

TK System

Innovations

1|2010

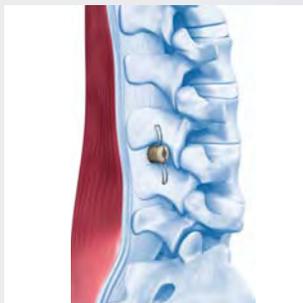


TABLE OF CONTENTS

EDITORIAL 1

ANGULAR STABLE LOCKING OF INTRAMEDULLARY NAILS (ASLS)—A NEW SYSTEM 2

SPINE 6

In-Space Interspinous Distraction

Zero P

Antegra-T Lumbar and Sacral Translating Plates

CRANIOMAXILLOFACIAL 11

Matrix Orbit System

Matrix Orthognathic System

Application Instrument for FlapFix System

iPlan CMF 3.0

THORAX/STERNUM 19

Primary Closure Plates

TRAUMA UPPER EXTREMITY 20

LCP Hook 3.5

Olecranon Osteotomy Nail

Shoulder Retractor Set

Expert Humeral Nail: End Caps for Locking Screws

TRAUMA HAND 26

1.5 mm LCP Modular Hand System

Headless Compression Screw extra small (HCS 1.5)

TRAUMA FOOT AND ANKLE 28

Orthopaedic Foot Instrument Set

Headless Compression Screw 4.5 mm and 6.5 mm

LCP Anterior Ankle Arthrodesis

TRAUMA LOWER EXTREMITY 34

3.5 Locking Attachment Plate

Expert Asian Femoral Nail (A2FN)

Percutaneous Insertion Handle for LFN and R/AFN
for obese patients

3.5 LCP Posteromedial Proximal Tibia Plate

3.5 mm LCP Low Bend Medial Distal Tibia

3.5 LCP Distal Tibia T-Plate

2.7/3.5 mm LCP Lateral Distal Fibula

TRAUMA MIO 46

Cerclage Passer

Cerclage Twister

TRAUMA POWER TOOLS 48

Trauma Recon System

TRAUMA OSTEOTOMY 49

Osteotomy Guiding Device

TRAUMA PEDIATRIC 50

Adolescent Lateral Entry Femoral Nail:

9 mm and 10 mm Diameters

3.5 mm and 4.5 mm Curved Narrow LCP and
Curved Broad LCP

VETERINARY 52

4.5 mm LCP Narrow and Broad with Stacked
Combination Holes

3.5 mm LC-DCP and LCP

Anvil for Bending Pliers

NEWS FROM AO EDUCATION 55

PRINCIPLES OF BRIDGE PLATING 56

FIBULA PRO TIBIA PROCEDURE COMBINED WITH EXPERT TIBIA NAIL AND ANGULAR STABLE LOCKING SYSTEM IN A DEFECT FRACTURE OF THE TIBIA 60

RESEARCH IMPLANT SYSTEM (RIS) 62

INNOVATION WORKSHOP 66

TK NEWS PORTRAIT 68

NEWS FROM THE TK OFFICE 69

DUE TO VARYING COUNTRIES' LEGAL AND REGULATORY APPROVAL REQUIREMENTS PLEASE CONSULT THE APPROPRIATE LOCAL PRODUCT LABELING FOR APPROVED INTENDED USE OF THE PRODUCTS DESCRIBED IN THIS BROCHURE. ALL DEVICES IN THIS BROCHURE ARE AOTK APPROVED. FOR LOGISTICAL REASONS, THESE DEVICES MAY NOT BE AVAILABLE IN ALL COUNTRIES WORLDWIDE AT THE DATE OF PUBLICATION.

Dear reader,

The TK System was one of the pioneers of specialization within the AO Foundation, reacting to the changing clinical problems by adapting its organization over decades. In 2003, AOTK Spine was founded, and in 2005 AOTK CMF followed. In the same year, the TK News was also separated into issues focusing on one area only. In development, specialization helps to tackle very specific clinical problems by experts in this field. But there is also a lot of value in cross-fertilization, evaluating technologies, materials, and the clever ideas of others. Two examples of the value of this exchange can be seen in the orthopaedic foot instrument set which was inspired by spine instruments or the primary closure sternal plates which were based on mandibular fixation systems. Furthermore, all specialties face the same general issues, such as, increasing regulatory demands, generating evidence on the advantages of the new techniques, and providing information to education. Due to the increasing need for more evidence we will enhance our cooperation with AO Clinical Investigation and Documentation (AOCID) to show the clinical benefit of the new techniques through state-of-the-art study designs. For these reasons, we decided to introduce our new methods and devices again combined in the same publication. This will also enable us to produce two issues annually and inform you more frequently.

Paul Pavlov handed over the chairmanship of the AOTK Spine to Robert McGuire on May 21, 2010. Paul joined the Spine Expert Group in 1998, to become its chairman 3 years later. Under his leadership the Spine Technical Commission was established as the first specialty pillar of the AOTK System with four dedicated expert groups. Under his pioneering leadership many innovative changes were initiated that triggered further improvements even beyond the AOTK System and AOSpine (of which he was a founding member). Integration of neuro-

surgeons, their techniques and priorities, a dedicated platform for minimally invasive spine surgery, and a process for the assessment of new techniques based on sound clinical experience, are just some examples. The AO Foundation thanks Paul Pavlov for his great commitment over all those years.

In the lead article of this issue, Dankward Höntzsch will give you a comprehensive overview of the angular stable locking system (ASLS) for intramedullary nailing, a bioresorbable sleeve which can be inserted optionally during the operation in all nails. This sleeve neutralizes rotational and tilting movements. First clinical results indicate less pain during healing, earlier functional loading, and less initial and delayed displacements of the bone fragments. Other new devices we like to highlight are the locking attachment plate for periprosthetic fractures, the preformed orbital plate, and the zero P stand-alone implant for anterior cervical discectomy which combines features of an anterior cervical plate and a spacer.

The column Portrait features Richard Hopper, who has joined the AOTK CMF last year. We like to encourage you to follow his example and to share your talents with us. You may approach the AO anytime if you have an idea for the improvement of patient treatment as he did.

