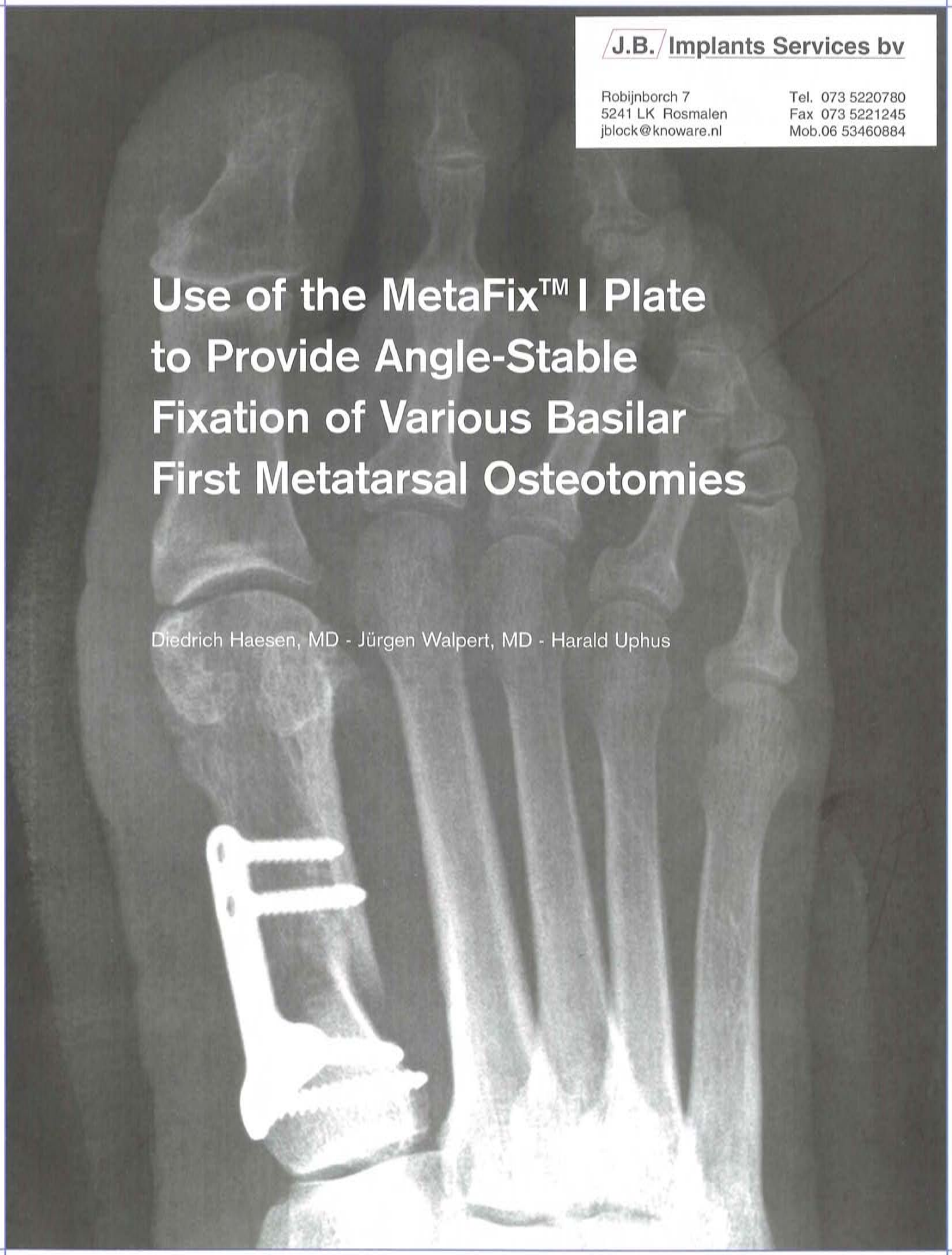
Use of the MetaFix™ I Plate to Provide Angle-Stable Fixation of Various Basilar First Metatarsal Osteotomies

Diedrich Haesen, MD - Jürgen Walpert, MD - Harald Uphus



Imprint

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Contents

Introduction

In the last two decades significant progress has been achieved in the treatment of foot diseases. This is essentially due to a better understanding of the biomechanics of the foot and its therapeutic implementation in conjunction with a more precise differential diagnosis of different foot disorders. However, the fact remains that only a careful analysis can lead to an effective therapy.

The most frequent deformity treated by orthopedic and podiatric surgeons is a valgus malposition of the big toe. Here genetic and constitutional traits play a decisive role in the etiology. Unfavorable biomechanical factors, such as abnormal positions due to pronation and hypermobility in the first ray as well as in the subtalar area are associated with these conditions and contribute to the development of hallux valgus [1, 2]. Ill-fitting shoes aggravate the deformity additionally but cannot be seen as the cause of the defective position.

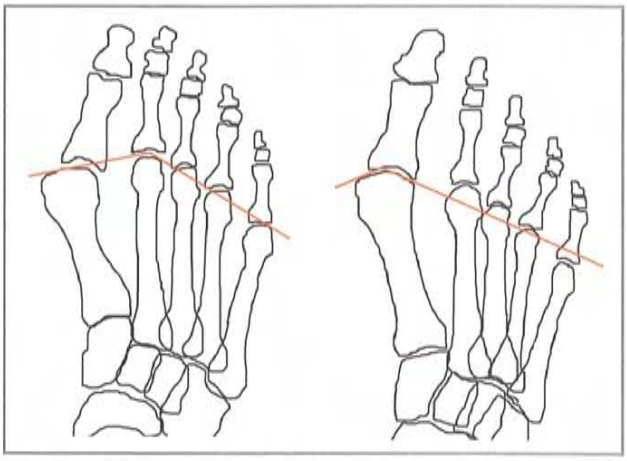
As this paper deals with the surgical treatment of hallux valgus, it is important to mention that an immediate operation is not necessary in every case. Some hallux valgus patients are able to live with the deformity relatively unproblematically without undergoing corrective surgery. When making a recommendation for surgery, the physician should never advise the patient that a quick decision is required. Since this indication constitutes a surgical intervention with all risks to be described, in each case it should be carefully considered whether the operation should be undertaken at the present time or whether it would be better to wait and see. With knowledge of the multitude of different interventions it is possible to select a suitable OP procedure for every condition and every time.

