

DISTAL INTERPHALANGEAL JOINT SURGERY: Classification and Surgical Options

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Deformities of the distal interphalangeal joints (DIPJ) of the lesser digits primarily involve flexion contracture with varying degrees of transverse plane adduction or abduction both as isolated presentations or in combination with a clawtoe deformity. They are referred to as the mallet toe deformity but this single term fails to account for the multiple presentation possibilities. The mallet toe or flexion contracture of the DIPJ is commonly associated with neuromuscular disease and pes cavus. Clinical symptoms result from shoe pressure or painful keratoses at the tip of the toe or dorsally over the distal interphalangeal joint. The surgical approaches to correct these deformities can be as complex as the flexion deformity of the DIPJ in a clawtoe of neuromuscular origin or as simple as a mallet toe in a foot of normal digital parabola. DIPJ deformities can be serious and limb threatening. Individuals with sensory neuropathy of a diabetic or non-diabetic origin and associated ataxia tend to grip the floor with their toes to aid proprioception. These at-risk patients are prone to distal digital flexion deformities and tuft ulcerations that can potentially result in serious infections or amputation. Careful attention to the assessment and classification of the deformity is vital to procedure selection even in the seemingly simpler presentations to help not only correct the deformity but help avoid recurrence, create a normal digital appearance, and increase patient satisfaction. A simple classification system for DIPJ deformities is offered that is practical in application in evaluating and managing these types of conditions.

TYPE I - ISOLATED DIPJ FLEXION

The Type I or isolated DIPJ flexion deformity is a flexion contracture of the DIPJ itself (Figure 1). Importantly, the the distal digital parabola is normal when the DIPJ is placed or held in a reduced or corrected position as part of the evaluation process. No significant elongation of the toe or toes involved is noted clinically or radiographically. The distal digital parabola is normal and no overriding neurologic component to the deformity is noted. The deformity may be rigid and fixed or flexible and reducible. The chief complaint is typically a painful distal digital keratosis in an isolated or multiple digital

presentation. The second toe may be involved, but more typically the third or fourth digits demonstrate this type of presentation. Adjacent digits may show clinical hammertoe or clawtoe malalignment in combination with an isolated flexion deformity of a particular toe. Each digital deformity should be individually and carefully assessed on every foot as multiple and varied presentations of digits on the same foot are possible.

Surgical correction involves isolated release of any flexion contracture at the DIPJ. No osseous pathology is present in this type of DIPJ deformity in terms of digital length. Bone resection options at the DIPJ in the Type I presentation can result in a fore-shortened digit and an unacceptable distal digital parabola. The DIPJ flexor release may include the flexor digitorum longus, the flexor joint plate and capsule, or both tissue layers. This release can be performed open through a transverse incision or closed through a stab incision. The open approach is through a transverse incision in the DIPJ flexor sulcus. Selective release of the flexor digitorum longus and flexor capsule can be directly visualized. The closed approach is through a medial or lateral stab incision at the level of the DIPJ. A lateral stab incision is generally utilized on the shorter digit side of the surgical toe for ease of access and to avoid an incision or scar directly adjacent to the neighboring longer digit. Following the stab incision, a freer-elevator may be introduced completely across the



Figure 1. Clinical presentation of a flexion deformity of the second digit or mallet toe as an isolated presentation in a digit of relatively normal parabola.

plantar DIPJ area to blunt dissect the subcutaneous layer from the deeper flexor tendon. The scalpel may then be re-introduced and turned with the sharp edge towards the DIPJ. The scalpel is then worked into the joint while manipulating the DIPJ into forced dorsiflexion. The release is easily palpable once effectively completed. Percutaneous pin fixation in either the open or closed technique can be applied through a distal to proximal blind stab technique.

