CHAPTER 9

Trephine Arthrodesis for Tarsometatarsal Joint Arthritis

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Trephine arthrodesis has many advantages over traditional cartilage resection for the tarsometatarsal joint (TMTJ) arthrodesis. These advantages include quicker fusion time with decreased incidence of nonunion, less likelihood of shortening the ray, less instrumentation and time, avoidance of sagittal plane deformity of the metatarsal, and the ability to easily fuse intercuneiform and/or intermetatarsal joints if necessary.

QUICKER FUSION TIME/ LESS NONUNIONS

We know that the best healing potential in long bones will be in the metaphysis. The subchondral bone plate is often left intact for stability in fusions. Healing time increases when bone has to bridge the subchondral bone plate. In arthrosis of the tarsometatarsal joints, there is typically significant sclerosis of this bone. With a trephine arthrodesis, the entire subchondral bone is removed and healthy metaphyseal bone is left for autogenous bone filling of the defect. This should allow for quicker incorporation of bone and no need for bridging of bone across sclerotic bone plates.

AVOID SHORTING OF THE RAY

When a tradition end-to-end arthrodesis is performed, cartilage and subchondral bone is typically removed, which can leave a 5 mm gap between the bones. If one takes a sagittal saw and passes it up and down the joint, there is little chance of removing the subchondral bone with that technique. Also, there is potential of thermal necrosis. I have found that this can lead to prolong healing times and more nonunions.

LESS INSTRUMENTATION/SAVE TIME

The most common method of joint preparation would be to expose the joint with a mini-joint distractor and to use a hand curette, rongeur, rotary burr, and/or a saw to prepare the joint. Without a joint distractor, one cannot really appreciate the plantar aspect of the joint and will leave cartilage or subchondral bone. This will lead to delay in healing. It wastes time to handle so many instruments and moreover, one is fiddling with a joint distractor and working around that. By the time one drills a couple of Kirschner wires, puts on the distractor, and opens the joint, the trephine would have cored the recipient site already.

AVOIDANCE OF SAGITTAL PLANE DEFORMITY

As discussed earlier, the plantar aspect of the fusion is the most difficult area to prepare and is often not adequately addressed. When this happens, dorsiflexion of the metatarsal will occur when the two ends of bone are brought together. Moreover, if there is a significant gap between the bones after saw resection of subchondral bone plates, it is more likely to have sagittal plane deformity as one is trying to counteract soft tissue constraints to make a tight fit.

INTERCUNEIFORM/ INTERMETATARSAL JOINTS

Another benefit of trephine arthrodesis is that one can encompass not only the TMTJ for fusion, but can also orient the plug to catch an intermetatarsal joint or even an intercuneiform joint if you suspect pain may be coming from those sites. I have found that the high arch and curved foot type (metatarsus adductus) is one of the most challenging foot conditions to treat. We know that this foot type tends of stress the lateral part of the foot and as a result premature, nontraumatic arthrosis occurs in the second and third tarsometatarsal joints (1) (Figure 1). Accompanying

Figure 1. In metatarsus adductus, premature non-traumatic arthrosis occurs at the second and third TMTJs.

the arthrosis is typically a large exostosis in the area causing pain to the dorsal foot when wearing shoes.

From a nonsurgical standpoint, oral and/or topical anti-inflammatory medication, occasional cortisone injections in a periarticular fashion to the TMTJs, alternating shoe lace patterns, and using a valgus orthotic device to prevent lateral foot overload is recommended. For many patients, these treatments are not adequate to resolve pain and surgery is indicated. For the most part, surgery will involve an exostectomy with or without a TMTJ arthrodesis of the affected joints. It is important to try to elucidate where the patient's pain is coming from. The exostosis will typically cause nerve irritation to the dorsal foot. When the primary symptom is from arthritis, one would have morning stiffness with post static dyskinesia. Certainly there can be both conditions. Diagnostic anesthetic injections can be very helpful in differentiating the two conditions.

