

# REVISITING PREDISLOCATION SYNDROME WITH DIRECT REPAIR OF THE PLANTAR PLATE

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## INTRODUCTION

Predislocation syndrome, as defined by Yu and Judge, is “an acute, subacute or chronic and exquisitely painful inflammatory condition of the plantar plate of the lesser metatarsophalangeal joints (MPJ), which if left untreated or mistreated, will result in eventual metatarsophalangeal joint luxation”.<sup>1</sup>

The anatomy surrounding the lesser MPJ consists of a fibrocartilaginous plantar plate with medial and lateral collateral ligaments. This structure is further reinforced by the extensor tendons and the expansion dorsally, the flexor tendons plantarly, along with the intrinsic musculature. It is when stress is applied to this complex structure, either biomechanical or traumatic, which allows chronic inflammation to develop that can lead to attenuation and rupture of the plantar plate. Rupture of the plantar plate will further predispose the patient to pathology of the capsule and flexor tendons, as well as a multitude of other painful pathological processes if not treated appropriately.

After failed conservative measures, surgical intervention may be warranted. With the wide range of procedures available for management, a standard approach to surgical treatment is a must. It is for this reason that the authors have developed a surgical staging approach for management of predislocation syndrome.

## PRESENTATION

Clinically, a patient with predislocation syndrome will describe symptoms of a “stone bruise” or a “fullness of my second toe.” They may relate a recent activity change that involves a moderate amount of high impact force to the foot and present with focal pain to the plantar aspect of the MPJ. Some patients may have subtle but obvious inflammation to the MPJ or possible fullness to the joint itself. The vertical stress test, as described by Thompson and Hamilton,<sup>2</sup> is positive when there is 2 mm of dorsal displacement or 50% joint subluxation. Due to the

subluxation of the joint, there may be loss of toe purchase associated with medial or lateral deviation. It is important to distinguish this pain from a neuroma presentation, as the two should not be confused. Often, patients will have undergone a neurectomy and associated revisional surgeries with no relief, leading to constant grief and discomfort.<sup>3</sup> It is for this reason, that an accurate diagnosis is paramount in preventing unnecessary surgery.

## DIAGNOSIS

Diagnosis of predislocation syndrome begins clinically when the patient presents with the above symptoms. When assessing predislocation syndrome, it is important to keep in mind differential diagnoses. Other processes that may mimic predislocation syndrome are MPJ capsulitis, bursitis, soft tissue masses, Freiberg’s, stress fractures, and osteochondral lesions. Due to the nature of the differentials, comparison with the contralateral foot and simple radiography is an obvious assessment when further examination is needed. On an anteroposterior view, subluxation and/or dislocation of the MPJ can be seen, as well as superimposition of the proximal phalanx base on the head of the metatarsal. Medial or lateral deviation of the digit itself, along with a decrease in the MPJ clear space may be evident, as well as contracture of the proximal interphalangeal joint (PIPJ). A nuclear medicine three-phase bone scan will show increase uptake at the MPJ in all phases but is less specific. Iodinated contrast material under athrography has been shown to be useful in assessing the MPJ capsule. The MPJ capsule does not normally communicate with the flexor tendon sheath and an extravastation of the contrast dye would confirm diagnosis of rupture.<sup>1,4,5</sup>

Magnetic resonance imaging (MRI) has proven to be most beneficial in assessment of the plantar plate. It is important to educate the MRI technician on toe position when scanning patients. Camasta describes a technique of taping the digit in a maximally dorsiflexed position in order

to effectively visualize and evaluate any possible plantar plate rupture (Figure 1). The plantar plate is best viewed on T1-weighted and echo images. Echo images should be obtained due to the difficulty in distinguishing the flexor tendon from the plantar plate, which will appear hyperintense.<sup>2</sup> Umans and Elsinger<sup>5</sup> state that most plantar plate ruptures occur at the distal lateral insertion into the proximal phalanx base. Yao et al describes a rupture that appears as an isointense region with synovium and joint fluid and will be adjacent to the metatarsal head.<sup>6,7</sup>

## CONSERVATIVE TREATMENT OPTIONS

Treatment goals of predislocation syndrome are aimed at relieving symptoms, halting progression of deformity and preventing dislocation. Initial treatment includes tapering doses of prednisilone, beginning at 60 mg and ending with a final dose of 10 mg. Therapy with nonsteroidal anti-inflammatory drugs is then initiated along with mechanical splintage in a plantarflexed position. In some cases, physical therapy modalities may be employed to decrease any early inflammatory changes as well as mechanical orthotic devices to offload the MPJ. The authors do not recommend cortisone injections into the plantar plate, which can predispose to rupture.