Performing osteotomies to correct the hallux valgus deformity can entail planned or surprising changes in the configuration of the first ray, e.g. a dorsal elevation or plantar flexion, a shortening or lengthening as well as rotation positions in pronation or supination [3]. The ideal osteotomy should correct the varus deviation and pronation – without unplanned elevation or lowering and without unplanned shortening of the first metatarsal. For that reason, the three-dimensional changes associated with every osteotomy must be scrutinized in-depth as to their chances and risks.

It is almost unnecessary to mention that the same method cannot be used on every patient. On the other hand, a too wide range of variation prevents building up reliable experience the surgeon can fall back on. The main criterion in determining the indication is based on how much pain the patient is suffering. A decision to perform surgery only for aesthetic reasons should remain rare.

There are a great number of quite different surgical methods and an infinite variation spectrum of the most diverse foot forms. Still, certain identical methods of proceeding exist that must be taken into account during every operation. Similarities exist, for example in the length of the foot or – more precisely – in the length of the big toe in relation to the neighboring toes. It is well known that the Egyptian foot is characterized by the fact that the big toe is longer than all of the other toes. By contrast, the Greek foot has a short big toe. Potential postoperative changes in the toe length can have as consequence that the shoe size changes for the corresponding foot. This circumstance, even after a successful correction of

valgus deformity, may not arouse much enthusiasm in some female patients. Another well-known factor is the metatarsal index, which does not have anything to do with the length relationships of the big toe described above. The short first metatarsal is designated as minus variant, the longer first metatarsal as plus variant. This initial situation must be carefully recorded prior to every planned surgical intervention, since e.g. a further shortening of a minus variant can cause major postoperative problems [4].



Negative and positive metatarsal index

Among other findings, past clinical studies report a dorsal elevation of approximately 7° in oblique osteotomies or a dorsal deviation after crescentic osteotomies in 28% of the cases. The cause of this can be traced back to insufficient technical fixation possibilities and early weight-bearing strain [5, 6]. Osteosynthesis materials and tissue-conserving OP techniques have continually improved and become more perfectionized over the years. What makes the use of angle-stable systems so interesting for proximal first metatarsal osteotomies and other kinds of osteotomies is the striving to achieve increased weight-bearing capability sooner after the operation, quicker bone healing and shorter convalescence periods.

The development of these systems has apparently reached initial completion – now these systems must prove themselves as far as their practical application is concerned. Of course, the experience we share here, after having performed over a thousand angle-stable basilar osteotomies, represents only a snapshot. To avoid this being perceived as a mere exercise in naive empiricism, it is important to evaluate these series as soon as possible and to scientifically analyze them exactly to prove their presumed improvements.

Past studies dealing with the evaluation of osteosynthesis procedures so far commonly used in basilar osteotomies name several undesired postoperative changes. Apart from losses in the angle correction, these include a gradual misalignment in the dorsal elevation, losses of supination and losses in length due to osteolysis at the saw cut [7]. Therefore, through an angle-stable osteosynthesis, it must be possible to have an even more constant postoperative stability vis-à-vis uncontrolled changes in elevation/plantar flexion, pronation/supination and changes in the length relationships.

In the use of angle-stable implants the plates no longer have to lie directly on the bone. There can be a little space in between, as with a scaffold in front of a building façade. The different directions of the screw threading provide an additional stabilizing factor, and the avulsion force of the screws in the bone is considerably increased. The angle-stable screw does not primarily build up tractive force like in conventional osteosynthesis, but rather works like a bolt that bears or holds something. The entire force accumulates in the metal-metal connection (screw-head with external thread plus internal thread in the plate implant). ▶

▶ The base osteotomy near the joint with its short proximal fragment can benefit from this. Furthermore, we could observe that in this way bones with osteoporosis could also be treated surgically. From a biomechanical perspective, internal fixators are what hold these constructions in proper alignment. Moreover, if the system also proves to have weight-bearing stability without interfering with the rest required at the fracture ends, if it reduces or prevents soft tissue swelling and shortens the convalescence time, it will find a secure place in the stabilization of base osteotomies. As the surgeon gains more experience, border-line distal osteotomies that were only indicated under the aspect of improved weight-bearing can be replaced with a base osteotomy closer to the pivotal point of the misalignment.

The Proximal Basilar Osteotomies

The clinical picture of a hallux valgus / metatarsus primus varus (adductus) is formed by various components in different degrees of severity. In this brochure we deal with the more severe forms of hallux valgus, which require a basilar osteotomy on the first metatarsal. Countless correction procedures and just as many variations are known. Here we will present several currently commonly used methods. Moreover, we will explore techniques that have been used less often up to now, but which can also bring about an effective correction.