Once again, we would like to stress that none of the articles in this publication is a substitute for the AO's surgical techniques or the AO teaching tools. You can obtain more detailed information on these devices from the AO or the official technical guidelines and documentation.

If you have any comments or questions on the articles or the new products, please do not hesitate to contact any one of us.

Yours faithfully,



Tim Pohlemann
AOTK Trauma



Edward Ellis III
AOTK CMF



Robert McGuire
AOTK Spine

Dankward Höntzsch

ANGULAR STABLE LOCKING OF INTRAMEDULLARY NAILS (ASLS)—A NEW SYSTEM

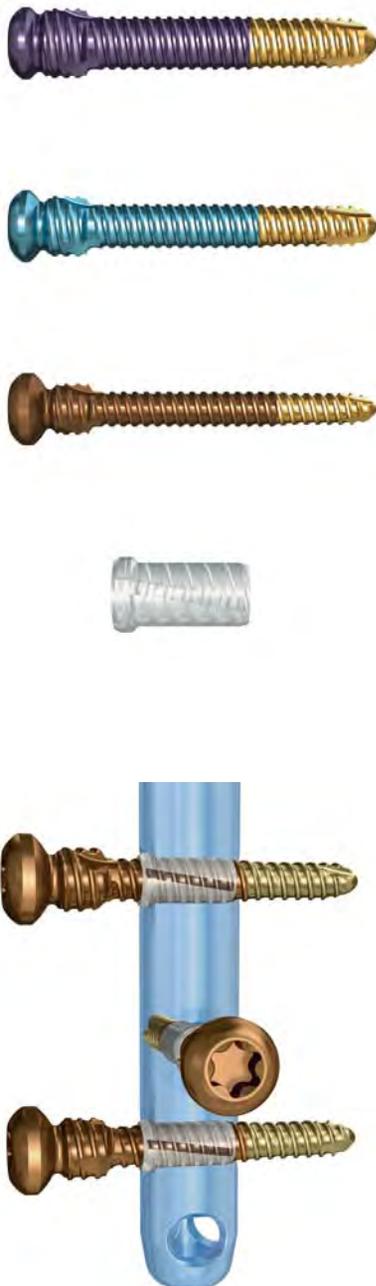


Fig 1
Intramedullary nail with angular stable locking screws.

Intramedullary nailing of the tibia, femur, and humerus is a long-standing traditional approach to surgical fracture treatment. An important advance in intramedullary nailing was the so-called locking technique.

In intramedullary nailing the fracture fragments of the long bones are threaded onto a tubular or solid intramedullary nail and secured. Additional stabilization of the large fragments is generally achieved by transverse insertion of locking screws. This technique neutralizes rotational and tilting movements. Due to this development almost all fractures in the mid-4/5ths of the long bones could and can be treated by insertion of a locked intramedullary nail.

Previous locking techniques meant that there was always a certain amount of free toggling between the screw and the nail.

Experimental studies [1, 2] have shown that blocked locking would, in principle, be advantageous. In fact, in the area of plating systems, this has already been achieved in the form of so-called angular stable plates.

Why?

The question of why this development was needed is quickly answered: The existing technical solution was not entirely adequate. Residual looseness was disadvantageous to fracture healing and stability and imperfect in terms of patient symptoms, especially in osteoporotic bones weakened by age. The correct technical approach is angular stable locking.

Solution

In the meantime, this technique has been successfully introduced in the form of a new system known as angular stable locking system (ASLS) for nails, which is designed so that all the holes in the nail can be locked at a stable angle. Biomechanically, the angular stable locked nail has similar features to a locked plate including the more even load distribution over the nail, therefore decreasing individual stress raisers, reducing loosening of locking screws. The system has also been designed to enable the use of all existing intramedullary nails so that there is no need to invest in new nails. It is also possible to decide during surgery whether and which parts of the nail and/or which bone fragments should be combined with the nail at a stable angle, ie, locked in position.

The dowels are made of 70:30 poly(L-lactide-co-D,L-Lactide). No critical reaction has been reported so far. Resorption of the sleeve may lead

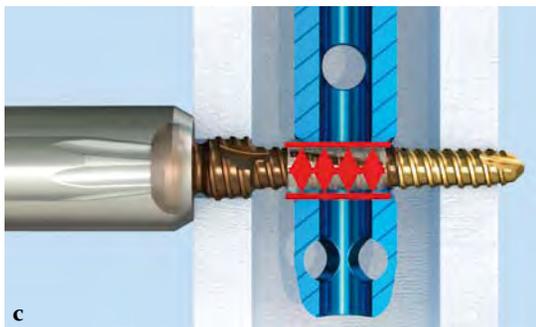
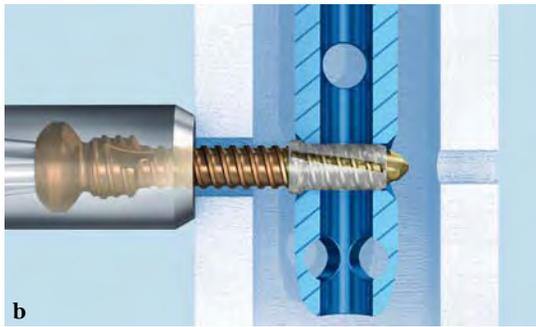
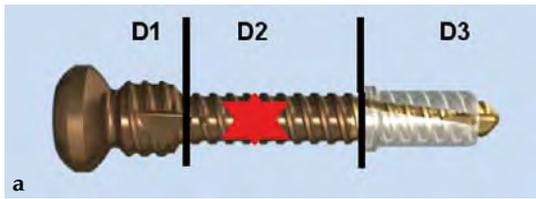


Fig 2a–c
a Screw with three core diameters.
b Unexpanded sleeve fits into locking hole on smallest diameter (D3). Sleeve is retained in nail when screw is advanced.
c Screw expands at screw insertion at middle diameter (D2). Largest diameter (D1) provides optimal hold in near cortex.

to an intrinsic dynamization. Resorption starts not before 12 weeks but it depends on the individual. The bioresorbable material makes the system forgiving, if any debris was caused by extra manipulations in the primary operation or by the removal. The first removals of the nails caused no problems.

