SURGICAL TECHNIQUE

Neurovascular Advancement Flap to Release Flexion Contracture of the Proximal Interphalangeal Joint

James Tseng, MD,* Yu-Te Lin, MD*

Various methods have been described to surgically release posttraumatic flexion contracture of the proximal interphalangeal joint. Extension of the distal digit often creates a soft tissue defect on the volar aspect of the finger. Although various flaps and skin grafting have been utilized for coverage of this defect, they can be associated with morbidity. We present our experience with a volar neurovascular advancement flap to achieve soft tissue release in proximal interphalangeal joint flexion contracture. This advancement flap is designed to include both digital neurovascular bundles and eliminates the need for a secondary procedure as it allows primary closure of the subsequent defect. It is indicated for contracture lengthening of 10 to 14 mm. Surgical considerations of flap design are discussed. *(J Hand Surg Am. 2017;■(■):1.e1-e5. Copyright © 2017 by the American Society for Surgery of the Hand. All rights reserved.)*

Key words Flap, flexion contracture, neurovascular, PIP joint.

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Flexion contracture of the finger proximal interphalangeal (PIP) joint can affect hand function and thereby limit activities of daily living. Common reasons for flexion contracture of the PIP joints include (1) shortage or fibrosis of soft tissues, skin, subcutaneous tissue, flexor tendon sheath, collateral ligaments, and volar plate of the PIP joint, (2) adhesion of the flexor tendons, (3) contracture of flexor muscles, (4) osteoarthrosis of the PIP joint, or (5) any combination of these sequelae. When the articular joint is spared, correction of flexion contracture can be accomplished by releasing the affected soft tissues and tendons. We describe a neurovascular advancement flap derived from existing techniques for fingertip reconstruction and applied to flexion contracture release of the PIP joints.

*From the *Department of Plastic and Reconstructive Surgery, Chang Gung Memorial Hospital, Chang Gung Medical College, and Chang Gung University, Taipei, Taiwan.*

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Corresponding author: Yu-Te Lin, MD, Department of Plastic and Reconstructive Surgery, Chang Gung Memorial Hospital, 222 Mai-Chin Road, Keelung City 204, Taiwan; e-mail: linutcgmh@gmail.com.

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INDICATIONS

Options for contracture release can vary depending on etiology. For contracted tendons, tenolysis and lengthening of the tendons are options or even sacrifice of the flexor digitorum sublimis can be considered. If the joint capsule is affected, capsulotomy with sequential release of the volar plate and accessory collateral ligaments release may be indicated. Compared with a palmar approach, a midlateral incision offers greater improvement in range of motion (ROM), attributed to its less traumatic nature and postoperative pain allowing for earlier and more intensive rehabilitation.[1] A severe contracture or tissue loss can result in an open defect once the finger is fully extended. Local or distant flaps are usually required when the defect is not suitable for resurfacing with skin grafting. In order to avoid additional patient morbidity,

this neurovascular advancement flap allows for flexion contracture release with primary closure of the wound.

CONTRAINDICATIONS

Patients who require extension distance of 15 mm or more may not be appropriate candidates for this technique. Our experience shows that the flap can be advanced for approximately 10 to 14 mm without causing arterial insufficiency or nerve damage to the digit. Although we have achieved advancements of 15 and 20 mm in 2 patients with camptodactyly, these cases are atypical. In addition, the surgeon should be cognizant of the condition of the soft tissues on the volar aspect of the flap because significant scarring may also limit the distance of advancement. Previous injury to the digital arteries, although not an absolute contraindication, should be considered carefully along with any conditions that may cause ischemia to the flap.

SURGICAL ANATOMY

The PIP joint is a simple hinge joint bounded by periarticular soft tissue. Collateral ligaments originate from the proximal phalanx condyle and insert on the base of the middle phalanx. More proximal and volar are the origin of radial and ulnar accessory collateral ligaments (ACL). They attach to the volar plate, which in itself is anchored to the periosteum by checkrein ligaments and constitutes the base of the PIP joint. A thin capsule overlies the dorsal aspect of the joint, with some reinforcement provided by the central slip and lateral bands of the extensor mechanism. The joint is enveloped by flexor and extensor tendon sheaths and the transverse retinacular ligament that bridges them. The A3 annular ligament arises from the volar plate at the level of the PIP joint. The neurovascular bundles pass along each side of the joint within the Cleland and Grayson ligaments.

SURGICAL TECHNIQUE

Preoperative evaluation begins with eliciting the patient's pertinent medical history regarding any conditions, injuries, or interventions to the involved finger. On examination, the length of the volar aspect of the contracted digit can be compared with the contralateral digit to determine the distance for advancement. Measurement is taken from the metacarpophalangeal (MCP) joint crease to the fingertip. Distances of 10 to 14 mm have readily been attained in our cohort of patients. The skin is also inspected for the availability of appropriate pliable soft tissue for use in the advancement flap.

Incisions are planned on the midlateral lines from the distal interphalangeal (DIP) crease to the MCP crease on one side and from the PIP to the MCP crease on the other side. Asymmetrical lateral incisions provide a wider pedicle base that helps to increase flap perfusion and to reduce venous congestion. To allow better exposure of the underlying soft tissue, an oblique incision can be extended from the midlateral incision at the DIP crease toward the pulp. The proximal incisions of the flap are designed on the palmar surface at the level of the MCP joint and are based on the standard V-Y advancement flap. Incision begins on the longer midlateral incision and is dissected dorsally to the neurovascular bundle by dividing the Cleland ligaments. Dissection then continues on the volar surface of the flexor tendon sheath toward the opposite neurovascular bundle. Care is taken to ensure both digital neurovascular bundles are included in the flap. All the soft tissue at the proximal V incision is divided, save the neurovascular bundles, which can be traced from their initial point of dissection and preserved. To expose the volar plate of the PIP joint, the flexor tendon sheath between the A2 and the A4 annular ligaments is opened, or resected if fibrosed. Tenolysis of adherent flexor tendons is done accordingly. The volar plate of the PIP joint is divided from its origin at the proximal phalanx. Accessory collateral ligaments and the corresponding flexor digitorum sublimis tendon are transected. The digit is then extended passively, and the flap is advanced and closed in a V-Y fashion at the proximal donor site.

The dissection plane of this volar neurovascular advancement flap is similar to that of a Moberg flap used for fingertip reconstruction. This flap includes 2 midlateral incisions dissected volar to the flexor sheath, preserving the neurovascular bundles, and advanced on the palmar side for thumb tip reconstruction.[2] Hueston[3] later described the eponymous L-shaped lateral palmar advancement flap pedicled on a single neurovascular bundle for coverage following distal pulp amputation, with the transverse incision located over the MCP joint. Souquet[4] later modified the Hueston flap to include both digital neurovascular bundles within the flap. Both flaps leave a triangular defect proximally at the transverse incision after advancement, necessitating secondary coverage, typically skin grafting. However, secondary scar contracture and vulnerability of the digital nerve should be considerations prior to grafting. By extending a V-shaped incision across the MCP palmar crease, any tension in the soft