# Disorders of the Lesser Metatarsophalangeal Joints

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## Abstract

*Pain in the region of the lesser metatarsophalangeal joints (often termed metatarsalgia) is a common complaint. It can be due to a variety of causes, and accurate diagnosis is essential for effective treatment. Understanding the anatomy and functions of the extrinsic and intrinsic musculature and the plantar plate, ligaments, and fat pad is important in evaluating metatarsophalangeal joint disorders. Claw toe is a hyperextension deformity of the metatarsophalangeal joint in combination with a hammer toe. Pathologic changes involving an isolated metatarsophalangeal joint may be due to monarticular synovitis. Systemic inflammatory disorders can cause variable degrees of instability, resulting in subluxation or dislocation. Other specific disorders at the lesser metatarsophalangeal joints include discrete and diffuse intractable plantar keratoses, Freiberg's infraction, and cock-up fifth toe. Once the specific pathologic entity has been determined, the appropriate course of nonsurgical or, if necessary, operative treatment can be instituted.*

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Pathologic changes involving the metatarsophalangeal joints of the lesser toes can present as a variety of forefoot problems, often leading to the diagnosis of "metatarsalgia." This is a nonspecific term that serves only to denote the location of the pain without describing the pathoanatomic and pathophysiologic basis, natural history, expected prognosis, or appropriate plan of treatment.

The aim of this article is to provide an understanding of the various types of disorders of the lesser metatarsophalangeal joints. A description of the anatomy serves as a basis for consideration of the pathologic entities that can occur and is followed by a discussion of specific clinical conditions in terms of presentation, diagnosis, treatment options, and prognosis. This should enable the clinician to have a more specific approach to the problem of metatarsophalangeal joint disorders manifested as forefoot pain.

## Anatomy and Pathophysiology

The forefoot is comprised of the hallux (great toe), the four lesser toes, and the five metatarsals. Each lesser-toe ray consists of a metatarsal and a proximal, a middle, and a distal phalanx. The position of the lesser toes is maintained by a balance between the extrinsic and intrinsic muscles in combination with passive restraints.[1,2]

Dorsally, the extrinsic extensor digitorum longus tendon traverses the ankle and then divides into four tendons, each of which becomes the central dorsal structure of one of the lesser toes (Fig. 1). The four tendons each divide into three slips; the central slip inserts into the base of the middle phalanx, and the two lateral slips rejoin to form the terminal tendon as it attaches to the base of the distal phalanx. The central position of each tendon is maintained by the extensor hood, which is secured to the plantar plate by an extensor sling at the level of the metatarsophalangeal joint. The extensor digitorum longus does not insert on the proximal phalanx, but it dorsiflexes the metatarsophalangeal joint through the extensor hood mechanism. The extensor digitorum brevis muscle, which originates from the dorsal aspect of the calcaneus, is flattened on the lateral aspect of the foot and sends out tendons that attach to the long extensors at the level of the metatarsophalangeal joints of the second, third, and fourth toes and occasionally to the extensor hallucis longus. The long and short extensors are usually innervated by the deep peroneal nerve.

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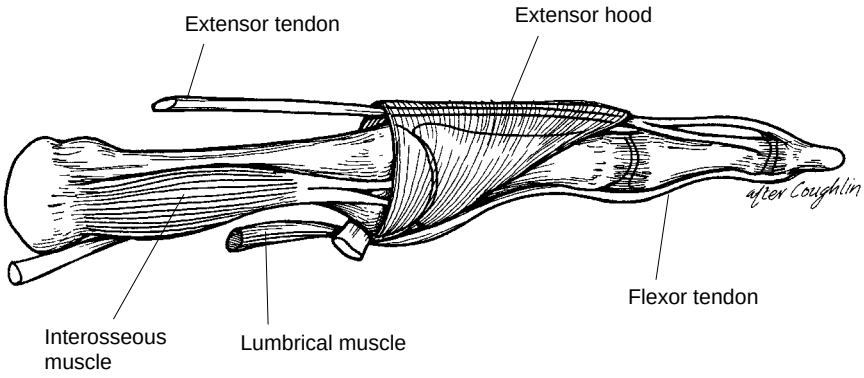


**Fig. 1** Lateral view of the metatarsal and phalanges of a representative lesser toe. The lumbrical and interosseous muscles pass plantar to the axis of motion of the metatarsophalangeal joint and act as flexors of that joint. They pass dorsal to the interphalangeal joints and act as extensors of those joints.