TYPE II - LONG MIDDLE PHALANX

This digital deformity is noted by not only flexion contracture of the DIPJ but an elongation of the digit (Figure 2). When the deformity is held in a corrected position a long distal digital parabola is noted. This type of distal digital deformity may be flexible and reducible or rigid and fixed. The second digit is the most commonly involved in this type of presentation and may be an isolated or multiple lesser digital presentation. Radiographically, the elongated nature of the digit is noted to occur most commonly through the middle phalanx. On careful clinical inspection, the proximal interphalangeal joint parabola is noted to be normal. The DIPJ lesser digital parabola is noted to be abnormal with elongation through the middle phalanx of the affected digit and a distally displaced DIPJ. The chief complaint is typically a painful dorsal DIPJ shoe irritation or keratosis occationly associated with a distal digital tuft keratosis.

The surgical approach to a flexion deformity of the DIPJ in the presence of a long middle phalanx and elongated distal digital parabola is a middle phalanx head resection, arthroplasty of the middle phalanx, through a dorsal transverse incision with or without a skin plasty. The transverse incision or skin plasty incision is placed

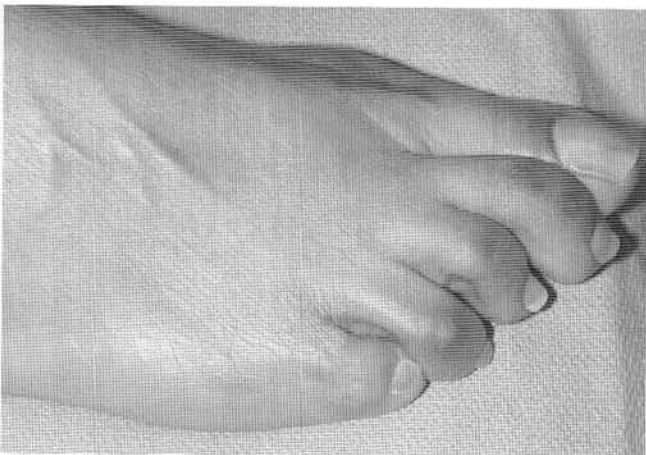


Figure 2. Clinical presentation of a flexion deformity of the second digit or mallet toe with an elongated middle phalanx and resultant abnormal digital parabola.

directly over the apex of the deformity dorsally. Generally, a double ellipse incision approach is employed to create the skin plasty. The double ellipse incision approach has the advantage of removing redundant dorsal DIPJ skin to aid corrective dorsiflexory positioning and splinting of the digit following surgical correction. Deep seated dorsal DIPJ keratoses can be excised. The center of the ellipse can be rotated medially or laterally to relatively abduct or adduct the DIPJ as may needed to aid correction. The more lesser digital flexion DIPJ flexion deformities generally have a degree of frontal plane varus or a degree of transverse plane adduction that are well aided by a skin plasty approach.

The extensor digitorum longus is transected just proximal to the DIPJ joint line to allow tissue for closure. The head of the middle phalanx is then dissected free of soft tissue and delivered into the operative site. The amount of bone resected is predicated by the abnormal length of the middle phalanx. The osseous digital parabola must be carefully re-established. A degree of bone resorption may occur over time post-operatively. A strictly transverse resection is needed to avoid iatrogenic angular DIPJ malalignment following the surgery. If adequate flexor release is not affected by adequate middle phalanx osseous resection to establish a more normal distal digital parabola, a separate flexor release is employed as an adjunctive measure. If further bone resection is utilized in this instance, a fore-shortened digit can result. The adjunctive flexor release can be performed through the original incision or as a closed stab technique. Pinning is generally recommended by a retrograde technique through the DIPJ or from the tip of the toe directed proximally for a short time to aid post-operative corrected position splintage and allow the surgical dressing to concentrate on edema control.