When there is arthritis pain, then an arthrodesis is necessary in addition to the exostectomy to resolve pain. A computed tomography (CT) scan or magnetic resonance image (MRI) can be helpful to ascertain the amount of arthrosis. The CT will give you the best picture of the amount of damage to the joints where as the MRI will determine how much bone marrow edema and inflammation is associated with each joint.

CASE REPORT

For illustration of the trephine arthrodesis technique, a case report is presented. A 66-year-old female presented to the office with dorsal midfoot pain. She had prior foot surgery, which included a dorsal TMTJ exostectomy and a bunionectomy. Her radiographs were remarkable for second and third TMTJ arthritis and a CT scan confirmed severe arthrosis. On examination, she had some residual abduction of the great toe with some undermining of the second toe. Pain was noted with palpation of the second and third TMTJs and with sagittal plane motion of the second and third metatarsals. In addition to arthritis of the TMTJs, radiographs revealed a short first ray and residual exostosis in the mid foot (Figures 2, 3). Therefore, the surgical plan was to perform a modified McBride bunionectomy with an Akin osteotomy to help straighten the big toe without any more shortening of the first ray as well as a trephine arthrodesis of the second and third TMTJs with autogenous bone graft form the ipsilateral heel.

Focusing on the trephine arthrodesis, a linear incision was made over the second and third tarsometatarsal joints. Dissection was carried down through the soft tissues with care to avoid the artery and nerve in the area. The capsule and periosteum was reflected from the joint and a Freer elevator was used to find the joint (Figure 4). Next a 10 mm trephine was used to remove three-quarters of the joint leaving a plantar shelf of bone to serve as the floor. Generally, 20 mm in depth is adequate. Ryan et al reported the average depth of the second and third TMTJs were 26.9 mm and 23.6 mm, respectively (2). Typically, the bone plug removed is discarded. The autogenous bone was now harvested from the ipsilateral heel.

Figure 2. Preoperative radiograph revealing prior surgery and arthrosis of the second and third TMTJs.

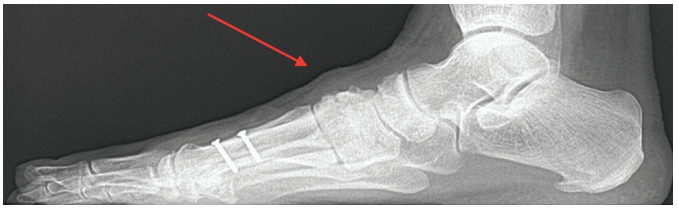

Figure 3. Preoperative radiograph revealing residual exostosis and arthrosis. The arrow indicates the chronic soft tissue swelling.

Figure 4. A Freer elevator is used to find the joint and you can confirm on fluoroscopy if necessary. When these joints are arthritic, they can be difficult to find.

An oblique incision was made over the lateral heel, similar to a Dwyer incision. Dissection was carried down to the periosteum of the heel, which was then reflected with a Freer elevator. A Weitlaner retractor was used for two purposes, first to aid in retraction and second to confirm where the plug will be taken. A fluoroscopy image with the retractor in place allows you to cut the plug between the teeth of the retractor and you will always have it taken from the precise area you want (Figure 5). A 12 mm trephine was used so that there was a tight fit of the graft (Figure 6). The autogenous bone was then tamped into the recipient site and made flush to the surrounding bone (Figures 7, 8).

For the third joint, the same process was performed. Since you are only taking about 20 mm of bone, you can get another plug from the same site where you obtained the first plug. After grafts are in place, I will typically place

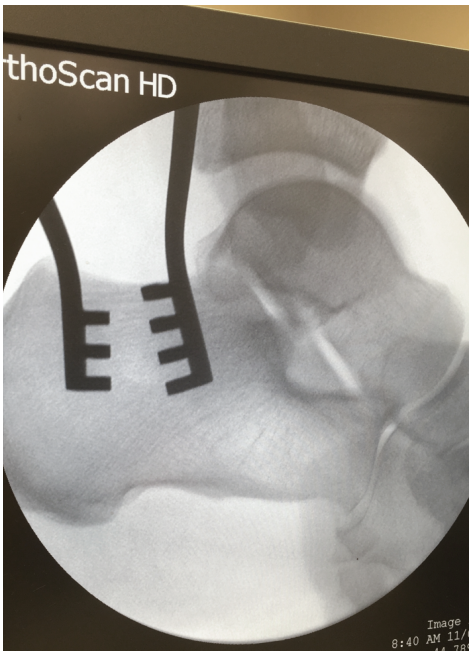

Figure 5. Once the soft tissue dissection is completed on the lateral heel, a Weitlaner retractor is used to retract tissue and confirm the area for your bone graft procurement.