When planning a base wedge osteotomy, the intermetatarsal angle (IM) is of great significance. As approximate reference value for the size of the normal IM angle, 10° can be considered for the normal foot and 7°-8° for the adduction foot. Assuming that there are flexible limits and that the surgeon has varying experience and preferences, base osteotomies are the treatment of choice for intermetatarsal angles of 15° and more in a rectus foot type or for angles of more than 11° to 12° in an adductus foot type. Although the indication limits can be expanded for soft or flexible forefeet in conjunction with decompressing shortening, at some point, however, the various distal and diaphysal osteotomies reach their maximum. "Stretching" beyond these limits imperils the stability of the osteotomies with all conceivable consequences.

Corrections at the base specifically discussed in this paper such as oblique osteotomies, crescentic osteotomies or modified chevron osteotomies are by contrast ultimately unlimited [8, 9]. If angle-stable systems subsequently allow a rapid increase in weight-bearing tolerance comparable to a distal osteotomy, this innovative fixation technique should be the center of attention. Of course, for a final decision the entire clinical and biomechanical picture must be considered.

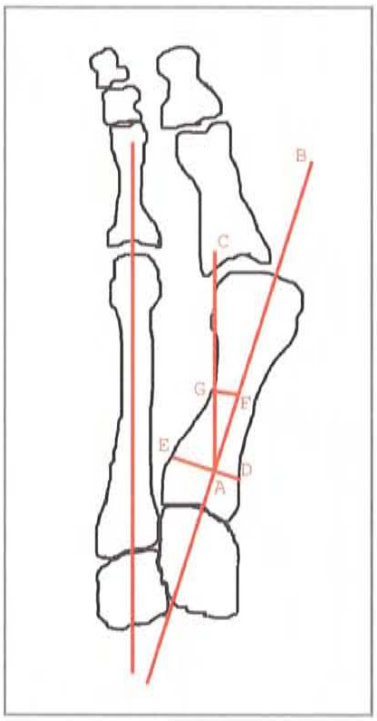
Even the proximal joint surface angle (PASA/DMAA) deserves attention in every base osteotomy. Its normal value is assessed to be under 8° [10]. Different base osteotomies can amplify this angle. Therefore, where appropriate, flanking subcapital or proximal phalanx osteotomies should be included.

Preoperatively, the forefoot length parabola must be determined radiologically. In almost all cases it can be seen that the second metatarsal bone is

longer than the first metatarsal bone. Here a plus-minus variance of approximately 2 mm is considered to be within normal limits. In principle, a closing base wedge osteotomy is considered feasible if the first metatarsal is longer than or as long as the second metatarsal, as this technique involves a slight shortening of the first metatarsal. Nearly all osteotomies have one basic problem in common: They shorten the bone, even if partially only to a very small extent. A change in direction with displaced or opening osteotomies can make up for this shortening. As with every other surgical intervention, the patient's physical situation and ability to cope with strain should be assessed preoperatively. A good microcirculation is important.

Preoperative Planning

Sharpe [10] describes a technique to determine the size of the bone wedge which must be extracted in a closing base wedge osteotomy. For this, the intermetatarsal angle is drawn in the typical manner. The line over the first metatarsal shaft is marked A-B. Then a line is drawn of the planned osteotomy (line marked D-E). A further line shows the eventual correction position of the first metatarsal (A-C). After that the line segment D-E is measured and projected from point A both onto line A-B as well as onto line A-C. The limitation points are marked with G and F. At the level of points F and G the necessary breadth for the individually planned base wedge osteotomy with the corresponding correction extent becomes clear. For an opening base wedge osteotomy the distance between the points F and G likewise applies for the distance to be opened.



Sharpe technique to determine the wedge size

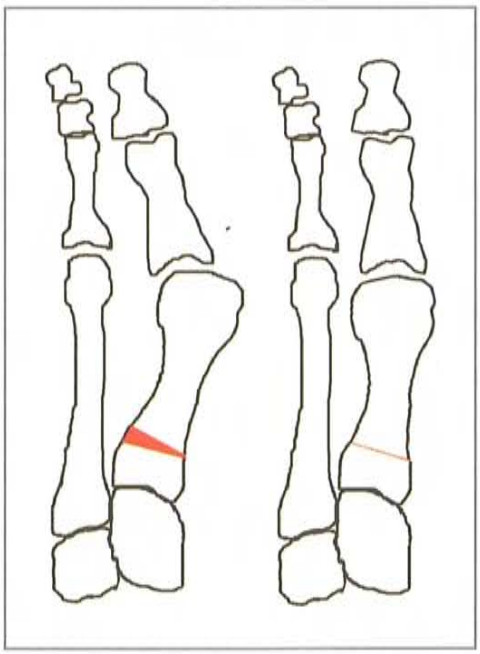
For a closing base wedge or opening base wedge osteotomy the "hinge-axis concept" is favored for placing the saw cut. Here greatest attention must be given to making the saw cuts vertically to the weight-bearing plane. Thus sufficient security exists that a dorsal flexion of the fragment is avoided in the primary execution.

OP Technique

For the surgery we prefer a medial access of approximately 10 to 12 cm in length. Begin the incision at the height of the proximal phalanx of the big toe and proceed proximally to the first metatarsal cuneiform articulation. Carefully retract the subcutaneous structures on the first metatarsal base dorsally and plantarly, conserving the vessels as far as possible. Open the first metatarsal phalangeal joint capsule in the usual manner and carry out a lateral release. At the height of the intended osteotomy it is recommended to leave the sinewy / periosteal structures intact to stabilize the hinge-axis system. Important neurovascular structures are a dorsal vein, which transverses the base of the first metatarsal, the deep plantar artery between the base of the first and second metatarsal bone and a medial dorsal cutaneous nerve branch, which also crosses the base of the first metatarsal.

A distance of 1.2 to 1.5 cm distally to the first metatarsal/first cuneiform joint must be maintained for more or less all osteotomies.