TYPE III - ANGULAR DIPJ DEFORMITY

An angular component to the DIPJ flexion deformity can be subtle or more gross in presentation, but needs to be carefully considered and compensated for in the surgical correction of the DIPJ (Figure 3). An angulation of the DIPJ through the distal phalanx or the proximal phalanx or a rotation of the toe at the DIPJ in the frontal plane is possible. Frontal plane rotation may include varus or valgus positioning. The angulation in the transverse is typically dominant with adduction or abduction at the DIPJ. The lesser digital nail, which represents the position of the distal phalanx, seems to be directed medially or laterally. This transverse plane angulation can result in medial or lateral interdigital transverse plane

pressure lesions associated with the more typical dorsal DIPJ or distal digital tuft lesions. Radiographically, the transverse plane distal digital component to the DIPJ deformity can occur through osseous angulation within the distal phalanx or middle phalanx or both. Cosmetically and functionally following the surgical correction, it is generally best to have the lesser digital nail and thus the distal phalanx oriented straight forward and linear with the long axis of the digit. This can be accomplished surgically by a slight angulation to the middle phalanx resection if the deformity is within the distal phalanx or a squaring off of the middle phalanx if the deformity is within the middle phalanx. Any osseous correction through the distal phalanx is typically not possible or practical as the bone is small and manipulation of the base of the distal phalanx could result in dystrophic changes to the nail through damage to the nail matrix. Only a subtle degree of angular correction is possible in this fashion, but any angular improvement in position short of exact is generally helpful.

Skin plasties are very effective in aiding angular corrections of adduction or abduction as well as rotational DIPJ distal deformities of varus or valgus. The center of a double elliptical skin incision can be rotated medially to aid adduction or laterally to aid abduction in the transverse plane. The double elliptical incision can likewise be oriented from distal-medial to more proximal lateral to aid varus re-alignment or from distal-lateral to proximal-medial to aid valgus re-alignment. Painful deep seated dorsal or interdigital DIPJ keratoses can be excised. Most commonly, an adducto-varus deformity is noted at the DIPJ with the flexion deformity. The flexion deformity may require release by osseous resection if the digit is elongated or flexor release if a normal parabola is



Figure 3. Clinical presentation of flexion deformity of the second digit or mallet toe with an adductory component underlapping the hallux complicated by a degree of hallux abductus interphalangeus.

noted. This may be combined with an angular middle phalanx osseous resection with or without a strategically oriented skin plasty to aid transverse or frontal plane positioning. Percutaneous pinning of this more complex type of deformity is recommended until fibrosis and scarring is sufficient to maintain the correction and help avoid joint subluxation. The pinning aids edema control through the rigid nature of the fixation and permitting the surgical dressing to be focused on edema control not maintenance of position.

TYPE IV - NEUROMUSCULAR DIPJ DEFORMITY

The addition of a neuromuscular component to the flexion deformity at the DIPJ generally implies the presence of a clawtoe deformity to the entire digit (Figure 4). A clawtoe is distinguished from a hammertoe by a flexion deformity of the DIPJ as opposed to an extension deformity associated with the proximal interphalangeal flexion deformity. Any neuromuscular imbalance affecting the foot, by its nature, should be considered as a progressive condition resulting in changing and worsening deformities over time. The etiology of the neuromuscular involvement affecting the foot may be static and non-progressive as represented by a cerebrovascular accident with a static or slowly progression nature to the clawtoe deformity. Progressive types of neuromuscular diseases that affect the foot such as Charcot-Marie-Tooth disease will tend to worsen more substantially over time. The surgical correction options to be considered in the presence of neuromuscular disease should be stable and rigid to stand the test of continued and ongoing forces of neuromuscular imbalance. The



Figure 4. Clinical presentation of flexion deformity of the distal interphalangeal joint in a patient with neuromuscular disease and multiple clawtoe deformities of the entire digit.

forces that created the deformity in the first place must still be considered present to affect the outcome unless otherwise surgically compensated.

Generally arthrodesis type procedures of both the DIPJ and proximal interphalangeal joints combined are considered in these instances. The DIPJ and proximal interphalangeal joints can be simultaneously resected and pinned. Access to both the DIPJ and proximal interphalangeal joints can be accomplished through a T-shaped skin incision. The transverse arm of the incision, or double ellipse if indicated, is located at the dorsal DIPJ as in isolated DIPJ procedures. Each joint is individually approached and resected as needed for overall distal digital parabola, angular realignment, and flexor release needs. Pinning is highly recommended through a retrograde technique at the proximal interphalangeal joint holding each joint carefully in corrected position. Failure of DIPJ consolidation and arthrodesis does not typically present a problem. The fibrosis and scarring that exists at the resected joint site promotes longer term stability over hemi-joint resection alone.