The technique is illustrated clearly by Figs 1–5:

An appropriate hole is made in both bone walls for insertion of the transverse locking screw. The former looseness is eliminated by a dowel system. To insert these dowels, the hole on the side of the surgeon has to be enlarged slightly. The screw has been designed so that it expands the dowel in the nail hole, leading to angular stable locking. The larger thread just beneath the screw head fits tightly into the threaded nail hole.

ASLS is tolerant with non-exact drilling. Intraoperative change of screws is easy.

We predict:

- Less pain during the healing phase
- Earlier functional loading
- Less initial and delayed displacements of the bone fragments from their ideal positions (maintaining the achieved reduction, preventing secondary malalignment)

A multicenter comparative study to address the issue of conventional versus angular stable locking has just started under the management of the BG Unfallklinik, Tübingen (Department of Medical and Technical Developments) and AOCID.

With respect to all previous criteria the new locking system will make it possible to rehabilitate patients faster, to restore function sooner, and to lessen and shorten the duration of pain even in nonunions. ASLS is especially advantageous for very proximal fractures which have a higher risk of secondary dislocation, and distal fractures, also in osteoporotic bone. Overall, ASLS is also expected to expand nailing indications.

Final recommendation

Before doing the first case, look very precisely at the operation technique. The system with drills, screws, and sleeves is very easy to understand. The learning curve is very short, if you accept the special additional 2 or 3 steps. In this case the time for the ASLS locking is not significantly longer. A teaching set is available on request.

Note for AO Faculty

A lecture "Intramedullary Nailing—Evolution, Concept of Angular Stable Interlocking (ASLS), Indications for the Intramedullary Fixator" is available on the faculty support website under "AOTrauma Course: Principles in Operative Fracture Management".

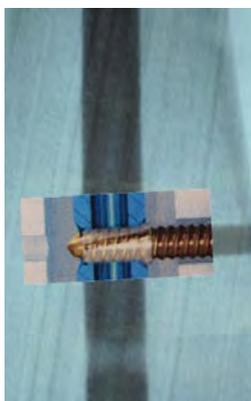


Fig 3

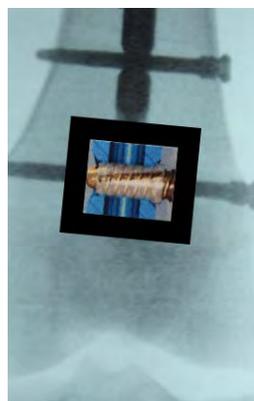


Fig 4



Fig 5a–c

A 25-year-old male sustained a fracture of the tibia close to the subtalar joint. He was treated with TNS and ASLS. Early weight bearing was enabled.

Bibliography

- 1 Kaspar K, Schell H, Seebeck P, et al (2005) Angle stable locking reduces interfragmentary movements and promotes healing after unreamed nailing. Study of a displaced osteotomy model in sheep tibiae. *J Bone Joint Surg Am*; 87(9):2028–2037.
- 2 Epari DR, Kassi JP, Schell H, et al (2007) Timely fracture-healing requires optimization of axial fixation stability. *J Bone Joint Surg Am*; 89(7):1575–1585.

First clinical experience with ASLS in patients with tibial, femoral, and humeral fractures

Denise Schmid, AOCID

The performance, handling, and technique of ASLS were investigated in a prospective multicenter case series including 31 patients with tibial, femoral, and humeral fractures. Surgeon satisfaction with the handling of ASLS and fracture stability was assessed on a numeric scale ranging from 1 (not satisfied at all) to 5 (extremely satisfied). Radiological assessments were performed at 6 weeks, 12 weeks, and 6 months postoperatively. Time to weight bearing and the occurrence of complications were monitored throughout the 6-month postoperative period.

Of the 31 patients included (cases provided from Berlin, Hannover, Innsbruck, Mainz, and Tübingen), 28 had a tibial fracture (46% open), 2 a femoral, and 1 a humeral fracture. 29 patients were available at each of the 6-week, 12-week, and 6-month follow-up assessments; 2 patients with a tibial fracture dropped out. The follow-up rates were 94% for all examinations. The mean patient age was 45.1 years with the majority of the study population being male (84%).

In 21 cases (68%), the surgeons were very to extremely satisfied with the handling of ASLS. In 30 cases (97%), the surgeons rated the achieved fracture stability as very to extremely satisfactory. Half of the patients with tibial fractures were able to bear full body weight 11 weeks after surgery. Partial and full weight bearing was accompanied by minimum pain.

A follow-up of 94% could be reached. The handling of ASLS is considered simple and satisfactory. Furthermore, surgeons were satisfied with the achieved fracture stability. Only two mild complications were assessed as being related to ASLS. We hypothesize that patients treated with ASLS bear full weight earlier compared to patients with conventional locking. The results and new questions arising from this prestudy led to the planning of a randomized controlled trial, in order to prove the advantages of ASLS with respect to pain progression, weight bearing, gait pattern, and fracture healing compared to conventional locking.



Fig 1a–d
X-rays before and after primary treatment.



Fig 2a–e
Six weeks postoperatively.



A 58-year-old male sustained a closed multifragmentary 42-C1 fracture in the distal tibia with compartment syndrome.

Case provided by Dankward Höntzsch, Tübingen, Germany

Primary treatment consisted of an external fixator and release of compartments. Mobilization of the limb started with an applied external fixator.

Secondary treatment: insertion of an unreamed intramedullary nail with three ASLS screws inserted distally providing angular stability.

Partial weight bearing started on postoperative day 2 (with 20–30kg). The weight was gradually increased over the following weeks. At 6 weeks, the patient was able to fully bear weight even though a high fibula fracture was present and no callus had yet formed. This suggests that angular stable interlocking of the nail markedly enhances stability. The patient was able to bear weight faster than planned and full weight bearing was possible with little pain.