On the plantar aspect, the flexor digitorum longus tendon divides into four tendons, each of which inserts into the base of the distal phalanx of one of the lesser toes. The flexor digitorum brevis also divides into four tendons, each of which inserts in the center of the middle phalanx of one of the lesser toes. These tendons flex the distal and proximal interphalangeal joints, respectively. As with the extensors, there is no insertion on the proximal phalanx.

The intrinsic musculature consists of the interosseous and lumbrical muscles. Each of the interossei inserts onto the base of a proximal phalanx, the plantar plate of a metatarsophalangeal joint, and the extensor sling. All the fibers of the lumbricals terminate in the extensor sling. The intrinsic tendons pass plantar to the axis of motion of the metatarsophalangeal joint, acting as flexors. More distally, they pass dorsal to the axis and serve to extend the interphalangeal joints.

A structure that is important in stabilizing the metatarsophalangeal joint is the plantar plate, which consists of the plantar aponeurosis and the plantar capsule, a static structure without muscle attachments. This structure, together with the intrinsic muscles, provides resistance to the hyperextension at the metatarsophalangeal joint that normally occurs during gait. Stability of the metatarsophalangeal joint is also maintained by the collateral ligaments and the lateral and medial joint capsule.

Another important anatomic structure in the region of the metatarsophalangeal joint is the plantar fat pad, which is situated beneath the metatarsal heads and which serves as a protective cushion to dissipate the stresses of standing and ambulation. It is normally connected to the bases of the phalanges, but in certain pathologic conditions it may become distally displaced and cause severe functional impairment.

Pathologic changes at the metatarsophalangeal joint can occur as a result of deformities caused by altered function of the stabilizing structures. Such deformities can be secondary to external events, such as trauma, or internal conditions, such as proliferative synovitis. During ambulation, there is dorsiflexion at the metatarsophalangeal joint in the heel-rise phase of gait. The return to a neutral position is the result of a combination of dynamic forces from the intrinsic flexors and the static, stabilizing force of the plantar aponeurosis and the plantar capsule. If the plantar structures become attenuated and elongated, the base of the proximal phalanx may remain dorsally displaced instead of returning to the neutral position.

The dynamic forces acting to maintain the position of the proximal phalanx at the head of the metatarsal are a balance between the extensor digitorum longus and the weaker intrinsic muscles. With hyperextension at the metatarsophalangeal joint, the intrinsic muscles become less efficient as plantar flexors. Consequently, the hyperextension deformity progresses in the metatarsophalangeal joint as the opposition of the intrinsic muscles to the extensor tendon lessens. This is in contrast to the situation in the interphalangeal joints, where the stronger flexors overpower the weaker intrinsic muscles, which act as the extensors. This combination of events leads to hyperextension at the metatarsophalangeal joint and flexion deformities at the interphalangeal joints, resulting in claw toe.

## Physical Examination

A thorough physical examination of the foot is essential for the evaluation of the lesser metatarsophalangeal joints. This should begin with inspection, noting the position of each of the joints of the toes and any deformity of the hallux. During palpation, the dorsal aspect should be checked for callosities; the plantar aspect, for intractable plantar keratoses, which may be diffuse or discrete. Special attention should also be directed toward detecting cysts and ganglia, bony prominences and

condyles, and thickened, "boggy" synovium. Any deformity of the lesser toe joints should be evaluated for a fixed or flexible component. The interdigital spaces should be individually examined for the presence of a neuroma.