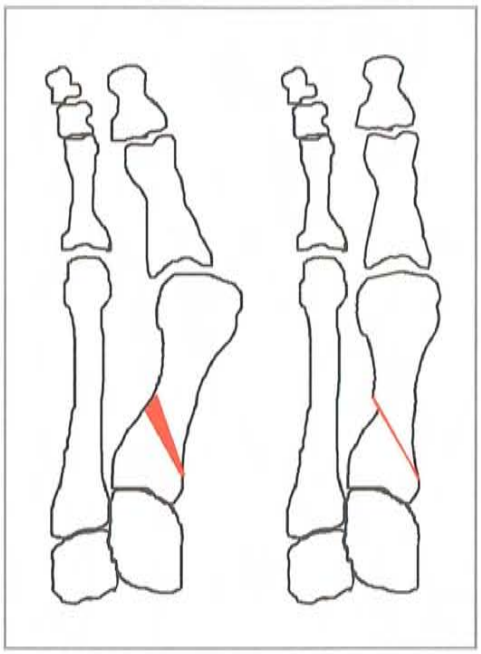
Closing Base Wedge Osteotomy



For this osteotomy the hinge is positioned medially, the base is aligned laterally. A Kirschner wire in the medial corticalis (in vertical direction to the weight-bearing plane) can help to hold the medial hinge intact. After removal of the wedge the osteotomy is closed. Finally, the periosteal and soft tissue structures are sutured over the osteotomy.

Fixation of a closing base wedge osteotomy with the angle-stable MetaFix™ I plate after individual fitting

Oblique Base Wedge (Juvara) Osteotomy

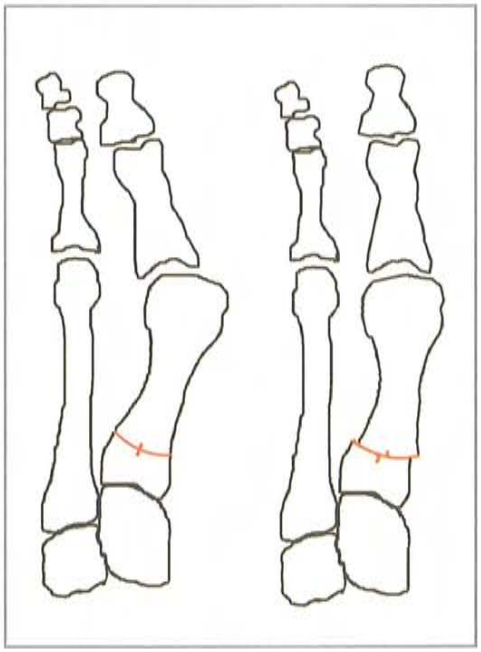


The placement of the osteotomy proceeds from proximal-medial to distal-lateral in an angle of approximately 40° to the length axis of the first metatarsal. This osteotomy is also closed over an intact medial hinge after lateral removal of the wedge [12]. The hinge lies approximately 1.2 to 1.5 cm distally to the MT-I/C-I articulation. It is recommended to first make the distal saw cut. Thus, the proximal cut can be carried out in a still relatively stable bone without risking destabilizing the hinge. Retract laterally through medial pressure on the first metatarsal head and close the intermetatarsal angle. The osteomy – actually rather unstable – is then stabilized with the MetaFix™ I plate.

Oblique base wedge (Juvara) osteotomy

Due to its inherent instability this osteotomy has lost popularity in recent years. It became evident that with the previously used fixations, loosening and fractures occurred on the medial hinge and that thus an uncontrolled rotation and/or a dorsal elevation of the distal fragment could develop.

Crescentic Base Osteotomy



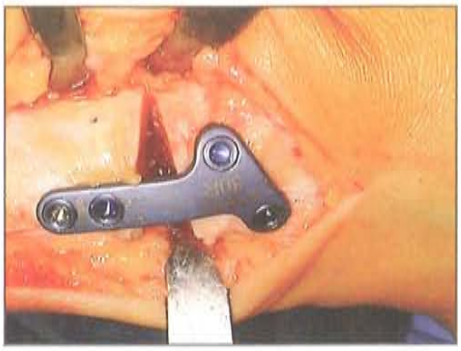
With the development of arch-formed saw blades crescentic base osteotomy came into being. Its advantages are due to the fact that it does not involve removing a wedge of bone. This osteotomy is appropriate for short first metatarsals, potentially even for metatarsals that are more than 2 mm shorter than the second ray. The arched line allows a maximum of correction of the intermetatarsal angle with a minimum of displacement of the fragments. The disadvantages previously were the instability and the difficulty to achieve a good fixation. That is why this osteotomy – in itself very advantageous – has been avoided by many foot surgeons until now.

The size of the saw blade is adjusted to the breadth of the first metatarsal, the convex line of the osteotomy is facing proximally. A longitudinal axis demarcation line and a dorsal marking over the osteotomy help in checking the height relation of the distal fragment and the rotation of the IM angle after complete separation.

Fixation of the crescentic osteotomy was difficult until now. Uncontrolled postoperative mis-healing was described in up to 28% of the performed osteotomies. With angle-stable fixation these results can be improved significantly.

Crescentic base osteotomy

Opening Base Wedge Osteotomy



In opening base wedge osteotomy the hinge is positioned laterally and the base medially. Temporarily a suitable small instrument is inserted to facilitate the opening up, in order to preserve the developing opening when the intermetatarsal angle is closed. Transient stabilization prior to fixation with the angle-stable plate is shown here.