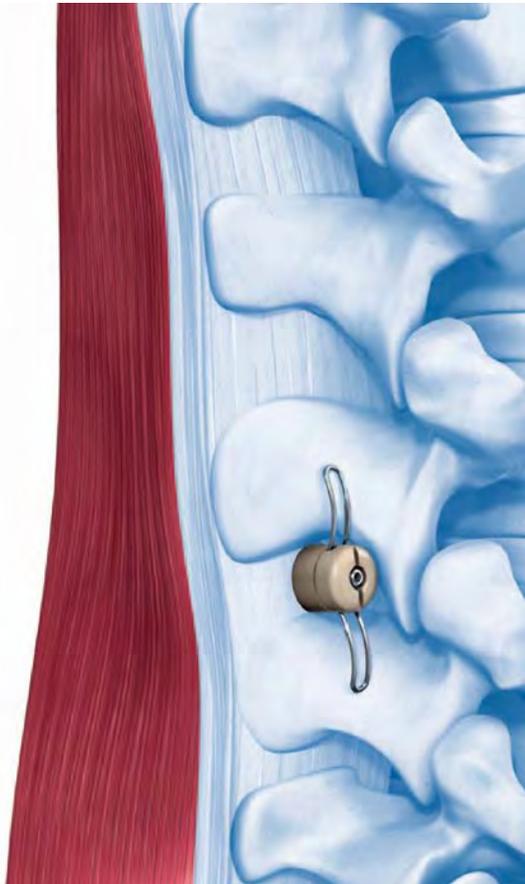
Twelve-week follow-up shows callus formation, and the patient was able to fully bear weight without any pain.

The nail was removed 15 months postinjury as planned. There is good callus formation and proper healing of the tibia fracture.

Fig 3a–d
a–b Three months postoperatively.
c–d 15 months postoperatively.

Paul W Pavlov, Frank Kandziora, Robert McGuire

SPINE



In-Space Interspinous Distraction

With the growth of the aging population, the incidence of lumbar spinal stenosis continues to increase. Decompression of the affected spinal level may be performed to relieve pressure off the spinal cord or nerve roots.

As a less invasive alternative for suitable patients, interspinous devices are available to act as an “extension stopper”, since it is this motion that places additional pressure on the affected neural structures and causes pain. Patients with central, lateral and foraminal lumbar spinal stenosis with leg, buttock, or groin pain, which can be relieved during flexion, are good candidates for this procedure.

The in-space interspinous distraction device has been available in Europe since 2006. This device was designed to be a minimally invasive alternative to existing interspinous distraction devices or decompression surgery. In-space is available in two approaches: the lateral, percutaneous approach requires only a small incision of 2 cm, while the posterior, mini-open approach requires an incision of 3–6 cm. Both approaches are less invasive compared to the incision needed for a standard decompression surgery.

For the percutaneous approach, a guide wire is inserted to the spinal level that needs to be distracted. Next, distractors are placed sequentially one over the other until adequate distraction is reached. Finally, the implant is inserted and wings are deployed to help keep the implant in place.

With the posterior, mini-open approach, muscles only need to be stripped unilaterally, therefore it is less invasive than some competitors’ bilateral approach. Trial distractors are placed sequentially one after the other until adequate distraction is reached. The final step, as with the lateral approach, is to insert the implant and deploy the wings.

Both surgical approaches are aided by x-ray imaging, to better visualize proper placement of the in-space. Unlike standard decompression surgery, in-space does not require the removal of any bone and supporting ligaments remain uncompromised. Thus, spinal stability is not affected by the procedure.

A single level in-space surgery is typically performed in 15–35 minutes, significantly less compared to decompression surgery. Therefore, and due to the minimally invasive nature of the procedure, patients tend to experience less postoperative pain, minimal bleeding, and a shorter hospital stay, followed by a quicker return to daily activities.

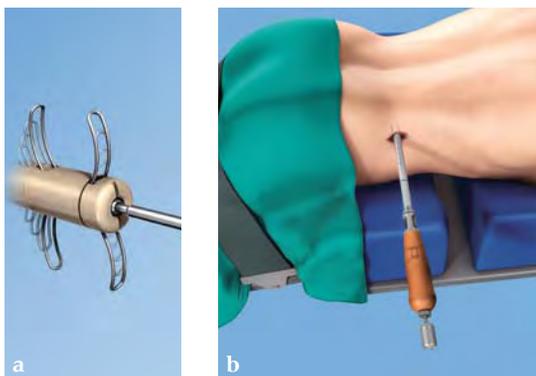


Fig 1a–b
Lateral, percutaneous approach.

32-year-old male with neurogenic claudication due to spinal stenosis (degenerative bulging discs). Complete relief of symptoms.

It is important to note that interspinous technology is not a cure-all. It is only one step in the continuum of surgical treatment for degenerative spinal disorders.

Case provided by Paul W Pavlov, Nijmegen, The Netherlands

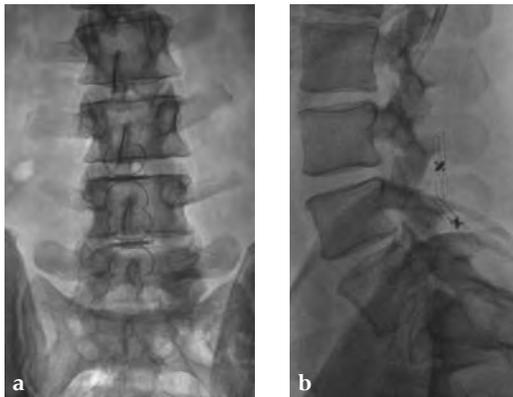


Fig 1a-c
X-rays show a good mobile spine at the affected levels.