The stability of the metatarsophalangeal joint can be evaluated by performing the anterior drawer test. The examiner holds the head of the metatarsal between the index finger and the thumb and with the other hand grasps the base of the proximal phalanx and applies dorsally directed pressure. If there is instability, the joint can be felt to displace dorsally, and the patient's painful symptoms may be reproduced.

## Claw Toes

A claw-toe deformity consists of a hammer-toe (flexion) deformity at the proximal interphalangeal joint in combination with a dorsiflexion deformity at the metatarsophalangeal joint.[3] This condition is usually acquired and slowly progressive and tends to involve multiple toes.

The underlying cause may be an imbalance between intrinsic and extrinsic muscle forces. However, chronic external application of a deforming force, such as that due to wearing a tight shoe, can also be a cause. The relatively strong extensor digitorum longus musculature pulls the metatarsophalangeal joint into hyperextension, which cannot be adequately neutralized by the intrinsic musculature and the static forces of the plantar plate. There are many possible causes for the development of this imbalance, including neuromuscular disorders (e.g., Charcot-Marie-Tooth disease, Friedrich's ataxia, myelodysplasia, cerebral palsy, multiple sclerosis, and cerebrovascular compromise); systemic inflammatory disorders, such as rheumatoid and psoriatic arthritis; collagen deficiency disorders; metabolic disease, such as diabetes with neuropathy, and posttraumatic compartment syndrome, which results in altered intrinsic and/or extrinsic muscle function. As the deformity develops, it may be aggravated by wearing shoes. As the toes flex at the proximal interphalangeal joint, pressure is exerted dorsally from the top of the shoe. This further pushes the metatarsal heads plantarward and eventually may cause distal displacement of the plantar fat pad.

On physical examination, there is hyperextension of the metatarsophalangeal joint with plantar displacement of the metatarsal heads and distal migration of the fat pad. This may be accompanied by plantar keratotic lesions and occasionally ulcerations under the metatarsal heads. There is usually a hammertoe deformity of the proximal interphalangeal joint. However, the distal interphalangeal joint may be flexed, extended, or neutral. The claw-toe deformity may be flexible or fixed. This is determined by examining the foot with the ankle in dorsiflexion and plantar flexion. If the claw-toe deformity disappears when the ankle is in equinus, it is a dynamic, flexible deformity. A dynamic deformity can also be reduced or eliminated by application of dorsally directed pressure on the plantar metatarsal heads.

In treating the patient with a claw-toe deformity, an effort should be made to determine the underlying cause, although in many cases the cause cannot be determined. Initial nonsurgical treatment is aimed at shoe modification. The patient should wear an extra-depth shoe with a toe box that has a soft upper portion. Padding and protection of specific callosities or pressure points may be indicated and can be combined with taping and strapping for flexible deformities. Painful pressure under the metatarsal heads may be relieved with the use of metatarsal pads or bars.

If these measures are not satisfactory, surgical treatment may be indicated. The goal is to bring the metatarsophalangeal joint and proximal interphalangeal joint to a neutral position. If the deformity is flexible, this can be accomplished by a flexor tendon transfer, sometimes with concurrent release of the metatarsophalangeal joint capsule and extensor tenotomies. In the case of a fixed deformity, the metatarsophalangeal joint will also require release. Alternatively, a Du Vries resection arthroplasty (Fig. 2) at the metatarsophalangeal and proximal interphalangeal joints may be necessary for correction. Collateral ligament release may also be needed. In addition, flexor tendon transfers may be required in severe cases. Resection of an individual metatarsal head should be approached cautiously and avoided

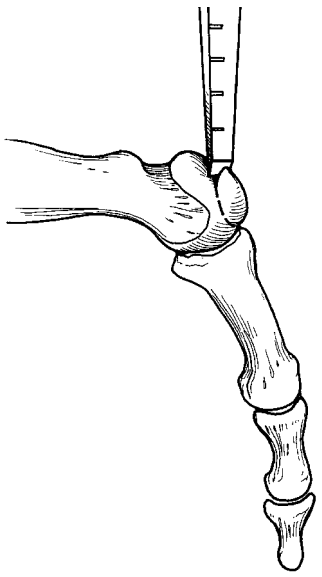

**Fig. 2** Du Vries arthroplasty is performed by resecting the distal portion of the articular surface of the metatarsal head with an osteotome.

if possible, because of the risk of transfer metatarsalgia.

