CHAPTER **35**

ARTHRODESIS USING THE DARCO LOCKING PLATE

Christopher R. D. Menke, DPM

INTRODUCTION

There are many forms of fixation used for arthrodesis within the foot, including Kirschner-wire, Steinmann pins, cerclage wire, staples, crossed screws, standard plates and screws, and external fixation. Recently, locking plates have been shown to provide an increase in rigidity and stability to both osteotomies and arthrodesis within the lower extremity. In particular, the Darco locking plates (Wright Medical, Arlington, TN) have been gaining acceptance for use in various forefoot and rearfoot procedures. In 2007, Gallentine and DeOrio[1] reported their results using the Darco locking plate in stabilizing proximal metatarsal chevron osteotomies. They concluded that the locking plate held both alignment and position of the first ray and that it may improve stability of the proximal metatarsal after osteotomy. Cohen[2] noted that the plate may have advantages clinically, with juxta-articular bony defects or when crossed screw compression fixation was not possible. McGlamry and Castellano also reported success with the Darco plate for stabilizing various forefoot procedures.[3,4]

THE DARCO PLATES

The Darco plating systems were first developed in Germany (Normed Medizin-Technik GmbH, Tuttlingen, Germany) during the late 1990s and eventually the titanium implants were distributed in the US. Wright Medical purchased the product line in 2007. Currently there are 2 different Darco plating sets, a modular rearfoot set (MRS) and a modular forefoot set (MFS). The modular rearfoot set contains 3.5-mm screws ranging from 14 to 40-mm in length. The forefoot set utilizes 2.7-mm screws with lengths ranging between 8, and 30-mm. Screws in both sets increase incrementally by 2-mm. Overall, there are 10 different plates between the 2 sets, including a calcaneal plate, a first metatarsophalangeal joint fusion plate (with 10° of valgus built in), flat plates with up to 8-mm of interpostional spacing, displacement plates with up to 10-mm of step off, and a variety of flat plates ranging from 4 to 14 holes (12 to 66-mm in length).

All plates within the sets are rhombus (parallelogram) by design with a crossed screw orientation. This creates fixation in multiple planes given that the screws both converge and diverge as they go through the plate (Figures 1, 2). All screw holes within the plate can accept either a nonlocking or locking screw. Utilizing locking plate technology, the screw can lock into the plate at a fixed angle, therefore reducing the chance for toggle between the screw and plate interface.

Figure 1. The screws both converge and diverge as they go through the plate.

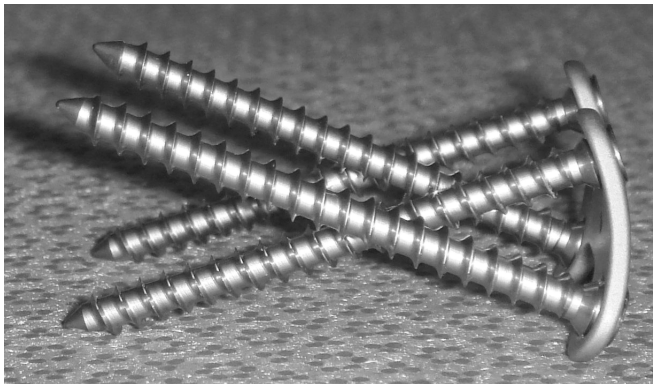

Figure 2. Lateral view.

INDICATIONS

At our institution, we have successfully used various Darco plates for arthrodesis in major forefoot and rearfoot joints. The plates have been utilized in correcting severe hallux abducto valgus, isolated arthritic joints, nonunion repair, collapsing pes plano valgus, and Charcot foot breakdown. A 4-hole locking plate is sufficient for various isolated fusions including the first metatarsophalangeal joint, metatarsocunieform joint, naviculocunieform joint, talonavicular joint, and calcaneocuboid joint. The 3.5-mm plating system also contains plates with up to 14 locking holes that can be used in complicated rearfoot cases, such as in medial column Charcot reconstruction and collapsing pes plano valgus surgery (Figure 3).

OPERATIVE TECHNIQUE

When applying the Darco locking plate for a metatarsocunieform arthrodesis, standard preoperative patient preparation is performed. Once distal soft tissue procedures are performed and dissection down to the metatarsocunieform joint is accomplished, a mini-distractor is placed dorsally over the exposed joint. This allows for either contoured joint resection accomplished with rongeurs, curettes and a power burr, or planar joint resection with a power saw. It is important keep in mind the 4 basic tenants laid out by Glissan in achieving a successful arthrodesis.[5] First, all cartilaginous, fibrous, and any other material that may prevent bone to bone contact must be removed from the opposing surfaces. The arthrodesis sites must be realigned into optimal position as well as accurate and close fitting of the fusion surfaces. Finally, successful union of the arthrodesis site requires maintenance of the bone apposition in an undisturbed fashion until the fusion is complete.

