and web space closure without the risks of nonunion, device irritation, or tendon adhesions.[8,14,15,19] Closure of the web space with soft-tissue imbrication is less technically demanding than transposition, with satisfactory results reported.[15,18,19]

The incision pioneered by Plasschaert and Hage[25] is preferred for accurate reconstruction of the web space (Figure 4). As in resection of the border digits, the extensor tendons are transected proximally and allowed to retract to prevent carpal tunnel congestion.[16,23] The digital vessels are ligated and the digital nerves are repaired end-to-end or buried in the interossei to prevent neuroma formation.[11,14,30] The subperiosteally exposed metacarpal may be partially removed via osteotomy or may be disarticulated from the carpus (ie, ring finger). Although satisfactory results can be achieved with both techniques, disarticulation of the ring finger may allow for translation of the little finger at the level of the carpometacarpal joints to close the large web space; however, this may increase the risk of angulation and malrotation.[26]

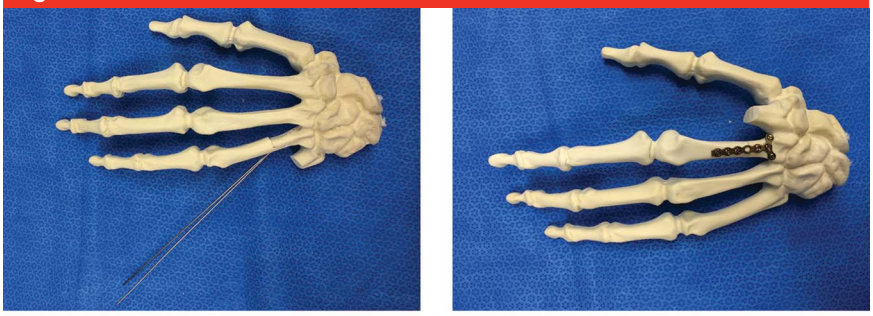
Controversy also exists with regard to what should be done with the interossei attached to the resected central digit. Some authors advocate the removal of the interossei to facilitate closure of the web space;[9,18] others suggest repairing the periosteum of the resected metacarpal, leaving the interossei in place.[15,19] When disarticulation or osteotomy of the central digits is performed, the deep motor branch of the ulnar nerve must be protected, along with the deep palmar arch.[13] The surgeon may elect to achieve web space closure with repair of the deep transverse intermetacarpal ligament and dorsal dermodesis[15] or transposition.[11,14]

When a metacarpal osteotomy is performed, the metacarpal is cut transversely 2 cm from the articulation with the carpus; this allows both adequate fixation of the osteotomy site and preservation of the extensor carpi radialis brevis insertion on the long finger and takes advantage of the superior union rates of the metaphysis.[9,14,27] The appropriate border ray is then cut, as described. A second transverse cut is made after measuring to allow for alterations in length.[11,18] The donor metacarpal is then transferred to the neighboring residual metacarpal base en bloc, allowing preservation of the native digital neurovascular bundles, tendons, and intercarpal ligaments.[11,14] A T-plate is commonly used for osteosynthesis, but Kirschner wire stabilization also has been performed successfully with a step-cut osteotomy[11,17,18] (Figure 10). Bone graft from the metacarpal base of the border digit or a bone plug may be packed into the osteotomy site to enhance union rates with minimal morbidity.[11,17]

Repair of the deep transverse intermetacarpal ligament is performed after bony stabilization. During resection of the long finger, the adductor pollicis origin may be transferred to the transposed index finger to preserve adduction of the thumb.[11,14,18] This is commonly performed by subperiosteal elevation of the origin of the adductor off the long finger and placement of a braided suture to tag the origin. The adductor is then transferred to the transposed index finger with soft-tissue imbrication,[14] through drill holes,[11] or with a suture anchor or anchors. No consensus exists on whether the transfer of the adductor pollicis is necessary.[8] Carroll[8] suggested that subperiosteal elevation without repair allows scarring of the adductor into a functional position.

Finally, transposition may be performed by intercarpal osteotomy, as originally described by Le Viet.[20] After the resected metacarpal is removed by disarticulation, the

Figure 10



A B

Photographs of Sawbones models (Pacific Research Laboratories) of little finger transposition (**A**) after ring finger resection using a step-cut osteotomy with Kirschner wire osteosynthesis, and index finger transposition (**B**) for resection of the long finger using a T-plate for osteosynthesis.