## Monarticular Nontraumatic Synovitis

Symptoms isolated to a single metatarsophalangeal joint in the absence of trauma or a systemic inflammatory disease may be caused by monarticular synovitis.[4] Affected patients present with pain in the region of the metatarsophalangeal joint, accompanied by palpable fullness, warmth, and tenderness to palpation. The base of the toe may be thickened. The toe may be more curled than the adjacent toes, and there may be a hammer-toe deformity. The dorsal drawer test often reveals a feeling of instability and laxity, or there may be subluxation at the metatarsophalangeal joint. The range of motion, especially in plantar flexion, is often reduced. Some patients have discomfort with palpation of the intermetatarsal space, consistent with irritation of the common digital nerve. Therefore, patients with a diagnosis of interdigital neuroma should be carefully assessed for concomitant metatarsophalangeal joint synovitis.

Anteroposterior (AP) radiographs may show widening at the metatarsophalangeal joint. If the joint is subluxated, the base of the proximal phalanx may overlap the metatarsal head as it overrides dorsally, which will be reflected on the AP radiograph as narrowing or disappearance of the joint space. There should not be any evidence of joint erosions or polyarticular disease.

The cause appears to be proliferation of the inflammatory synovium (Fig. 3), but rheumatoid nodules, granulomatous tissue, and stigmata of systemic disease are absent. The thickened synovial tissue stretches and attenuates the capsule, resulting in loss of its stabilizing function at the metatarsophalangeal joint. The chronic edema and distention of the capsule may cause pain, which increases as instability of the joint progresses. The thickened synovium and surrounding soft tissue may also exert extrinsic pressure on the common digital nerve, resulting in the neuritic symptoms experienced by some patients.

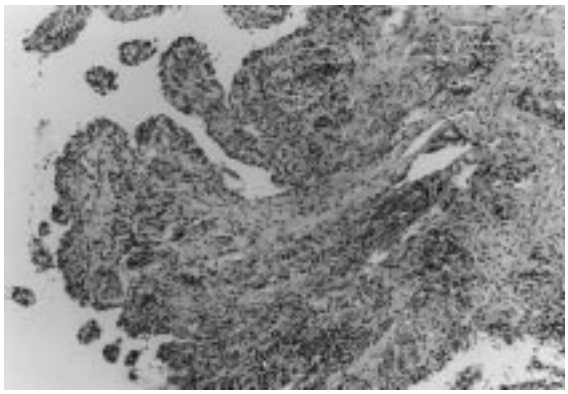

**Fig. 3** This pathologic specimen from a patient with monarticular synovitis of a metatarsophalangeal joint shows chronic inflammatory changes.

The initial treatment should consist of nonsteroidal anti-inflammatory medication and shoe modifications. A rheumatologic workup should be performed to rule out systemic causes of the synovitis. Wide, soft shoes with a metatarsal support may improve symptoms by relieving weight-bearing at the metatarsophalangeal joint. An alternative shoe modification is insertion of a full-length steel stiffening plate into a sole with an anterior rocker bottom, which will immobilize the forefoot and all metatarsophalangeal joints. If these measures are not successful, an intra-articular corticosteroid injection combined with a steel sole stiffener can give good results.[5]

Nonresponsive patients with persistent symptoms may require surgical treatment. The affected metatarsophalangeal joint is explored through a dorsal approach, and as complete a synovectomy as possible is performed. The collateral ligaments and the extensor digitorum longus tendon may require division to permit decompression and reduction of the subluxated metatarsophalangeal joint. In patients with significant neuritic symptoms, the common digital nerve should be explored and, if necessary, decompressed by sectioning the transverse metatarsal ligament or by resecting the nerve. In our surgical experience, we have not encountered significant intermetatarsal bursitis.