## STAGING AND SURGICAL MANAGEMENT

The authors have utilized the staging technique described by Yu and Judge<sup>1</sup> and have proposed subsequent surgical treatment modalities for each stage, including radio frequency coblation and plantar plate repair. Previous reported procedures include the following: digital

arthrodesis, flexor tendon transfer and metatarsal osteotomies, alone or in combination. The authors recommend direct repair of the plantar plate, which is the underlying etiology. Radiofrequency coblation is used in adjunct to the plate repair. The principal theory is believed to induce an inflammatory response of the plantar plate to aid in the production of angiogenesis, similar to extracorporeal shockwave therapy.

### Predislocation Syndrome Staging

Stage I is a clinically aligned digit with no digital contracture or luxation noted. Mild edema may be present with tenderness noted.

Stage II is a clinically and radio-graphically deviated, contracted digit with moderate edema and no luxation. There is loss of toe purchase.

Stage III is clinically and radiographically subluxation or dislocation of the digit with notable edema. There is pronounced deviation.

### Proposed Surgical Management

The proposed surgical management in surgical stage I is plantar plate wedge resection and radiofrequency coblation. In stage II, it is plantar plate wedge resection and radiofrequency coblation, with the option of PIPJ arthrodesis; and in surgical stage III it is plantar plate wedge resection, and radiofrequency coblation with needed PIPJ arthrodesis.

Sharp dissection is carried through a longitudinal incision directly beneath the plantar plate and through the level of the subcutaneous tissue with care to minimize dissection and prevent subcutaneous tissue compromise. A longitudinal incision is made in the plantar capsular sheath, which houses the flexor tendons (Figure 2). The flexor tendons are retracted and the plantar plate is



Figure 1. The digit is taped in a maximally dorsiflexed position, allowing adequate visualization.

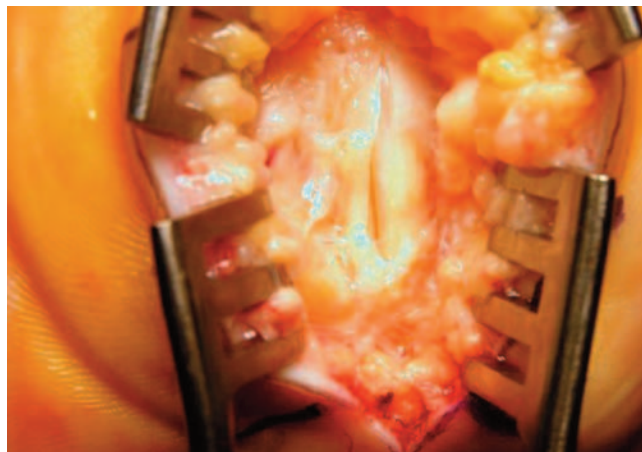


Figure 2. A longitudinal incision is made within the plantar capsular sheath, allowing flexor tendons to be visualized.

visualized. Repair is then performed with wedge resection of the plantar plate, followed by augmentation with radiofrequency coblation. Approximately 6 coblations are made within the plantar plate with a curved wand (Figure 3).

The digit is then slightly plantarflexed and the wedge will be visualized closed. Non-absorbable suture is used to repair the wedge resection (Figure 4). It should be noted that coblation should be done first followed by suture repair in order to prevent inadvertent suture damage by the wand. The wound is then re-approximated with non-absorbable sutures through the skin only (Figure 5). It should also be noted that no subcutaneous suture is used, to prevent prominent scar tissue and adhesions. If a PIPJ arthrodesis is deemed necessary, fixation need only cross the fusion site and not cross the MPJ. The sagittal plane correction of the digit is achieved through the plantar plate repair, and does not rely on Kirschner-wire (K-wire) fixation across the MTPJ.

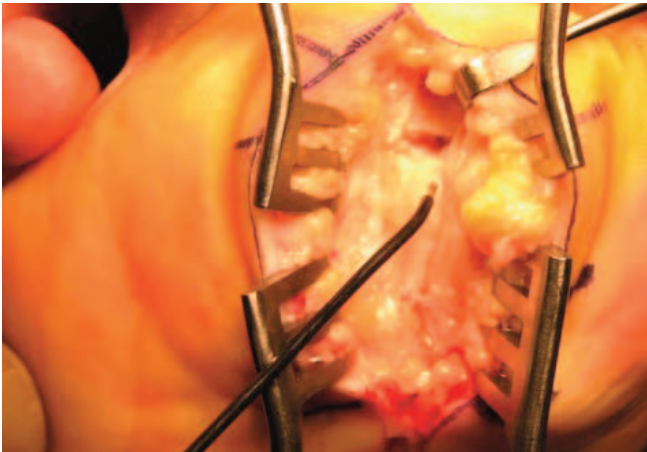


Figure 3. Following wedge resection of the plantar plate, radiofrequency coblation with a curved wand is performed.