When using the MetaFix™ I plate, a metal bridge for the medial corticalis is no longer necessary. Depending on experience or preference, the resulting free space can be filled up with bone: possibly from the medial pseudo-exostotic prominence or with bone material from the surrounding area. Due to their experience with opening wedge osteotomies in the tibia segment, some surgeons have refrained completely from filling the space in between with bony material. This has not led to any delay in the healing process.

Opening base wedge osteotomy in combination with a distal counter-correction (Reverdin-Green-Laird with bioreabsorbable osteosynthesis)
Akin osteotomy (fixation in suture technique)

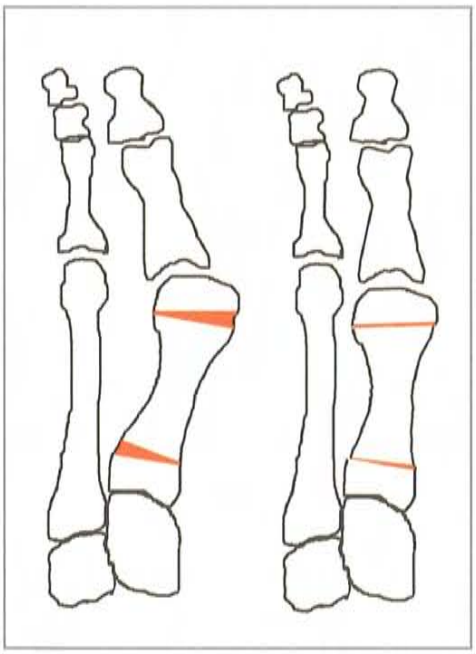
First Metatarsal Double Osteotomy

For this combination we name here as examples of distal osteotomy the medial closing (Reverdin-Green-Laird) osteotomy or the displaced chevron osteotomy in conjunction with a proximal closing wedge osteotomy or an opening wedge osteotomy. As early as 1948 Logroscino [13] recommends using this procedure for especially severe deformities.

As first metatarsal base osteotomy he advises using the closing or opening wedge osteotomy. Thus the individual length conditions of the first metatarsal can be considered. The combination or rather the selection of the respective procedures depends on the experience and decisions of the surgeon, alongside the initial diagnostic findings. In any case, the double osteotomy deserves consideration for abnormal lengths (short or long) of the first metatarsal, for a wide PASA/DMAA angle and in view of possible occurring changes following a base osteotomy.

For the surgical procedure we recommend initially performing the base wedge osteotomy because the angle-stable fixation creates ideal stable conditions for the subsequent measures with the distal osteotomy. On the other hand, as is known, the "swivel" base osteotomies increase the PASA/DMAA upon closure of the intermetatarsal angle. To correct this angle discrepancy, distal closing osteotomies and/or displaced osteotomies are now performed. In any case, a hinge is oriented laterally and the base medially. Fixation can be carried out with small pins, screws or, as is shown below, with reabsorbable materials.

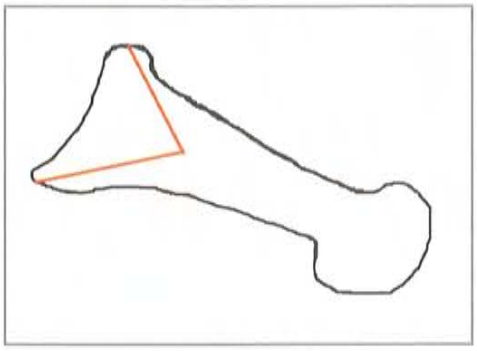
Years ago already, Weil et al. [14] were able to report outstanding results with this individual technique. According to our current experience, the traumatization caused by the surgery can be mitigated further with an angle-stable fixation.



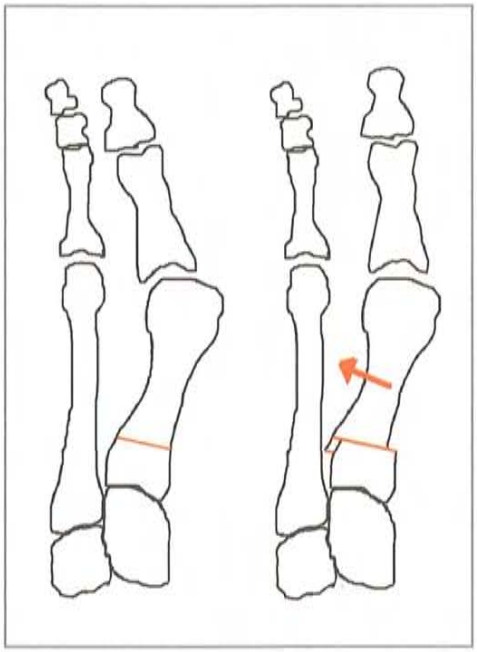
Double osteotomy with oblique base (Juvara) osteotomy with angle-stable MetaFix™ I plate and distal (Reverdin-Green-Laird) counter-correction, fixated with bioreabsorbable screws

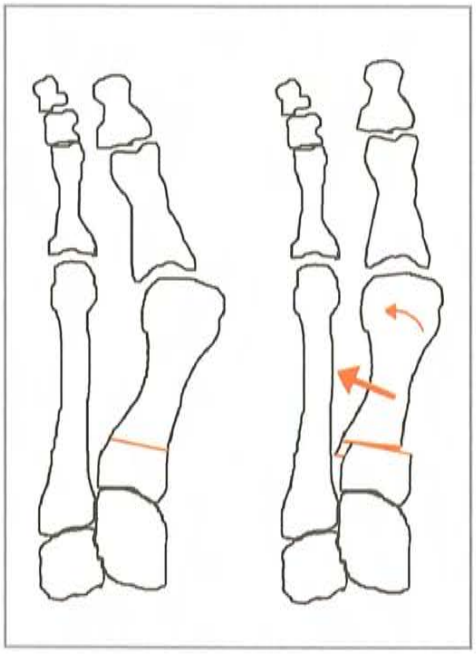
Modified Proximal Chevron Osteotomy (V-Type Base Osteotomy)

This V-type osteotomy is carried out from medial to lateral. The apex is oriented distally, its sides form an angle of 45°.