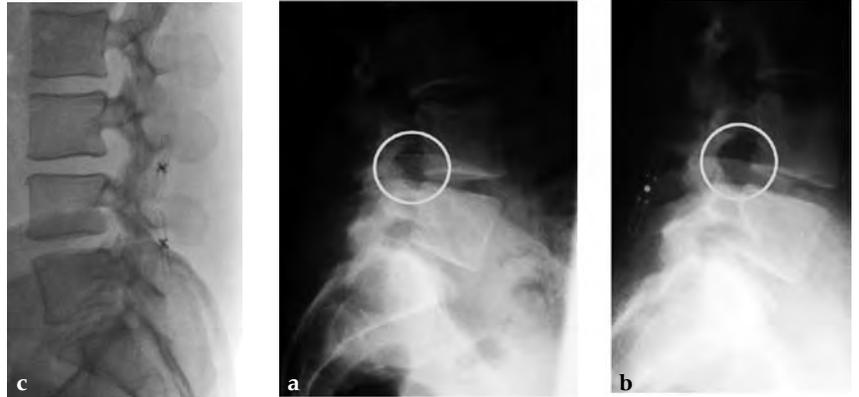
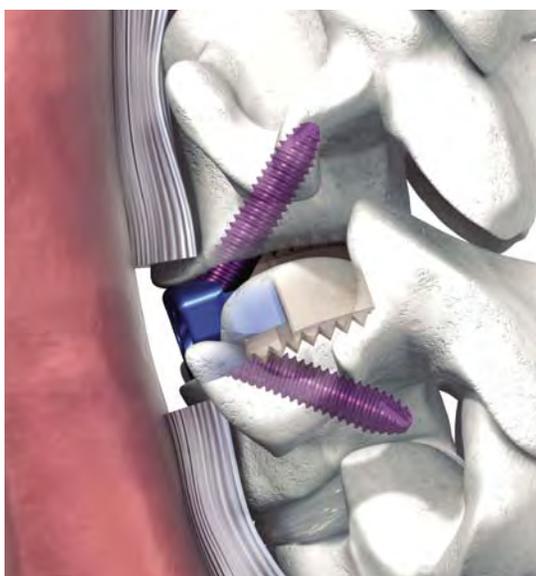


Fig 2a-b
X-rays demonstrate a significant disc height increase after in-space.



Zero P

Cervical degenerative disc disease (DDD) is a common pathology and part of the natural process of ageing. When DDD becomes symptomatic or painful, it can cause several different symptoms, including neck pain, nerve root pathology (eg, numbness or pain in shoulders/arms), and spinal cord compression. Some of the patients with persistent pain or neurological deficits need surgery to relieve the symptoms.

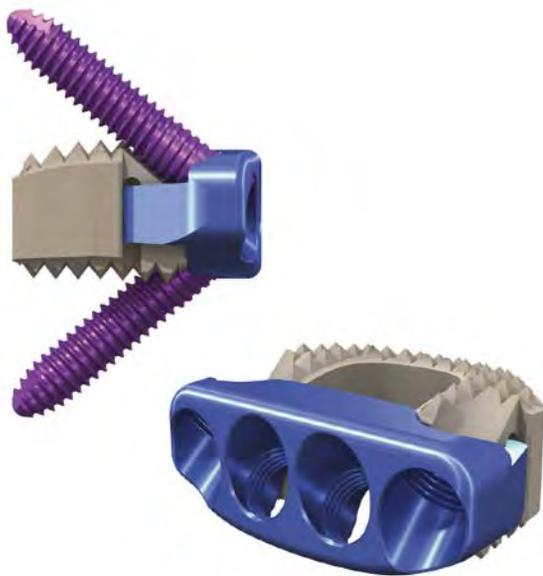
So far the standard surgical treatment is to fuse the adjacent vertebrae to the degenerated disc. This is achieved by removing the disc and filling the cavity with an autograft (the patient's own bone), allograft (bone from a donor patient) or with a cervical interbody spacer made of titanium or PEEK. Finally the entire segment is fixed with a plate-and-screw construct. In this way the affected segment is fused and stabilized.

Studies show that anterior cervical plating helps increase fusion rates [1, 2], however, anterior cervical plating also has potential drawbacks such as longer surgical times, the potential of postoperative dysphagia and heterotopic ossification at adjacent spinal levels.

A new option for anterior cervical fusion

Zero-P acts as stand-alone implant for use in cervical interbody fusions. Its design combines the functionality of a cervical interbody spacer and the benefits of an anterior cervical plate.

The name Zero-P refers to the zero anterior profile or the fact that it is contained in the excised disc space and does not protrude past the anterior wall of the vertebral body as do anterior cervical plates. Since the



implant has zero profile, it may reduce the occurrence of adjacent level ossification and postoperative dysphagia.

The device is designed as a plate/spacer combination with four rigid screws so that it provides similar stability to a traditional cervical plate and spacer [3]. Zero-P is the first implant on the market offering both a zero anterior profile as well as a biomechanical stability similar to a plate-spacer construct.

Implants and instrumentation

For optimal adoption to the patient's anatomy, Zero-P is available in three different spacer shapes (convex, lordotic, and parallel), two different footprint sizes (standard and large) and eight different heights (5–12 mm). Zero-P is delivered preassembled and sterilely packaged.

After the removal of the cervical disc, trial spacers are used to determine implant height, shape, and footprint size. After the correct trial spacer is fitted, the corresponding Zero-P implant is inserted using the aiming device. Because plate and spacer are preassembled, the plate is automatically aligned upon implant insertion. This avoids the process of aligning and realigning an anterior cervical plate.

To prepare the screw holes, instruments for awling and drilling are available. For anatomically challenging situations like patients with short necks, angled instruments are available. The Zero-P screws have a one-step locking conical head, which locks the screw to the plate by simply inserting and tightening the screw.

Bibliography

- 1 Kaiser MG, Haid RW Jr, Subach BR, et al (2002) Anterior cervical plating enhances arthrodesis after discectomy and fusion with cortical allograft. *Neurosurgery*; 50(2):229–236.
- 2 Fraser JF, Härtl R (2007) Anterior approaches to fusion of the cervical spine: a metaanalysis of fusion rates. *J Neurosurg Spine*; 6(4):298–303.
- 3 Scholz M, Reyes PM, Schleier P, et al (2009) A new stand-alone cervical anterior interbody fusion device: biomechanical comparison with established anterior cervical fixation devices. *Spine*; 34(2):156–160.

59-year-old female with neck pain and right radicular arm pain C5 and C6 and weakness during walking.

An MRI was performed and a severe DDD with soft spinal stenosis C3–C6 was diagnosed. Neurophysiology revealed myelopathic spinal cord changes. Decompression and stabilization C3/4, C4/5, and C5/6 using Zero-P was performed. After surgery the patient was nearly free of pain, had no complains regarding dysphagia, and was neurologically improved.

