CHAPTER 10

Approaches To Midfoot Degenerative Joint Disease

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INTRODUCTION

The joints of the midfoot are susceptible to degenerative changes as a result of a variety of forces, including biomechanical faults, frank trauma, and Charcot neuropathy. Such degeneration may be accelerated by concurrent osteoarthritis, or compensation for a functional foot deformity such as equinus. Diagnosis can be elusive until radiographic changes are evident. Conservative treatment is effective only while symptoms are tolerable, while surgical intervention becomes the treatment of choice in order to achieve pain free function.

ANATOMICAL CONSIDERATIONS

The joints of the midfoot include LisFranc's (tarsometatarsal) joint, Chopart's (midtarsal) joint, and the joints in between. Because of its unique function (which is more in tandem with the subtalar joint), the midtarsal joint will not be addressed in this paper.

The tarsometatarsal joints consist of the first, second, and third metatarsocuneiform joints, as well as the fourth and fifth metatarsocuboid joints. This is an intricate network of articulations which make up the transverse arch of the foot, where the keystone is the second metatarsal and cuneiform. The transverse arch is connected by dorsal, plantar, and interosseus ligaments which bond all metatarsal-cuneiform/cuboid articulations except for the first and second metatarsal bases. Although the bases of these two metatarsals have no ligamentous attachment between them, the second metatarsal is stabilized by an extremely strong ligament from the medial cuneiform bone (LisFranc's ligament). The intertarsal joints consist of the first, second, and third naviculocuneiform articulations, as well as the adjacent interfaces between the first and second cuneiform bones, the second and third cuneiform bones, and the third cuneiform-cuboid bones.

Motion is limited to each ray as well as adjacent articulations. The shapes of the joints allow only limited motion, making them particularly susceptible to jamming injuries, which are exaggerated in the Charcot foot. The midfoot is the interface between the rearfoot function (subtalar and midtarsal joints) and forefoot function (metatarsals and digits). In addition, there is a limited amount of intertarsal motion.

PATHOPHYSIOLOGY

Midfoot degenerative joint disease is the product of trauma, biomechanical abnormalities, or neuropathy (Figs. 1A, 1B). Trauma can include blunt or crush injuries, contusions, or high velocity impact. Tarsometatarsal joint dislocations or fracture/dislocations can be devastating injuries which rapidly progress to degenerative joint disease. Injury to this group of articulations can also involve other midfoot bones and joints, as well as the base of the metatarsals (particularly the second). With trauma, there is direct articular damage which causes significant joint degeneration over time. Underlying biomechanical deformities can further accelerate arthrosis.

Figure 1A. A 67 year-old female with non-traumatic degeneration of the tarsometatarsal joint.

Figure 1B. Note the point of sagittal plane collapse on the latency radiograph.

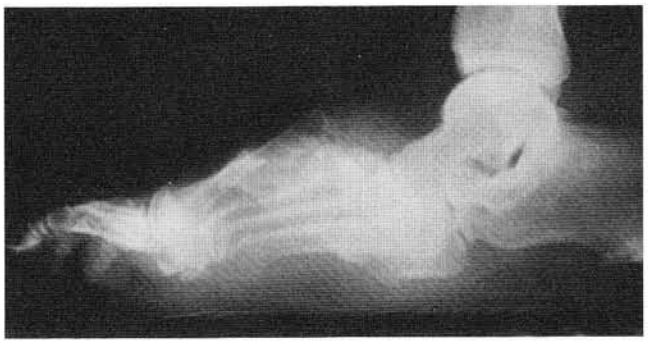

Figure 2A. Lesser tarsus joint destruction aggravated by an equinus deformity. Note the point of compensation at the talonavicular joint.

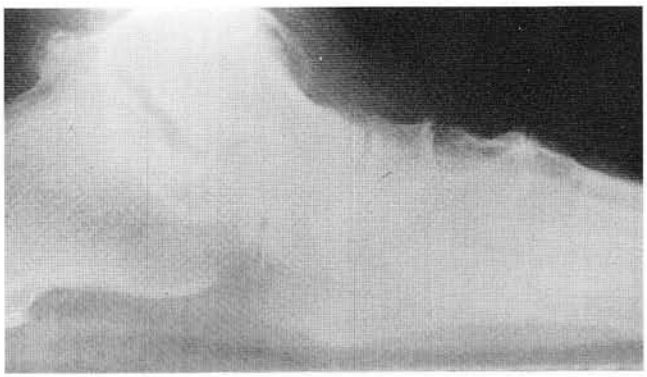

Figure 2B. The point of compensation is at the naviculocuneiform joint.

