Introduction:

Plate fixation of a fracture, osteotomy or arthrodesis of the foot needs to be versatile, precise and adaptable to the local anatomy. Due to the marked variation in the structure of each metatarsal as well as the metatarsocuneiform and metatarsophalangeal joints, the plates need to have a varied shape, while maintaining flexibility and strength where needed.

The array of plates available with the F³ Fragment Plating system meets the needs described above. There are two basic types of plates, High Flex and High Strength, both of which have a locking screw capacity. (Figure 1) This locking screw technology provides a very stable construct in poor bone, although both locking and non-locking screws are available for each plate.

Each plate hole has Fixed Angle Screw Targeting guides (F.A.S.T. Guides®), facilitating drilling and in situ bending of the plate. (Figure 2) These locking screw guides provide a source for leverage, so that both the High Flex and High Strength plates can be contoured and bent in both the axial and coronal plane, while affixed to the bone.

The High Flex plate can also be bent in the sagittal plane. (Figure 3) The plate can be initially fastened to the bone, and then contoured, or may be bent initially to allow for insertion into a concavity as for example at the neck of the metatarsals.
Plate cutters can easily trim the High Strength and the High Flex plates, although the benders can also be used to bend the High Flex plate up and down until it breaks. (Figure 4)

Fractures and Non-Unions of the

Lesser Metatarsals:

Fractures of the lesser metatarsals associated with comminution are difficult to fix, particularly if they are intra-articular. The alternatives for fixation include longitudinal K-wires introduced axially in a retrograde manner from the toes across the MP joint and into the metatarsal. While this may be effective with fractures of the metatarsal neck, diaphyseal and more proximal fractures require more stable fixation. The more significant problem with the use of K-wires however is these need to cross the MP joints and in doing so, create stiffness of the joint which can be minimized with a low profile plate. Either the High Strength or the High Flex plates can be used in these cases. If comminution is present at the base of the metatarsal with articular preservation, then a Y-plate or L-plate can be used to span across the joint into the cuneiform or cuboid until healed, when the plate can be removed. Due to the paucity of motion at the 2nd and 3rd tarsometatarsal joints, and if the patient is asymptomatic, the plate may be left in situ following this treatment.

Plate Fixation of the 1st Metatarsal:

In general, fixation of the 1st metatarsal can be successfully accomplished with screws for various osteotomies, and small and mini fragment plates for fixation of fractures. However, there are situations where these methods of fixation are not sufficient, nor meet the anatomic requirements for stable metatarsal fixation. One important application of the F3 plating system is for fixation of osteotomies where standard screw fixation has failed, whether this is a Ludloff, proximal chevron, scarf or base closing wedge osteotomy. This typically occurs in patients with osteopenia, or where complications of screw fixation such as metatarsal fracture or fragmentation occur. The advantage of the F3 plating system is its ability to adapt to the medial or dorsal surface of the 1st metatarsal base, particularly with a Y or L-shaped plate. (Figure 5 and 6)

This patient underwent a Ludloff 1st metatarsal osteotomy and bunionectomy for correction of hallux valgus. Intraoperatively, a fracture of the dorsal surface of the 1st metatarsal occurred and stability of the fixation was lost. This was corrected with a medially applied L-shaped F3 plate with an excellent result. (Figure 6)
The Tarsometatarsal Joint(s):

Due to the low profile and the limited surface area of the joint, it can be difficult to secure the 2nd and in particular the 3rd tarsometatarsal joints. The articulation of the 1st tarsometatarsal joint is larger and generally can easily be secured and compression obtained using 3.5 mm or 4.0 mm screws. However, arthrodesis of the 2nd and 3rd joints are not as easy, due to the vertical triangular shape of the joint, and the difficulty with insertion and compression with screws. Frequently these joints are sclerotic, and following joint preparation, large gaps are present in the articulation which require bone graft and secure, stable fixation. If there is hypertrophy of the base of the joint with dorsal osteophytes, screws may be easier to insert, using the enlarged base of the 2nd metatarsal and cuneiform to insert one compression screw. Although staples may be considered in these joints, the fixation obtained is never secure, and only one staple can be safely used without increasing the risk of fracture. A small contoured plate is ideal in this location, particularly in the setting of arthritis or fracture with comminution. A High Strength plate is an excellent choice for the lesser tarsometatarsal joints, since it can be gently contoured into flexion which will compress the articulation with fixation. (Figure 7 and 8)

Figure 7: A good indication for the use of a small flexible plate is at the base of the 2nd or 3rd tarsometatarsal joint in the setting of joint comminution and fragmentation. Here is a patient with a fracture dislocation of the tarsometatarsal joint complex (a) which was treated with primary arthrodesis of the 1st, 2nd and 3rd joints. Although screws were comfortably used across the 1st and 2nd joints, there was significant comminution of the 3rd metatarsal base and the lateral cuneiform, and a High Strength Y-plate was used to achieve arthrodesis. (b)

Figure 8: This patient had a complex hallux valgus deformity associated with hypermobility of the 1st metatarsal and a chronic non-union of the base of the 2nd metatarsal associated with painful arthritis of the 2nd tarsometatarsal joint. (a) The hallux valgus was corrected with a Lapidus procedure using 4.0 mm cannulated screws, and the non-union and the 2nd TMT joint were simultaneously corrected with a High Strength Y-plate. (b)
All trademarks herein are the property of Biomet, Inc. or its subsidiaries unless otherwise indicated.

This material is intended for the sole use and benefit of the Biomet sales force and physicians. It is not to be redistributed, duplicated or disclosed without the express written consent of Biomet.

For product information, including indications, contraindications, warnings, precautions and potential adverse effects, see the product labeling.