Case provided by Frank Kandziora, Frankfurt, Germany

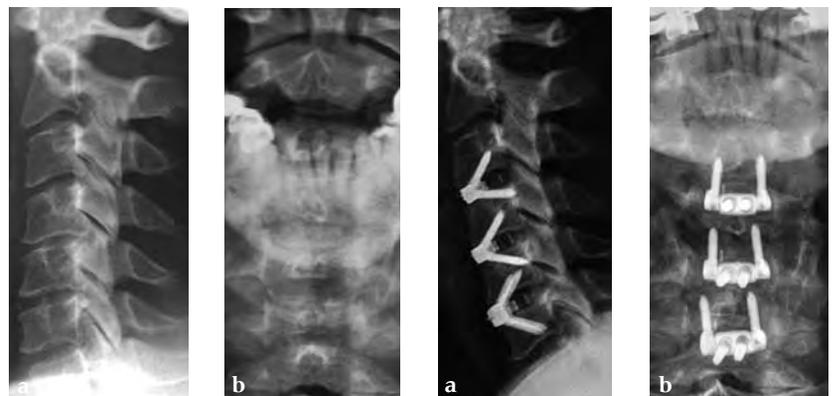


Fig 1a–b
Preoperative x-rays.

Fig 2a–b
Postoperative x-rays.



Antegra-T Lumbar and Sacral Translating Plates

The Antegra-T system offers unidirectional lumbar and sacral translating plates. The ratcheting feature maintains compression on the graft during settling and the conical locking screws ensure a rigid construct.

The system is indicated for use via the lateral or anterolateral surgical approach above the bifurcation of the great vessels or via the anterior surgical approach below the bifurcation of the great vessels as an adjunct to fusion. It can be used in the treatment of lumbar and lumbosacral (L1-S1) spine instability as a result of degenerative disc disease, pseudarthrosis, scoliosis, or a failed previous spine surgery.

The Antegra-T plate can be implanted using the same 6.0 or 6.5 mm StarDrive screws and instrumentation as the Antegra plate. Additional instruments include an intraoperative compression tool and a backtable release tool in case the implant is compressed prior to implantation. The Antegra-T plate is provided sterile.



Antegra-T becomes stiffer over the time under increasing loads as ratcheting occurs. It has the same longevity as a rigid screw construct, while offering a lower average stiffness early, to ensure load transfer to the graft. (Mechanical study at Synthes Mechanical Test Laboratory (West Chester, PA); data available upon request (n=4). Results may not necessarily be indicative of clinical performance.)

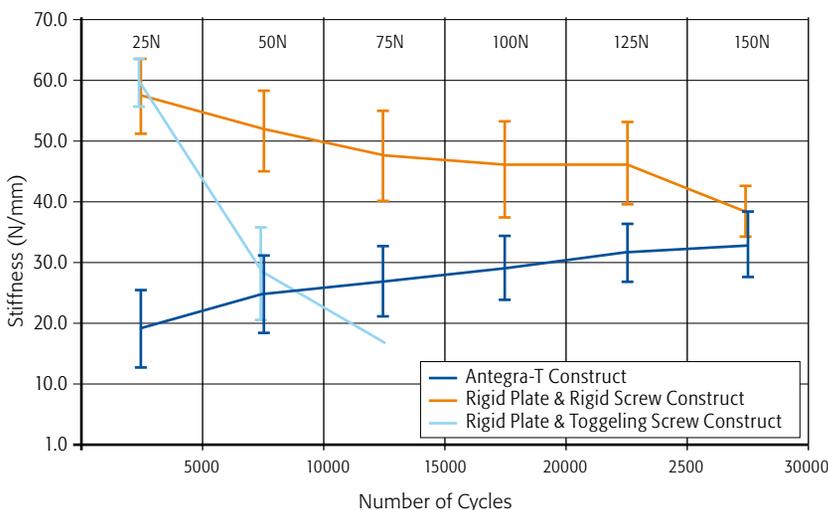


Table 1
Average construct stiffness.

29-year-old female with 2 years chronic back pain without radiculopathy. Degenerative disc disease at L5-S1 confirmed by discography. Previous epidural injection with facet rhizotomy provided no relief. Daily opioids/NSAIDs for pain. Unable to work. Treatment: Luminary CC-ALIF spacer and Antegra-T sacral translating plate. Clinical outcome 3 months postoperatively: no low-back or leg pain reported. Pain medication reduced to occasional acetaminophen use. Returned to work as a nurse. No wound issues or abdominal hernia.



Fig 1a-h
Preoperative pictures.

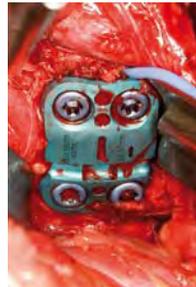


Fig 2
Intraoperative picture.

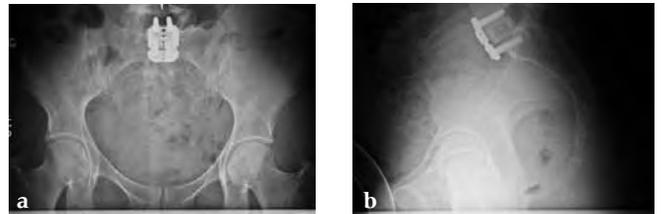


Fig 3a-b
X-rays 2 weeks postoperatively.

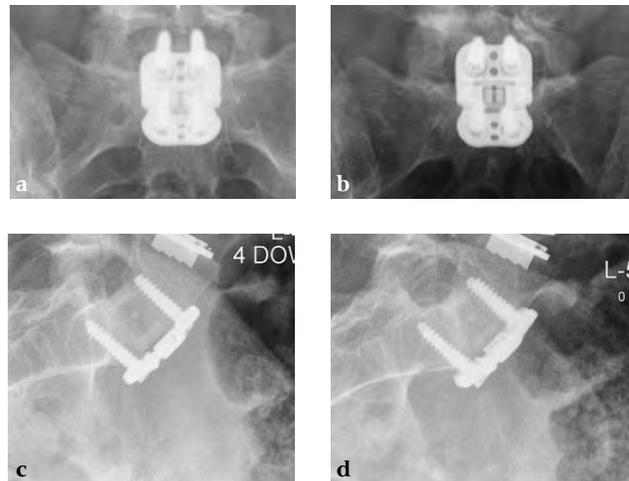


Fig 4a-d
X-rays 3 months postoperatively.