Figure 6. A 12 mm trephine is used to obtain the bone graft whereas a 10 mm trephine was used to prepare the recipient site.

Figure 7. A 20 mm plug of graft from the heel to be inserted into the recipient site.

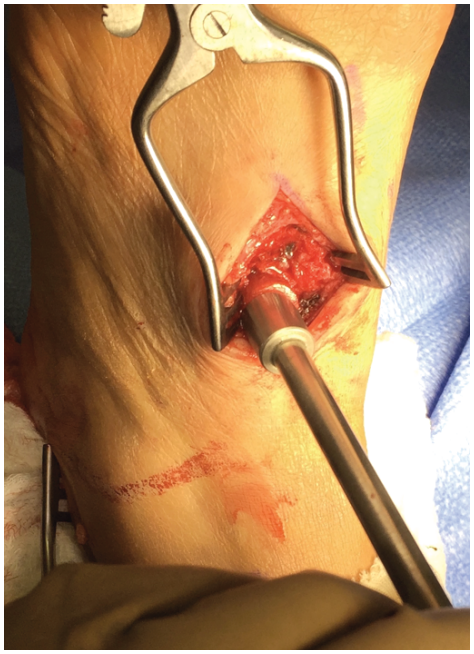

Figure 8. Due to a tight fit, a tamp is necessary to make a flush fit.

Figure 9. Radiograph 1 week postoperative. Staples are a simple way to prevent the graft from dorsally migrating.

a staple over the graft to prevent any dorsal migration of the graft. Allograft bone was backfilled to the calcaneus. Tissues were closed in layers and a dressing with below knee posterior splint was applied.

Postoperative protocol includes radiographs at week 1 (Figures 9, 10). I will usually use a fracture boot as a removable cast for 6-8 weeks of non-weightbearing until radiographs confirm healing. Gradual protected ambulation in the fracture boot is then recommended for 2-4 weeks. Once ambulating in the fracture boot without pain, then there is gradual return to shoes.

In summary, a trephine arthrodesis can be another technique that works very well for tarsometatarsal joints. It certainly can be done for other fusions in the foot; however, this condition seems to be the most common scenario where I employ this technique. Advantages of the trephine arthrodesis include simplicity for joint preparation, avoid shortening or angulation deformities of the metatarsal, rapid incorporation especially when using an autograft, and it is generally quicker to prepare and fixate than a traditional end-to-end arthrodesis.

Figure 10. Radiograph 1 week postoperative illustrating the donor site.

Simple pearls:

1. Trephine arthrodesis is ideal when there is no need for adjustment of the position of the bones (i.e., shortening, angulation, etc.).
2. Make sure you use a 2 mm larger trephine for your bone graft procurement to allow for a tight fit in the recipient site.
3. Leave a plantar shelf at the arthrodesis site to allow for a floor of the graft as well as maintaining ligamentous stability.
4. A fluoroscopic image with a Weitlaner in place in the heel will ensure you obtain your graft in the desired location.
5. Always consider this technique for a nonunion repair as there is typically a lot of fibrotic bone that needs to be debrided and this will prevent shortening that would otherwise occur.

REFERENCES

1. Fishco WD, Ellis MB, Cornwall MW. Influence of a metatarsus adductus foot type on plantar pressures during walking in adults using a pedobarograph. J Foot Ankle Surg 2015;54:449-53.
2. Ryan JD, Timpano ED, Brosky TA. Average depth of tarsometatarsal joint for trephine arthrodesis. J Foot Ankle Surg 2012;51:168-71.