The advantages of this osteotomy, which should not be overlooked, lie in its inner stability with many options for angling and/or displacement corrections. It is easier to perform than a crescentic osteotomy [15]. Moreover, it has the advantage of already being very stable in itself and can prevent shortenings or elongations. [16, 17].

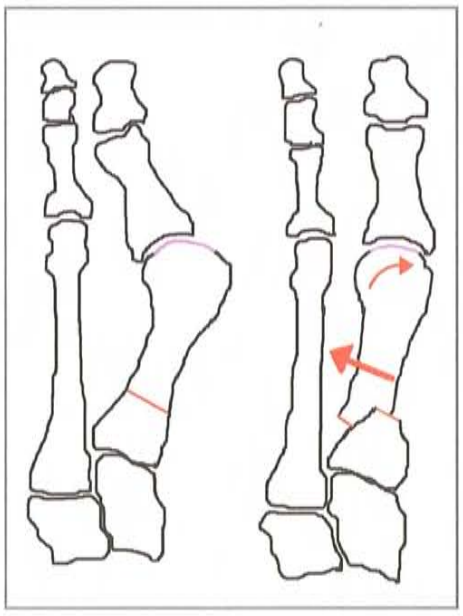




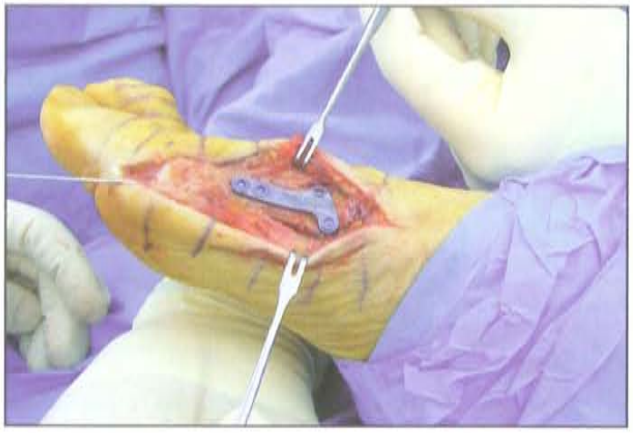
The distal fragment is then shifted laterally and impacted with the base. In this way the IM angle is corrected. A further augmentation of the angle correction can be accomplished by an additional lateral opening (similar to the opening wedge) (Pay careful attention to PASA/DMAA!).

Proximal V-osteotomy

Modified proximal V-osteotomy with Akin osteotomy at the phalangeal base



▶ It is especially worthy of mention that conversely, through a lateral opening after forceful displacement, the PASA/DMAA can be corrected as well. This osteotomy therefore offers the possibility of perfectly correcting both the intermetatarsal angle as well as influencing an abnormal PASA to a limited extent with the handling described above. Through one osteotomy the effect of two is achieved (two-in-one). After the displacement, the fragment which sticks out proximally is smoothed slightly and fitted to the level of the displacement. Taking individual conditions into account, the angle-stable plate can simply be put in position and then fixated.



Additional advantages are the weight-bearing stability achieved, the smaller risk of postoperative misalignments and the faster healing of the bones.

Modified proximal V-type base osteotomy "two-in-one"

Double osteotomy: proximal chevron osteotomy with MetaFix™ I plate and distal L osteotomy with scarf screw fixation

Arthrodesis of the First Metatarsal/First Cuneiform Joint (Lapidus Procedure)

Indication: Severely increased metatarsal angle with instability in the first TMT joint.

For this surgical procedure access begins either dorsally where the first cuneiform articulates with the navicular in the middle between the first and second ray, proceeding in "S" form to the phalangeal base, or it is also possible via a medial skin cut. An atraumatic subcutaneous preparation is carried out, ▶

▶ avoiding any damage to the skin nerves. In both accesses, the tendon of the extensor hallucis longus isheld laterally. Now the opening of the first TMT joint follows along with a mobilization – in part sharp and pointy, in part, blunt. For a controlled economic resection at the cartilage-bone border it is recommended to first ablate cartilage labrum in the dorsal segment at the first metatarsal and at the first cuneiform for inspection. Then the economic resection of the joint surface at the first metatarsal base can be carried out. Any potential sclerosis zones must be removed. Then the first metatarsal bone is transiently swiveled to the second metatarsal bone, as if the intermetatarsal angle were already closed.

The first metatarsal head is provisionally stabilized on the head of the second metatarsal with a 1.2 mm K-wire. In this position, taking a sufficient plantarization of the first ray into consideration, the saw cut is placed at the base of the first cuneiform parallel to the resection plane at the base of the first metatarsal. All released cartilage/bone parts at the first cuneiform are removed. The sclerosis zones are drilled open. Then the provisional guidewire between the first and second metatarsal heads is removed, and the final repositioning of the first metatarsal bone onto the first cuneiform as well as the transient fixation in reset position with two diverging K-wires take place. After that the MetaFix™ I plate is placed on the medial side; if necessary, any bony irregularities sticking up are smoothed. Thereupon follows the final check of the necessary plantarization, taking into consideration the shortening of the first ray which has meanwhile taken place. According to experience, the plantarization must amount to at least 3 to 4 mm. The first metatarsal bone is once again provisionally fixated distally between the first and second metatarsal head. The final fixation is done with the MetaFix™ I plate in the typical manner.