After debridement of the metatarsophalangeal joint, the patient should wear a wooden shoe for 3 weeks. Sutures can then be removed, and the patient can progress to wearing regular shoes and can advance walking activities as tolerated. Early range-of-motion exercise is discouraged until the soft tissues have healed, which usually occurs in 4 to 6 weeks.

## Instability, Subluxation, and Dislocation

The competence and stability of the lesser metatarsophalangeal joints can be affected by pathologic changes in the static stabilizing structures, intra-articular conditions, or imbalance of the dynamic muscle forces.[6,7] Initially, the joint may show evidence of instability when subjected to stress, causing

discomfort with activities but improvement with rest. With loss of the stabilizing mechanisms and continuation of deforming forces, the condition progresses to subluxation and, ultimately, dislocation.

Most of the systemic causes of metatarsophalangeal joint instability occur when an inflammatory process leads to attenuation and weakening of the stabilizing structures,[8] similar to the pattern described for monarticular nontraumatic synovitis. In systemic conditions, such as rheumatoid arthritis, pannus formation may also lead to severe articular and osseous erosion, further contributing to instability. During a normal gait cycle, the forces in the toe-off phase result in repeated dorsiflexion across the metatarsophalangeal joint. Eventually the plantar aponeurosis, plantar plate, and capsule elongate and weaken to the point that the dorsiflexion forces cannot be overcome. The joint subluxates and ultimately may dislocate. As the situation progresses, the base of the proximal phalanx may come to abut the neck of the metatarsal. The metatarsal head displaces plantarward, and the fat pad moves distally. The weight-bearing area beneath the metatarsal heads is then devoid of padding, which leads to increased loading. Painful callosities and ulcerations may then develop.

The initial presentation may consist of pain and swelling at the metatarsophalangeal joint. On examination, the joint often is warm and erythematous and feels boggy. There may be localized tenderness at the sites of capsular or ligamentous damage. When a drawer test (Fig. 4) is performed by dorsoplantar manipulation of the toe while stabilizing the metatarsal, pain may be produced as the toe subluxates and produces stress on the plantar capsule. More advanced cases may present with subluxation or even irreducible fixed dislocation. Associated with this may be distal displacement of the fat pad, which follows the toes, and the development of plantar callosities (Fig. 5).

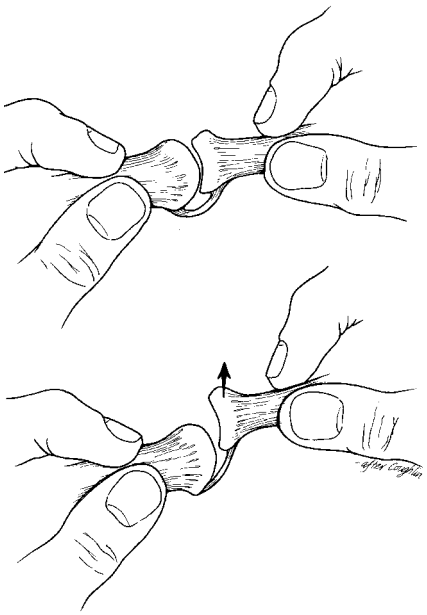

**Fig. 4** **Top,** Instability of the metatarsophalangeal joint may be tested by grasping the base of the proximal phalanx. **Bottom,** Manipulation in the dorsal-plantar plane may demonstrate increased laxity in an unstable joint.