Rainer Schmelzeisen, Nils-Claudius Gellrich, Daniel Buchbinder, Christian Matula, Richard Baillot

CRANIOMAXILLOFACIAL

Matrix Orbit System

Matrix Orbital Set

The complex geometry of the bony orbit makes precise anatomical reconstruction somewhat challenging, particularly in cases of two wall fractures and when the deep orbital cone is affected. The new matrix orbital set was developed to address the need to have all necessary implants and instruments available for all types of fractures in this area.

Based on the matrix midface system, it is a dedicated set with implants and instruments specifically designed intended for orbital reconstruction. It includes a variety of existing implants, such as the orbital floor mesh plates in two versions (0.3 mm and 0.4 mm in thickness) as well as the curved 12-hole orbital plate, and the straight adaption plate with 20 holes. All implants match the sizes and hence the color coding of the matrix midface system being available in 0.5 mm (blue), 0.7 mm (pink) versions.

Furthermore, as orbital floor fractures are quite frequently associated with medial wall fractures, anatomical restoration, especially in the transition zone between both walls, is a demanding procedure. As described by Hammer [1], the orbital floor has an initial shallow convex section behind the rim, then inclines upward behind the globe, and inclines upward to meet the medial wall, creating a distinct bulge behind the globe. These convex curves of the medial wall and floor create a "postbulbar constriction" of the orbital cavity, which must be reconstructed when the orbit is rebuilt following fractures. Treatment is directed at precise anatomical reconstruction of orbital shape and volume in order to restore the correct position of the eye. To provide surgeons with an adequate implant that addresses the requirements of two wall acute orbital fractures or for secondary reconstruction of enophthalmos and dystopia, a new series of preformed orbital plates was developed for the new orbital matrix system.

Preformed Orbital Plates

The preformed orbital plates were developed based on the evaluation of more than 3,000 CT scans of patient data and then reduced to approximately 250 in order to find anatomical averages. In the end it was possible to reduce the number of plates down to two per side and still match the vast majority of all patients including males and females [2].

Unlike the existing 2-D mesh implants, the geometry of the new preformed plates will be adequate to match the individual anatomical situation of the patient in almost any case. However, the mesh parts can be



Fig 1
Matrix orbital set.

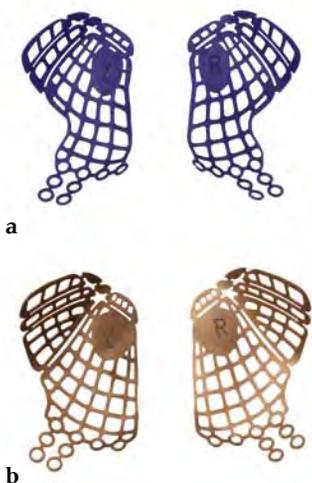


Fig 2a–b
Preformed orbital plates.

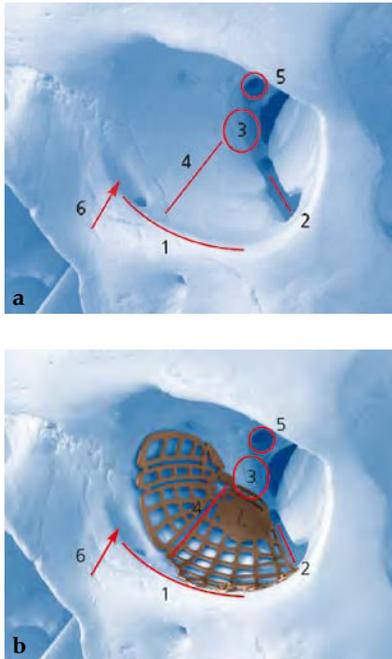


Fig 3a–b
 Implant placement according to the orbital landmarks: 1 Orbital rim, 2 Inferior orbital fissure, 3 Posterior orbital ledge, 4 Transition between the medial wall and orbital floor, 5 Optic canal, 6 Lacrimal fossa.

individually adjusted if necessary. In these cases the solid part in the central posterior area needs to remain untouched. Areas of the orbit that do not require a bridging can be spared out by trimming the implant along the designated cutting lines in the height of the medial wall and/or length of the orbital floor area. The lateral anterior part of the plate is intentionally prebent higher than the orbital rim anatomy to allow free plate movement during plate positioning.

The preformed orbital plates are indicated for trauma repair and reconstruction of fractures of the orbital floor, medial orbital wall, or combined fractures of floor and medial wall. It should be noted that in three-wall fractures where the lateral wall is also involved, a second orbital implant (ie, the mesh plate) must be used in addition to the preformed orbital plate.

Bibliography

- 1 Hammer B, Prein J (1995) Correction of post-traumatic orbital deformities: operative techniques and review of 26 patients. *J Craniomaxillofac Surg*; 23(2):81–90.
- 2 Metzger MC, Schön R, Tetzlaff R, et al (2007) Topographical CT-data analysis of the human orbital floor. *Int J Oral Maxillofac Surg*; 36:45–53.

30-year-old male with fracture of left orbital floor and involvement of medial wall.