Typically, the hole created in the metatarsal by the mini-distractor is used as the entry point for an interfragmental compressive screw. One nonlocking 3.5-mm screw from the Darco set is inserted across the metatarsocunieform joint from the metatarsal into the medial cuneiform. The 2.5-mm drill from the set can be utilized to create a pilot hole and a 3.5-mm drill (not included in the Darco set) is used to over drill the near cortex, creating lag compression. After confirming adequate compression by the screw, a 4-hole Darco H-locking plate is positioned against the plantar medial joint surface (Figure 4). The plate may be contoured for a better anatomic fit; however, this can both weaken the integrity of the plate as well as alter the locking ridges within the plate holes. If the ridges within the plate become bent, the locking drill guides will not insert correctly within the plate, consequently preventing the locking screws from locking correctly into the plate. This can lead to fixation failure postoperatively. Instead, the bone surface can be contoured to that of the plate with power instrumentation; the plate is not bent around the bone.

Once the plate is aligned to the side of the joint, the plate is secured with 4 3.5-mm locking screws. First, the locking drill guide is inserted into the plate and a 2.5-mm drill is used to drill a pilot hole. Care must be taken to insure that the drill guide is accurately fitted within the plate and that the drill is evenly advanced down the shaft of the drill guide. The drill guide is removed and the screw length is measured using the set's depth gauge. Since the screws are both self-drilling and self-tapping, the screw is ready to be inserted through the plate. If applied correctly, the screw should sit flush with the surface of the plate. Improper insertion can lead to stripping of the screw head. On occasion, while predrilling for the dorsal distal locking screw, contact is made with the interfragmental compressive screw. In these instances, by redirecting a

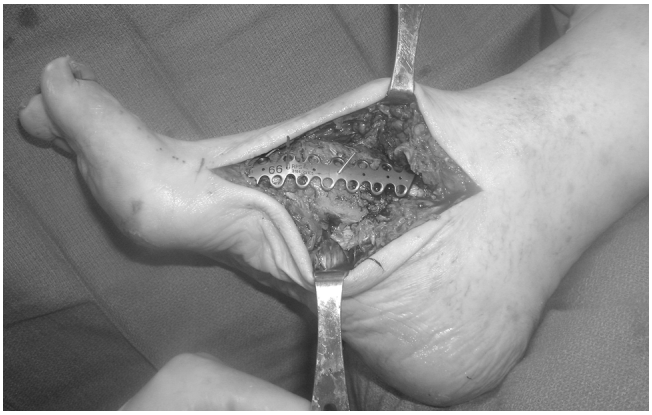

Figure 3. The 3.5-mm plating system also contains plates with up to 14 locking holes.

Figure 4. A 4-hole Darco H-locking plate is positioned against the plantar medial joint surface.

3.5-mm nonlocking screw within the plate, contact with the offending hardware can be avoided.

Wounds are closed in anatomic layers and the foot is placed in a hard Jones compressive dressing or posterior splint. Protected weightbearing is initiated at 3 to 4 weeks postoperatively in a pneumatic fracture walking boot; full-weightbearing in regular shoes begins with radiographic confirmation of osseous consolidation (Figure 5).

There have been many successful techniques described within the literature on fixating various forefoot and rearfoot arthrodesis. Locking plate technology and in particular the Darco plate has become a popular alternative within the surgeon's armamentarium. With multiple plates to choose from, the Darco plating system provides a reliable alternative for both isolated arthrodesis as well as complicated reconstructive procedures.

Figure 5. Radiographic confirmation of osseous consolidation.

REFERENCES

1. Gallentine, JW, Deorio JK, Deorio MJ. Bunion surgery using locking-plate fixation of proximal metatarsal chevron osteotomies. *Foot Ankle Int* 2007;28:361-8.
2. Cohen DA, Parks BG, Schon LC. Screw fixation compared to H-locking plate fixation for first metatarsocuneiform arthrodesis: a biomechanical study. *Foot Ankle Int* 2005;26:984-9.
3. McGlamry MC. Lapidus fusion for hallux limitus. In: Reconstructive surgery of the foot and leg - Update 2005. Tucker (GA) Podiatry Institute; 2005. p 18.
4. Castellano BD. Opening base wedge osteotomy of the first metatarsal: a revitalized procedure. Reconstructive Surgery of the Foot and Leg - Update 2005. Tucker (GA): Podiatry Institute; 2005. p 23.
5. Glissan D. The indications for inducing fusions at the ankle joint by operation with description of two successful techniques. *Aust New Zealand J Surg*, 1949;19:64.