The first TMT arthrodesis lies almost in the center of the resulting malposition. It has a very effective influence on the correction of the intermetatarsal angle. One can also characterize it as the furthest proximally situated closing base wedge osteotomy. Careful attention must be taken to its shortening and also to the effects of an arthrodesis on the neighboring joints.

With a difficult conclusion of the resected joint partners, taking the blood vessel/nerve supply into account in the first intermetatarsal space, a sagittal cut should be made proximally to straighten the lateral surface of the first metatarsal bone.

First metatarsal/first cuneiform fusion. Fixation with MetaFix™ I plate

Complications

We assume that the general possibilities of complications in foot-surgical interventions with osteotomies are known and therefore we will not describe them here again. That is why we only mention biomechanical and technical complications in this paper.

Complications of a base osteotomy include a possible postoperative hallux varus misalignment. Thus, for instance, a severe reduction of the intermetatarsal angle, in conjunction with a shortening of the first ray, can trigger a spontaneous reduction of the abductor force (lateral direction) of the extensor hallucis longus muscle, whereby the hallux is prone to a medial luxation. A too generous lateral release or a forceful resection of the pseudoexostoses can pave the way further for this. In critical postoperative analyses following base osteotomies, 10-12% varus deviations are described [18,19], although here not all varus deviations give the impression of being clinically relevant.

Another common malposition of the first metatarsal head is the deviation of the distal fragment in elevation (dorsal extension). This can occur secondarily with insufficient osteosynthesis or if the base wedge to be removed in the dorsal segment is wider than it was placed plantarly.

A shortening of the first metatarsal without sufficient plantarization leads to the well-known subsequent problems such as metatarsalgias under the neighboring rays, transfer lesions and stress fractures.

As is known, in every kind of osteotomy unplanned misalignment or delayed healing is possible. A stable fixation helps considerably to mitigate these problems.

Summary

Despite all enthusiasm over the different osteotomies and their stable fixation, it must be pointed out that the osteotomy comprises only one part of the surgery. Adept soft tissue technique, particularly at the base joint of the big toe, is indispensable for success. An extensor complex which is not centrally aligned or an incomplete repositioning between the sesamoid bone complex and the plantar head complex – even with a correct osteotomy – mean that patients are predisposed to a relapse.

Today, the available angle-stable systems can be taken into consideration when selecting the right surgical procedure. The final decision, of course, is the responsibility of the surgeon. Careful preoperative planning, a mature intraoperative technique with optimal fixation and good postoperative management should lead in the end to satisfactory results.

Hamburg, March 2006

Technical Details

MetaFix™ I, an angle-stable plate made of titanium, is available for the left and right foot in lengths ranging from 26 mm to 32 mm. To screw the MetaFix™ I plate, 4 screws are required. These titanium screws have a diameter of 3.0 mm and are available in lengths ranging from 12 mm to 32 mm.

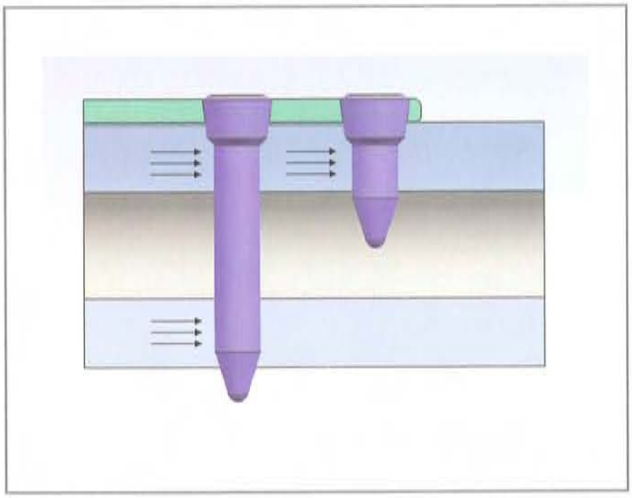
MetaFix™ I

MetaFix™ I is a unidirectional angle-stable osteosynthesis system. Here angle stability describes the force and form coherent connection between screw and plate, whereby the contact surfaces of both parts are connected firmly and immobily. The angle between screw and plate cannot be freely selected and amounts to 90°. With the aid of drill bushings that are screwed into the plate threads, the guide drill holes for the screws are made into the bones. Thus, for the assembly of the screws, the exact position of the screws can be achieved to match the plate.

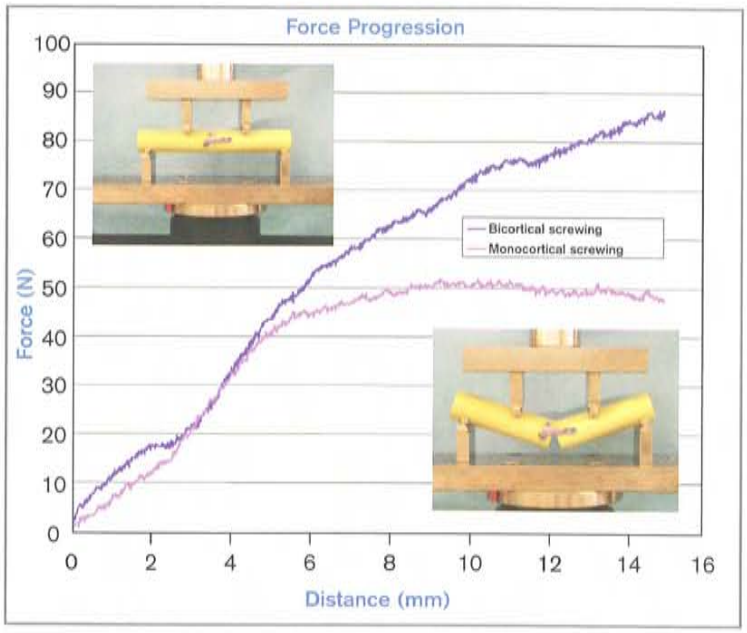
The main feature of the angle-stable system is the firm connection of the screws with the plate. The screw heads are equipped with tapered threads and lock unidirectionally and angle-stably in the threaded drill holes of the plate. A force and form coherent connection results between the screws and the plate. A cold welding process, which might cause abrasion, does not take place when inserting the screws. The forces affecting the implanted system are transferred via the screw head to the plate.