### Postoperative Management

A Jones compression dressing is applied and nonweight bearing is utilized until sutures are removed at 2.5 weeks. Steri-strips are applied at the time of suture removal and a cam-walker is then used for 6 weeks. The authors typically use an intramedullary K-wire for digital fusion (Figure 6).

### DISCUSSION

Insufficiency or rupture of the plantar plate can lead to MPJ instability, causing subluxation or dislocation of the joint.<sup>7</sup> Many procedures have been described in the surgical repair of the MPJ joint. Namely, primary plate repair coupled with joint procedures such as flexor tendon transfer, Weil osteotomy, and the MPJ arthrodesis.<sup>8</sup> In our experience, it appears that radiofrequency coblation coupled with primary plantar plate repair provides successful and reliable results.

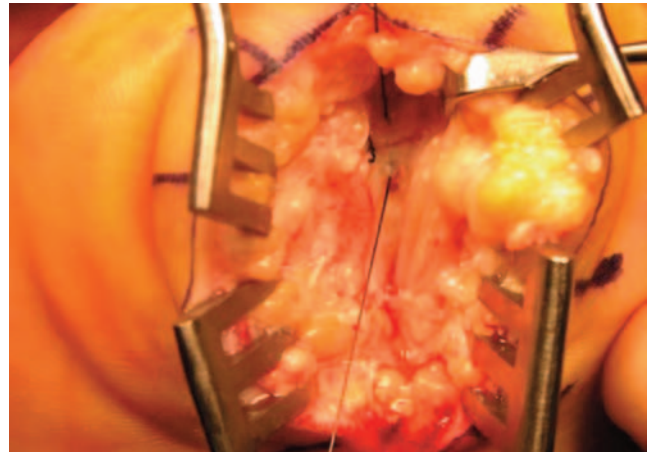


Figure 4. Non-absorbable suture is used to repair the wedge resection.



Figure 5. Skin reapproximation. Skin and subcutaneous layers are closed together with one suture.

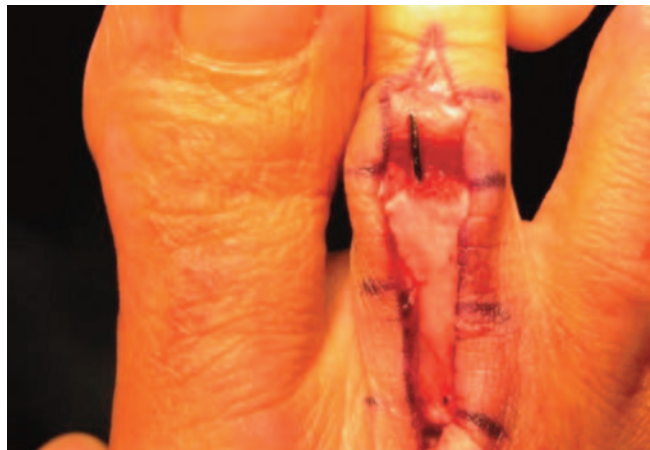


Figure 6. Intramedullary Kirschner-wire fixation for digital fusion.



Figure 7.

Radiofrequency coblation, using a controlled non-heat driven process, has been proposed to increase angiogenesis with minimal surrounding tissue damage. In a retrospective study of 15 patients with stage I predislocation syndrome who failed conservative treatments, the authors utilized radiofrequency coblation alone with no plantar plate revision. After a 14-month follow up, 14 patients related a 90% success rate with an increase in activity level. It should be noted that slight elevation of the digit was observed in 5 patients even though no subsequent repairs were made at 14 months. It is for this reason that the authors now recommend wedge resection repair with radiofrequency augmentation. It is the authors' belief that the success of

this ongoing study is the result of angiogenic properties obtained through radiofrequency coblation.

Predislocation syndrome is a frequent problem and is commonly misdiagnosed. It can be difficult to resolve and lead to plantar plate rupture if aggressive conservative treatment is not implemented. Once conservative measures have failed, surgical intervention should follow. In the authors' experience, successful results have been obtained with the proposed staging and treatment method.

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