Figure 11

Photograph of a Sawbones model (Pacific Research Laboratories) of the hand demonstrating intercarpal osteotomy after ring finger resection.

incision is extended proximally to expose the carpal bones. It is crucial that the wedge resection be planned using the angle of divergence between the resected metacarpal and the transposed metacarpal, which is typically 7° to 10°. Once the osteotomy is marked on the respective carpal bone and checked, it is performed with an osteotome or oscillating saw. The dorsal cortex is removed, and the remainder of the carpal wedge is subperiosteally dissected volarly and removed, with care taken to prevent damage to the neurovascular structures volar to the carpus. When a wedge osteotomy for long finger resections is performed, the wedge is taken out of the capitate only. For a ring finger resection, wedge osteotomy and arthrodesis of both the capitate and hamate is performed. Once the wedge of bone is removed, closure of the resulting gap brings the metacarpals closer together. Removal or supplementation of the dorsal or volar portion of the osteotomy site can help correct rotation and angulation. Once the resection is satisfactory, osteosynthesis can be performed successfully by using internal fixation with screws or by placing a suture in the periosteum, along with repair of the deep transverse intermetacarpal ligament[16,20] (Figure 11). After the deep layers are closed, excess skin is removed and the wound is closed; the rotation in both flexion and extension with the wrist is checked with the tenodesis test.[15,19]

Postoperative Care and Rehabilitation

Drains are inserted at the discretion of the surgeon. The patient's hand is placed in a soft dressing or immobilized in the intrinsic-plus position. A wound check is performed 2 to 7 days postoperatively. Early active ROM is encouraged to prevent extensor tendon adhesions and stiffness. If an extensor lag is noted on the postoperative examination, a dynamic splint may be used for 2 weeks.[11,14] When internal fixation of the intercarpal osteotomy is performed with suture, the newly transposed digit may be buddy taped to the more radial digit to ensure maintenance of the web space. If bony transposition is performed, unrestricted motion is allowed when the pain is minimal at the osteotomy site or radiographic union is noted.[2,11] If soft-tissue transposition is performed, unrestricted motion is allowed at 8 to 12 weeks postoperatively.[15]

Outcomes

Opinions vary on whether to transpose the neighboring digit after a central ray resection, and no consensus has been reached.[10,11,14-16,18-22] Soft-tissue imbrication of the deep transverse intermetacarpal ligament is an easier option and does not have the inherent risks of nonunion or bony malalignment associated with osteotomy.[7,11] However, scissoring of the adjacent digits and discrepancies in digit length and rotation are more prevalent with soft-tissue repair.[7,11,16] Metacarpal osteotomies may allow rotation and length correction, but they have an inherent risk of malunion and nonunion and must be rigidly fixed.[11,17] There is also no consensus as to whether the entire ring finger metacarpal should be resected to eliminate a painful stump or if a stump should be retained to preserve tendinous insertions.[4,8,16,19,22] Intercarpal osteotomies do not allow for length adjustments; however, rotational and angular corrections may be made.[16,20,21] Levy[22] described the long-term results of ray resection and soft-tissue imbrication without transposition performed in a patient with traumatic avulsion of the ring finger. The patient was a surgeon who was also an avid tennis player. Although the patient was

satisfied with the result, he reported that coins slipped through the gap in his hand.

As with ray resection of border fingers, strength of the central fingers after ray resection has been heavily studied. A decrease in grip, key pinch, and three-point pinch strength of at least 20% to 30% (even as much as 50% in some cases) can be expected after central ray resection, with or without transposition.[2,3,8-11,14]

ROM following ray resection has also been examined because of concerns about extensor tendon adhesions. In a study of 19 patients who underwent ray transposition for loss of a central digit, Colen et al[14] reported that the transposed fingers had average ROMs of 77.6° for the metacarpophalangeal joint, 87.6° for the proximal interphalangeal joint, and 80.8° for the distal interphalangeal joint. In a study of 10 patients treated with metacarpal transposition plate osteosynthesis after resection of the long finger, Hanel and Lederman[11] reported that no patient had decreased ROM, and one patient had increased ROM in the transposed finger. Steichen and Idler[15] reported similar results following ray resection; ROM was good even without transposition.