The most common biomechanical deformity that can cause midfoot jamming is pronation. Once the subtalar joint pronates and unlocks the midtarsal joint, the distal joints, including those of the midfoot, tend to lose their inherent functional stability as a rigid lever. With a loss of stability, the joints are in malalignment and reach an early functional end range of motion. This causes significant jamming as the weight of the body continues to propulse across them. Such forces result in significant degenerative changes where the impact of the joint is greatest, which is usually dorsally.

In pes cavus, there is a significant supination deformity which again causes midfoot jamming, but by a slightly different mechanism. The joints are inherently stable, but have no available end range of motion. This results in significant cartilage degeneration, particularly at the dorsal margins of the joints.

Compensation deformities can include forefoot or rearfoot varus, forefoot valgus, and equinus (Figs. 2A, 2B). Fusion, by way of triple, pantalar, or even single hindfoot joint arthrodesis, causes increased stress on the surrounding joints as they attempt to compensate for the lost motion. This too can result in joint jamming and destruction.

Perhaps the most dramatic manifestation of midfoot stresses is in the neuropathic foot. Loss of shock absorption mechanisms results in rapid joint destruction, and fractures accelerated by biomechanical deformities such as equinus. Conditions which predispose patients to degenerative joint disease of the midfoot include overuse, obesity, osteoporosis, rheumatologic disorders, biomechanical deformities, and neurologic disorders.

DIAGNOSIS

Stiffness, midfoot fatigue, and difficulty wearing shoes, especially if they are tight over the midfoot area, are all early symptoms of developing degenerative joint disease. The pain is usually of a dull aching nature, and is located more dorsally than plantarly. Pain is due to subchondral osseous damage after there is loss of articular cartilage. There may also be localized synovitis. Pain becomes more severe during weight bearing, resulting in difficulty with walking. It may present as poststatic dyskinesia, and the patient may report a significant increase in symptoms when there are temperature or weather changes.

Usually there is very little swelling, but often warmth is present at the affected articulations. The patient may often present with an antalgic gait. Palpation reveals tenderness along the joint lines dorsally where osteophytes may be evident. There are seldom significant clicks or crepitus, since there is insufficient motion in these joints to produce such signs. Careful and deep palpation of the midfoot from the plantar approach will also often

reveal tenderness. One should be able to anatomically identify the exact joint(s) affected before consulting radiographs.

In terms of diagnostic tests, blood studies are not usually helpful, with the possible exception of the ESR which is a nonspecific marker for inflammation. Radiographs show a loss of joint space, often with complete joint obliteration. If the x-ray is not pointed at the correct angle, visualization of the joint may be obscured. Repeat films with adjusted central ray angles may be necessary. Radiographic findings include narrowing of the joints, subchondral sclerosis, erosions, and periarticular osteophytes (Figs. 3A, 3B). Subluxation and dislocation may be evident in the most severe cases, especially in the Charcot foot. A CT scan is indicated only if joint damage is extensive, and if the information gained would influence the treatment.

Figure 3A. An example of degenerative changes in the midfoot.

CONSERVATIVE TREATMENT

Early intervention is most beneficial if initiated prior to radiographic evidence of degenerative joint disease. Treatment modalities include compression, heat, NSAIDs, and physical therapy. Heat delivered via ultrasound or a paraffin wax bath is the most effective treatment. Orthotic support is also essential. Occasionally, a short period of casting is necessary in order to effect sufficient rest for relief of symptoms.

Figure 3B. Note how the change in the angle of the central radiograph beam "opens" various midfoot joints.

Intra-articular corticosteroid injections can provide a variable duration of relief, but are generally effective in relieving symptoms. A soluble steroid should be utilized for the initial test injection. If this is successful, the longer acting crystalline steroid salts should be utilized. There is relatively low risk of further joint damage since the hyaline cartilage has already been destroyed by the degenerative process.

SURGICAL TREATMENT

Persistent pain and disability in spite of conservative care is the primary indication for surgical intervention. However, the patient should not be immediately scheduled for surgery merely due to marked joint destruction on the initial radiograph. The nature of the pathology, prognosis with and without treatment, and the alternatives for non-operative and operative care should be clearly delieated to the patient before surgical intervention is attempted.

Midfoot degenerative joint disease frequently occurs in the geriatric population. Because it is often impossible to keep this patient non-weight bearing during recovery from arthrodesis, alternative procedures may be considered. One such procedure is the osteoarthrotomy. This involves

resecting one side of a joint (usually the more mobile side), such as the bases of the metatarsals at the tarsometatarsal junctions. Complete medial to lateral resection of the midfoot should not be attempted, however, one or two joints may be addressed at a time. The patient must be made aware of the fact that a bone graft arthrodesis may be necessary in the future, if the procedure fails to produce painfree ambulation.