Radiographic evaluation is useful both for assessing the metatarsophalangeal joint and for providing information about the underlying cause of the condition (Fig. 6). The radiograph may illustrate characteristic joint erosions or other changes typical of a particular systemic disorder. A lateral view of the foot will show the extent of hyperextension of the proximal phalanx at the metatarsophalangeal joint. However, the AP or oblique view can be extremely useful for localization of a monarticular problem. As the degree of subluxation progresses, the amount of clear space between the head of the metatarsal and the base of the proximal phalanx decreases. The base of the proximal phalanx will appear to overlap the metatarsal head when there is a frank dislocation. If there is severe hyperextension of the proximal phalanx, the "gun-barrel" sign will be seen on an AP radiograph, as the phalanx is viewed end on (Fig. 7).

Initial treatment includes a rheumatologic evaluation and appropriate medical control of any underlying systemic disorder. Symptomatic treatment with extra-depth shoes, metatarsal pads, metatarsal arch supports, and well-padded liners or soft inserts may provide some relief. A rocker-bottom shoe may relieve stress on the metatarsal heads.

In systemic inflammatory disorders there is often additional involvement of the hallux, midfoot, or hindfoot, which also requires consideration when formulating a treatment plan. The goal of surgical correction is pain-free ambulation in standard shoes. In the early stages of the disease, with limited deformity, synovectomy may be used to decompress the joint and remove inflammatory tissue. However, the

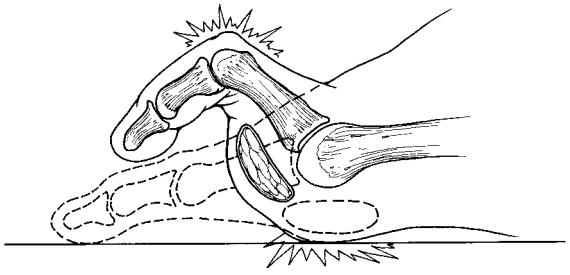

**Fig. 5** The fatty cushion is displaced dorsally with subluxation of the metatarsophalangeal joint.

**Fig. 6** This AP radiograph of the foot of a patient with rheumatoid arthritis shows dislocation of all of the lesser metatarsophalangeal joints.

**Fig. 7** The "gun-barrel" sign can be seen on this AP radiograph of the foot, as the dislocated second proximal phalanx is viewed end on.

usually progressive nature of these disorders often requires a more extensive procedure to prevent recurrence of the deformity. An appropriate surgical treatment, such as a fusion, is often performed simultaneously at the first metatarsophalangeal joint. Resection of the lesser metatarsal heads can decompress the forefoot, allowing the fat pad to return to its normal plantar position. We prefer a dorsal approach to eliminate the potential of painful plantar scars and to better protect the plantar neural structures. This relocation of the plantar fat pad decreases the stresses on the plantar skin, which is followed by resolution of the painful callosities under the metatarsal heads. Appropriate correction of interphalangeal joint deformities, such as hammer toes, can also be performed. Stabilization of the lesser toes can be accomplished with the postoperative use of Kirschner wires for 3 weeks or a soft dressing that is changed weekly to support and protect the toes while scar tissue is forming.

Factors other than synovitis or systemic inflammatory disorders can also be responsible for instability and subsequent metatarsophalangeal joint subluxation and dislocation. Extrinsic forces, often acting on the second (and longest) ray of the foot, can lead to an isolated subluxation or dislocation. Pressure applied on the distal aspect of the toe by footwear may cause the toe to hyperflex at the proximal interphalangeal joint. Eventually these external deforming forces may lead to dorsal displacement of the base of the proximal phalanx on the metatarsal head. With continued pressure, the plantar soft tissues may stretch and lose their function as stabilizers of the joint. The joint will subluxate and may proceed to dislocation.

A hallux valgus deformity may also be a source of extrinsic forces that lead to dislocation at the second metatarsophalangeal joint. Medial pressure from the hallux may lead to lateral or dorsal deviation of the second toe. If the hallux rides underneath the second toe, it may cause the second toe to displace dorsally, resulting in a crossover toe deformity.