Because of its association with grasp, palm width following ray resection of the long finger has also been studied. Nuzumlali et al[3] and Peacock[9] showed decreased palmar volume and width and decreased hand circumference associated with ray resection. Melikyan et al[10] found that total palm width after resection of a central finger was decreased by 7%.

Barring injury to the remaining nerves during resection, postoperative sensation has been uniformly acceptable,[2,11] but pain tends to be a problem after resection, with approximately 50% of patients reporting some pain and up to 10% claiming severe pain in one series.[15] Pain can be caused by neuroma formation, implant irritation, nonunion, or a prominent metacarpal stump.[8,11] Cold intolerance is also a problem. Steichen and Idler[15] reported that 4 of 13 patients who underwent central ray resection without bony transposition reported cold intolerance.

Patients treated with resection without transposition tend to return to work at approximately 10 weeks postoperatively, with most patients returning to the same job.[2,11,15] Radiographic evidence of transposition healing appears at 4 to 12 weeks postoperatively, and patients may return to work at 3 to 15 weeks—sooner for those with a less demanding occupation, later in the setting of secondary amputation and workers' compensation involvement.[2,11] Peimer et al[2] retrospectively reviewed 25 patients treated with primary (<2 weeks) and secondary single ray resections; 14 had resections involving the dominant hand. The authors performed resections and metacarpal transposition in 18 border and 7 central digits. Time to return to work was 9 weeks for the primary resection group and 16 weeks for the secondary group. Although 21 of 25 patients returned to work, those involved in workers' compensation/litigation performed poorly in functional testing.[2] Overall, most studies report good functional results using a variety of measures.[10,15] However, Peimer et al[2] demonstrated a 12% and 24% decrease in gross hand function and fine finger dexterity, respectively, using the Minnesota Rate of Manipulation test and timed grooved pegboard test.

Cosmesis tends to be considered favorable after the procedure, and most patients are pleased with the results.[3,15,19] Nuzumlali et al[3] compared the outcomes of patients treated with ray resection or proximal phalanx amputation for an avulsion injury of the ring finger. The authors found that patients who underwent resection were satisfied with the cosmetic and functional outcomes, whereas the patients treated with proximal phalanx amputation without ray resection considered the cosmetic outcome unacceptable and noted that small objects fell through the injured hand. No patients in the amputation group desired a ray resection because they were happy with a normal finger count, and only one wore a cosmetic prosthesis. The authors concluded that choosing between amputation and ray resection should be left to the patient, but ray resection should be avoided in patients who require strong key and chuck pinch function.[3]

Hanel and Lederman[11] concluded that successful reconstruction of long finger resection must address the following: web-space closure, malrotation, hand symmetry, rigid osteosynthesis, and end-to-end repair of the digital nerves. In general, patients who underwent central ray resections were able to preserve hand function and return to work; they were also satisfied with the surgical outcome regardless whether a transposition was performed.[2-4,10,11,14-16,18-22]

Summary

Ray resection of the index or little finger is usually performed by metacarpal resection, leaving the metacarpal base intact. Tendon transfers have failed to show functional benefits and lead to further complications. Resection of the long or ring finger involves partial or complete ray resection with soft-tissue imbrication or transposition of the border digit via metacarpal osteotomy or intercarpal osteotomy. Advocates of transposition report better correction of digit length, rotation, and closure

of gaps, whereas others report satisfactory results and a decreased risk of complications with soft-tissue imbrication. Burying the sensory nerves in the interossei or end-to-end repair may help decrease the high rate of hyperesthesia and neuroma, but this has not been clinically proven. Dexterity, function, patient satisfaction, and cosmetic results of ray resection are generally as good as or better than those of amputations at the proximal phalanx. However, a 15% to 30% loss of pinch and grip strength associated with resection should be expected. Thus, ray resection should be used with caution in patients who require strong grasp and pinch strength.

References

Evidence-based Medicine: Levels of evidence are described in the table of contents. In this article, references 2-4, 7, 10, 11, and 14 are level III studies. References 1, 5, 6, 8, 9, 12, 13, 15-21, 24-28, and 30 are level IV studies. References 22 and 23 are level V expert opinion.

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