Silastic implant material can serve as an interface at the osteoarthrotomy site. High density silicone polymer can be fashioned from a solid block, and shaped to fit in the appropriate space. Again, the patient must be prepared for possible failure and the need for further arthrodesis at the site. There are no long-term studies relative to the effectiveness of silastic material in these particular locations. Postoperative management includes the use of a closed suction drain and a surgical shoe. Weight bearing is allowed immediately as necessary.

A common and effective procedure for relief of midfoot degenerative joint disease is arthrodesis of either a single joint or a combination of joints, depending on the degree of pathology. Whether the bones need to be fused, at their side-to-side interfaces depends again on the pathology presented. Usually the bones within each ray can be fused, and it is not imperative to fuse the bones in between the rays, unless there is severe joint destruction present (Figs. 4A, 4B). The more mobile the joint, the greater the chance for non-union. Therefore, mobile articulations such as the first metatarsocuneiform joint require greater stabilization.

Incision Planning

Incision placement requires careful planning due to the many anatomical structures that lay between the scalpel and the affected joints. Each layer houses nerves and vessels, including the superficial peroneal nerve branches and the dorsalis pedis/deep peroneal neurovascular bundle, which lies on the periosteum of the midfoot. One should use a skin scribe to carefully draw the target articulations and the vital structures in the area before making an incision. The incision should be oriented to provide the best exposure with the least amount of scarring.

Figure 4A. Preoperative radiograph of a 54 year-old female with painful degeneration of the lesser tarsal joints.

Figure 4B. Complete relief of painful symptoms in medial lesser tarsal joints, resolved by fusion. Postoperative radiograph following arthrodesis of the first and second tarsometatarsal joints. The patient had complete resolution of pain following successful fusion.

Joint Resection

Articular osteophytes will be encountered first, and these must be removed along with any loose ossicles. The damaged articular surfaces must then be resected to expose the underlying cancellous bone. Overaggressive resection of bone should be avoided so as to not make consolidation difficult or impossible.

Fixation

Internal interfragmentary compression fixation is the ideal goal for immobilization of the arthrodesis sites. This may be augmented by neutralization plates, such as the one-third tubular plate. A T-plate is well suited for use along the medial surface of the first metatarsocuneiform joint, and can be extended proximally to include the navicular. A small dynamic compression plate can be placed over the tarsal articulations dorsally to provide interfragmentary compression and stabilization. However, there is a risk of irritation from this plate. Other methods of fixation include cross k-wires, staples, and absorbable pins. Staples should be pre-drilled to prevent fracture into the arthrodesis site.

Special considerations are given to the more mobile versus the more stable midfoot joints. Furthermore, consideration for motion must be made between the stabilized ray and the adjacent mobile ray. This is important when deciding to cross non-damaged joints with internal fixation devices.

Due to the anatomical complexities of the midfoot, the approach to fixation is variable in every clinical situation, depending on whether one or more joints are involved, if transverse fusion is required, and the age, bone quality, and activity level of the patient. Finally, one must address any concurrent structural or functional deformities.

Controversy exists regarding the crossing of unaffected joints in the area with screws in order to enhance fixation and stabilization of the arthrodesis sites. There is some concern for joint damage, even if the screws are to remain in place only temporarily. There is also the possibility that shear forces will lead to fracture of the screws. Although some authors have applied these with impunity, there is insufficient evidence to suggest that these joints will not break down over time, once they are damaged by the screws.

Bone Grafting

Bone grafting material, preferably cancellous bone, should be available for every midfoot arthrodesis procedure. The order of preference for bone grafting is autogenous, allogeneic, or a bone substitute such as that derived from coral. Bone graft material can be firmly wedged into the arthrodesis site to add some measure of compression to insure consolidation.

Postoperative Management

The patient should be placed in a compression cast until the surgical swelling subsides, usually between three and five days. A non-weight bearing below-knee cast is then applied for six to eight weeks, followed by a walking cast for an additional two weeks. Rehabilitation to pain-free walking in shoes is then instituted.

SUMMARY

Successful treatment of midfoot degenerative joint disease can be very gratifying to both the patient and the surgeon, since it usually resolves a painful and incapacitating problem. Although normal intertarsal and tarsometatarsal motion is relatively limited, stabilization can be quite challenging, especially the application of internal fixation in order to achieve stable osseous consolidation. Attention to the principles which have been presented will help achieve these goals.

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