## Discrete Intractable Plantar Keratosis

A well-localized, discrete hyperkeratotic proliferation under a metatarsal head can cause significant pain and disability.[9,10] These "seed corns" must be differentiated from plantar warts, which are caused by a virus. Plantar warts are painful, discrete raised lesions, which can occur anywhere on the plantar aspect of the foot, including non-weight-bearing areas. Such warts are highly vascular, exhibiting dark end capillaries or punctate bleeding when shaved. In contrast, the intractable plantar keratosis consists of a hard core of avascular keratotic tissue (Fig. 8), which is tender to direct pressure. The lesion is generally located under a metatarsal head or at any site of abnormal pressure, such as a prominent fibular condyle. The associated bony prominence can sometimes be appreciated on a radiograph if a marker is placed on the skin at the site of the keratosis.

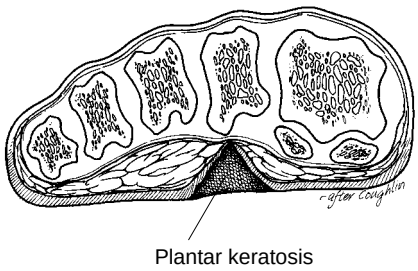


**Fig. 8** Cross section of the foot shows a discrete plantar keratosis beneath the prominent fibular condyle of a metatarsal head.

Initial management should be aimed at relieving the pressure with metatarsal pads and soft, flat shoes, with additional cushioning if needed. The padding should be placed proximal to the metatarsal head to reduce the weight-bearing on the lesion. Shaving the callus at regular intervals in the office, combined with use of a pumice stone by the patient after bathing, also may control the painful prominence and provide significant symptomatic relief.

If symptoms persist, surgical treatment can give satisfactory results. The surgery is aimed at removing the bony prominence under the metatarsal head formed by the plantar condyles, which will relieve the localized pressure. This is usually accomplished by a Du Vries arthroplasty (Fig. 2), in which the articular surface and the plantar aspect of the metatarsal head are excised. Alternatively, the articular surface is spared, and only the prominent plantar condyles are removed.

## Diffuse Plantar Keratosis

A diffuse painful thickening under the lesser metatarsal heads is the result of abnormal pressure.[9,10] This is generally caused by altered weight-bearing due to a congenital condition, such as a short or unstable first metatarsal or cavus foot, or is secondary to trauma or a surgical procedure that elevates the first metatarsal head. Shortening of the first ray, as in a Mitchell procedure for hallux valgus, may result in a transfer lesion under the lesser metatarsal heads as they are forced to bear more of the load. Surgery on one of the lesser metatarsals, such as a dorsal wedge osteotomy or a metatarsal-head resection, may also cause problems in the other metatarsals. Alternatively, a fracture of one of the lesser metatarsals may heal in plantar flexion, causing the bone to bear a greater proportion of the weight. Subluxation or dislocation of a lesser metatarsophalangeal joint may also lead to formation of painful plantar keratosis (Fig. 9).

Initial management follows the same principles as for discrete intractable plantar keratosis, relieving pressure and redistributing the abnormal forces with soft shoes and metatarsal pads. If these measures are not sufficient, surgical treatment may be indicated. For an abnormally long metatarsal, this can include shortening with an oblique longitudinal osteotomy. A plantar-flexion deformity can be corrected with a basal metatarsal dorsal-wedge osteotomy. These osteotomies should be stabilized, usually with a Kirschner wire, to prevent malunion or nonunion. In some cases, a first metatarsophalangeal joint arthrodesis may be necessary to decrease forefoot stresses during heel rise. Resection of a metatarsal head is rarely indicated; the procedure can lead to significant complications, including development of symptomatic deformities in the toe and/or new transfer lesions in adjacent toes.