TYPE V - NAIL/SKIN INVOLVEMENT

In the presence of severe nail deformity, chronic and thickened scar tissue at the tip of the toe, or an open wound with or without cellulitis or osteomyelitis, a distal digital amputation through DIPJ disarticulation is not an unreasonable option (Figure 5). The thick damaged skin of a chronic distal digital keratosis or the thin damaged skin of a healed neurotrophic ulcer can affect the padded nature of the tip of the toe and make recurrent problems possible even in the face of an adequate DIPJ surgical

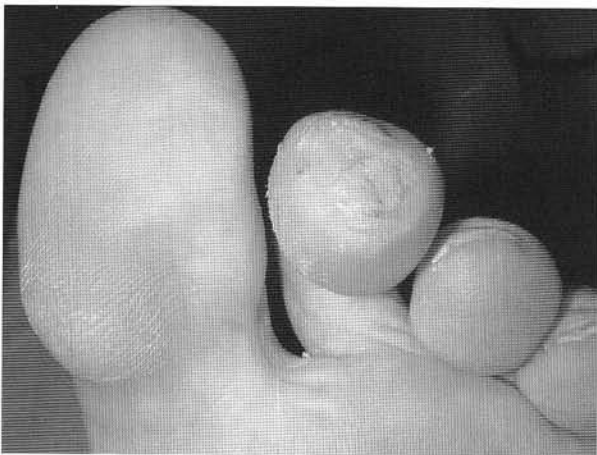


Figure 5. Distal digital ulceration in a patient with neuropathy associated with diabetes as a result of a mallet toe deformity of the DIPJ.

realignment. Corrective surgery may not be able to re-establish distal digital padding and the soft tissue defect sufficiently to reduce pain or lesion recurrence. Distal digital amputation can effectively shorten the toe reducing the distal digital parabola in an elongated toe and removes the permanently damaged tissues. The presence of severe nail dystrophy, like the compromised skin and scar tissue of distal digital ulcerations, may require permanent removal. This is especially of concern in the neurotrophic foot commonly seen in the second toe long term following a hallux amputation. DIPJ disarticulation eliminates the flexion deformity, effectively shortens a long digit, and removes dystrophic nail and compromised distal digital skin (Figure 6). Any proximal interphalangeal joint deformity must be addressed separately.

CONCLUSION

The DIPJ flexion deformity or mallet toe has a multitude of clinical presentations. It can be associated with an elongated toe through the middle phalanx or in a digit of normal parabola. It can be associated with progressive or static types of neuromuscular disease as a clawtoe. Multiple planer possibilities can be noted. A dystrophic nail plate or scarred and damaged skin may be present at the tip of the toe. All these factors can affect procedure selection to ensure patient satisfaction and maximize the surgical outcome. A classification system was presented that considers these possibilities and help aid procedure selection based on the presenting clinical deformity.

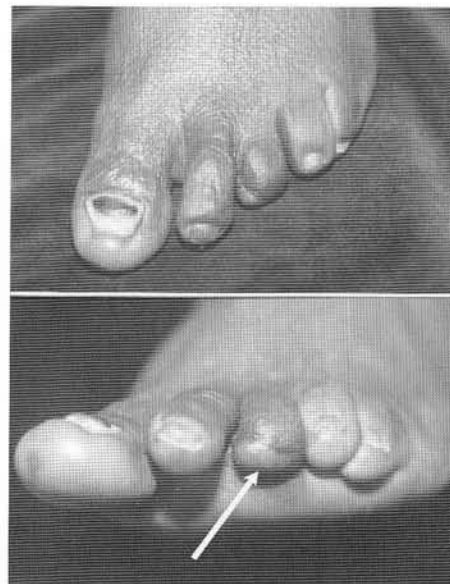


Figure 6. Clinical appearance of third digit following DIPJ disarticulation for severe flexion deformity of the DIPJ or mallet toe with associated nail dystrophy and deep chronic keratosis.