The angle-stability enables an optimal force transmission to the surface from the bones to the screw and plate.

Due to the bicortical screw fixation the force is transferred to a larger bone surface in comparison to monocortical screw fixation. Thus, the weight-bearing ability is increased.



Representation of the principle: bicortical vs monocortical screw fixation

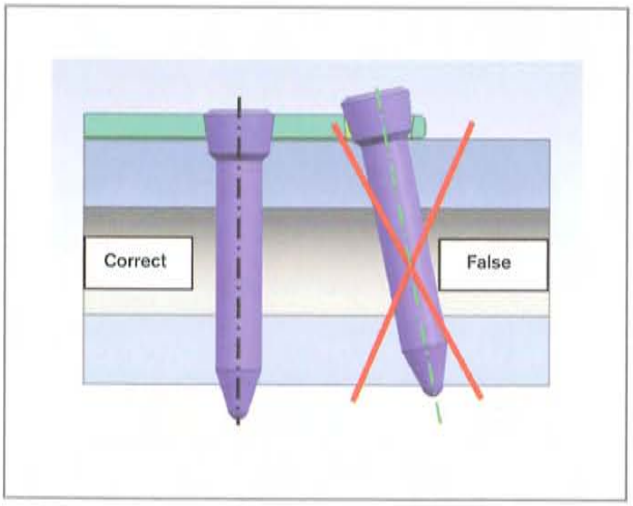


Weight-bearing ability of bi- or monocortically screwed MetaFix™ I plates in an experiment

The implant and the fragments are securely and exactly anchored even with poor bone quality. The angle-stable unidirectional bicortical screwing enables the use of a shorter plate with two screws on each fracture side. The system ensures a fixation with extremely good weight-bearing capability that is fundamentally superior to conventional screw and plate osteosyntheses. Due to the unidirectional and angle-stable screwing, pressure on the periosteum is considerably minimized in comparison with a classic plate osteosynthesis. Moreover, displacement of the bone fragments is also prevented by MetaFix™ I.

Mounting of the Screws

The screws must be mounted orthogonally to the plate. If they are not mounted orthogonally, for instance if the screwdriver is held in a slightly false position, there is a risk that the screw will not go into the drill hole in the countercorticalis, that it will cut into the corticalis next to the drill hole and become bent. There the bending forces in the shaft can lead to screw breakage. Furthermore, pieces of bone can break away in the area of the countercorticalis. Falsely mounted screws lead to cold welding processes with abrasion in the area of the screw head and deformation of the plate in the area of the plate drill holes. The screw cannot be flush screwed into the plate. Among other consequences, due to the deviation of the screw position, it may not be possible to anchor the screw bicortically.



Representation of the principle of the insertion position

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Addendum

Surgical Techniques

MetaFix™ I

Surgical Techniques MetaFix™ I

Opening Base Wedge Osteotomy

Closing Base Wedge Osteotomy

V-Type Osteotomy

Example of an Opening Base Wedge Osteotomy

- Marking the planned osteotomy level.
- Trial placement and selection of the plate.

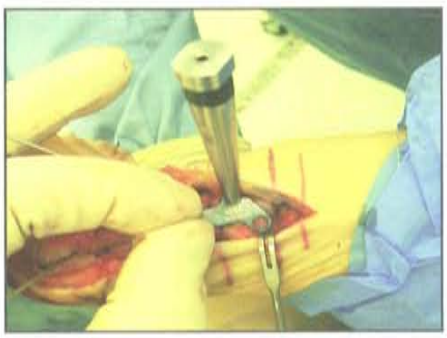
Example of an Opening Base Wedge Osteotomy

- Opening the first ray and performing the osteotomy.

- Fitting the plate by means of the bending instruments.

Example of an Opening Base Wedge Osteotomy

- Exactly centered drilling of the screw holes is easy to realize by means of the drill guides.



- Fastening the first and second screw.

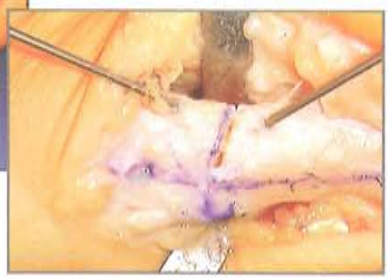
- Fastening the third and fourth screw.

Example of a Closing Base Wedge Osteotomy

- Marking the planned osteotomy level.
- Trial placement and selection of the plate.

Example of a Closing Base Wedge Osteotomy

- Performing the osteotomy.
- Repositioning the distal fragment und stabilization with K-wires.



- Fitting the plate by means of the bending instruments.

Example of a Closing Base Wedge Osteotomy

- Exactly centered drilling of the screw holes is easy to realize by means of the drill guides.

- Fastening the first and second screws.

- Fastening the third and fourth screws.

Example of a V-Type Osteotomy

- Performing the osteotomy.

- Repositioning the distal fragment and stabilization with K-wires. Cutting the medial edge of the proximal fragment.
- Fastening the screws.