## Freiberg's Infraction

Osteochondrosis of a metatarsal head, most often the second, can cause symptoms isolated to the metatarsophalangeal joint.[3] On presentation, the patient has pain at the joint, usually aggravated by activity. Physical examination may reveal warmth, swelling, and limited range of motion. Initial radiographs may appear normal. A bone scan, while not specific, may be useful for localizing the pathologic process to the metatarsal head. Magnetic resonance imaging may show changes consistent with suspected avascular necrosis. Follow-up plain radiographs may reveal progressive deformities of the metatarsal head, often with irregularity, fragmentation, and flattening.

**Fig. 9** **Top,** Diffuse plantar keratosis caused by dislocation of the metatarsophalangeal joints of the second and third toes. **Bottom,** Radiograph shows the underlying dislocation of the metatarsophalangeal joints in the second and third toes.

This entity usually occurs during adolescence and is presumed to be caused by avascular necrosis of the subchondral bone. It is speculated that this condition is secondary to repetitive stresses at the metatarsal head, which cause microfractures

and subsequent compromise of the blood supply. Although the condition may heal with only minimal deformity, some patients have progressive degenerative changes with articular destruction. Synovitis may also accompany the osteochondral changes.

Treatment of the acute phase of the condition includes use of a stiff-soled postoperative shoe or a short-leg walking cast to rest and immobilize the joint. An intra-articular corticosteroid injection may provide some relief. If the patient continues to be symptomatic with pain and restricted motion, particularly with evidence of hypertrophy and degenerative changes, surgical management may be indicated. The usual approach includes exploration of the joint, synovectomy, and debridement of bone fragments and osteophytes. More extensive deformity may require more extensive decompression of the metatarsophalangeal joint. A Du Vries arthroplasty (Fig. 2) with subsequent fibrous healing of the joint can yield a stable, pain-free result. If the volar portion of the joint is well preserved, a distal metatarsal Moberg-type osteotomy can be considered. This consists of a dorsal closing wedge at the level of the metatarsal neck approximately 1 inch proximal to the joint, which results in dorsiflexion of the metatarsal head.

## Cock-up Fifth Toe

A severe dorsiflexion deformity at the fifth metatarsophalangeal joint can cause the proximal phalanx to become almost perpendicular to the shaft of the metatarsal.[2,3] This cock-up deformity at the metatarsophalangeal joint may also have a hammer-toe component. If the toe cannot be accommodated by wide or extra-depth shoes, surgery may be indicated. This should aim to correct the alignment at both the metatarsophalangeal joint and the proximal interphalangeal joint. A mild deformity may be corrected by release of the soft tissues at the metatarsophalangeal joint, extensor tenotomy, and perhaps a hammer-toe procedure.

A more severe fixed deformity may require excision of all or part of the proximal phalanx. Complete excision of the proximal phalanx, the Ruiz-Mora procedure, provides good relief of symptoms. However, significant problems may occur postoperatively[11]; for example, a painful, prominent fifth metatarsal head may cause a bunionette-type deformity, a painful hammer toe of the adjacent fourth toe, and development of a floppy fifth toe. Resecting less bone or sparing the proximal portion of the phalanx may help to avoid these complications.

In performing a corrective procedure, it is important to release contractures of the skin and soft tissues to obtain a satisfactory result. To resolve contractures of the skin, it is often necessary to perform a V-Y advancement at the base of the proximal phalanx in conjunction with release of the extensor tendons and the dorsal capsule. Syndactylization of the fourth and fifth toes after release of all soft tissues can be considered for severe deformities.

## Summary

Pain in the region of the metatarsophalangeal joints of the lesser toes, often termed metatarsalgia, can arise from any of several specific causes. Formulation of an appropriate treatment plan is dependent on taking a rational approach to diagnosis. This requires a thorough history and physical examination of the foot and ankle, in conjunction with appropriate radiographs. Decision making involves a careful analysis of the underlying cause to determine whether the therapeutic measures will be successful and to avoid creating problems secondary to surgical procedures. With proper evaluation and treatment, potentially disabling pain and deformity in the forefoot can often be satisfactorily resolved.

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