Case provided by Marc C Metzger, Freiburg, Germany

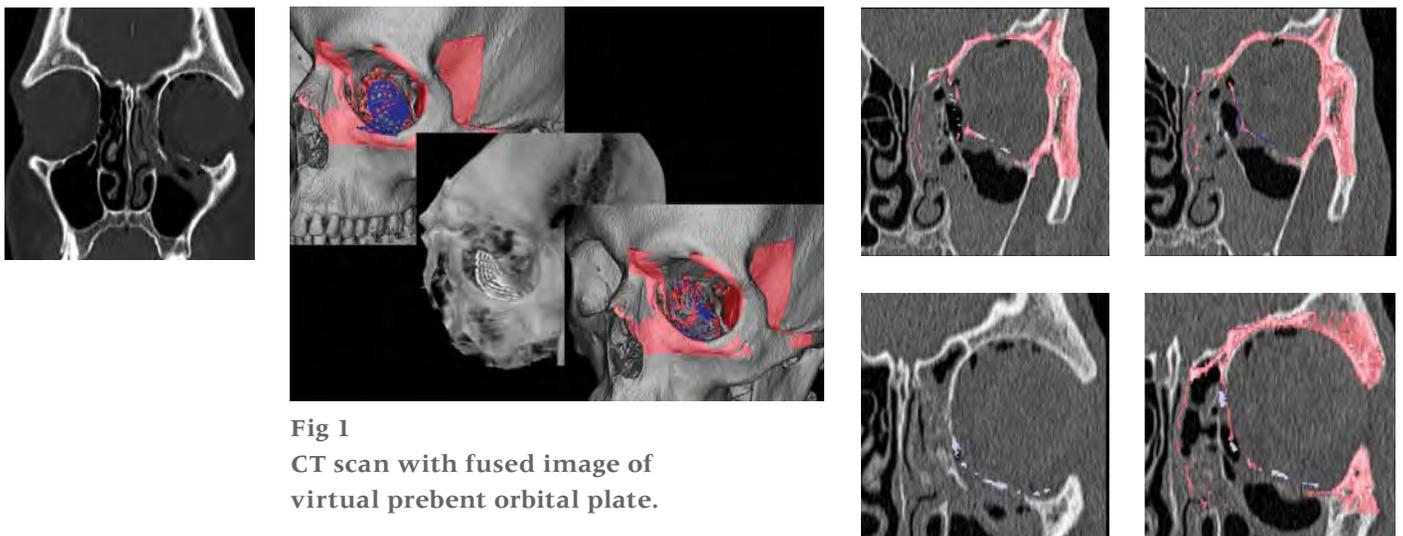


Fig 1
 CT scan with fused image of virtual prebent orbital plate.



Fig 4a–b
Orbital retractors.



Fig 5
Intraoperative use of the retractor.

Orbital retractor

The new orbital retractor was developed to address the need for better instrumentation to aid implant placement in cases of orbital fracture fixation. It is intended to minimize orbital soft-tissue prolapse and provide soft-tissue protection.

The retractor comes as a pair with one version for each side. Both are clearly marked as “left” and “right” and are also etched with a calibration scale on both sides that helps to estimate the anatomical situation in the patient’s orbit. The retractor is made out of stainless steel, yet it is malleable. Each version has a large and a small end with the design following the orbital anatomy.

Along with the preformed orbital plates the retractor is part of the new matrix orbital set.



Fig 1
0.5 mm blue curved L-plate.



Fig 2
0.5 mm blue L-plate.



Fig 3
0.7 mm pink curved L-plate.



Fig 4
0.7 mm pink L-plate.

Matrix Orthognathic System

For many craniomaxillofacial surgeons, orthognathic surgery procedures are a common part of their clinical practice. The aim of this type of surgery is to correct conditions of the jaw and face related to structure, growth, jaw alignment, and joint disorders, or to correct occlusal problems for which braces or other nonsurgical treatments would be inadequate. The most important procedures in orthognathic surgery are maxillary and/or mandibular osteotomies to advance or set back the respective jaw utilizing the AO principles.

The new matrix orthognathic system was developed to address the procedure-specific requirements obtained from CMF surgeons’ feedback from 14 countries: according to this survey the most critical features for an orthognathic system are:

- Easy to handle (42%)
- User-friendly (39%)
- Screw engagement (36%)
- Easy to bend plates (33%)
- Better screw retention (30%)
- Assorted shapes (24%)

A simple, yet comprehensive solution

It is the newest addition to the matrix platform for internal fixation of the craniomaxillofacial skeleton—already addressing neuro, craniofacial, and mandibular surgical procedures. As with all systems of the matrix family it is simple yet very effective and efficient.



Fig 5
0.8 mm gold
curved L-plate.



Fig 6
0.8 mm gold
curved L-plate.



Fig 7
Complete orthognathic skull.



Fig 8
Complete set of
plates and screws.



Fig 9
Plate module.



Fig 10
Genioplasty plate.



Fig 11
Instrument tray.

This new system offers one standard screw diameter for all orthognathic indications both in the midface and mandible and consequently only one screwdriver blade is needed for all screws.

In addition, some of the plates are reversible and can be used on both the right and left sides allowing for a significant reduction of the implant inventory. The maxillary L-plates, as well as the BSSO-plate, show etched lines in 1 mm increments providing visual aid for plate bending and adaptation with the desired movement in mind.

The color-coding of the implants in the matrix orthognathic system helps to identify the strength of the implant. The color-coding scale for plates and screws conforms to the matrix system strength color-coding scheme.

Screws

The matrix orthognathic system offers one screw diameter (1.85 mm) for all orthognathic indications: depending on the individual surgeon's preference; these are either self-tapping (blue) or self-drilling (purple) screws. They have a coarse pitch for bicortical placement, as well as improved retention, and are available in 4–8 mm length (0.6 mm thread pitch) and 10–18 mm (1.0 mm thread pitch).

2.1 mm self-tapping (pink) emergency screws, 1.5 mm self-tapping (bronze) and 1.5 mm self-drilling (silver) are also available on request for specific indications or for surgeon's preference. All screws are made of titanium alloy (Ti-6Al-7Nb). The standard 1.5 mm diameter screw (known to many surgeons) from the matrix midface system is also compatible with the plates in the matrix orthognathic system.

Plates

The matrix orthognathic system also offers a variety of plates for bone fixation in LeFort I as well as bilateral sagittal split osteotomy (BSSO) procedures. Three different plate thicknesses are available:

- 0.5 mm thick plates (blue)
- 0.7 mm thick plates (pink)
- 0.8 mm thick plates (gold)

The low profile L-plates come as 90° versions with either two or three holes on each side and anatomical version with a bend in the bar. As mentioned earlier, they are reversible so they can be used on either side of the patient and have etched lines in 1 mm increments which allow for determining the achieved bone advancement. Additionally, in order to address the request for prebent (anatomical) plates for maxillary fixation, 0.8 mm plates with the third leg offset between 2 mm and 10 mm are included in the system.



Fig 12
L-plate.

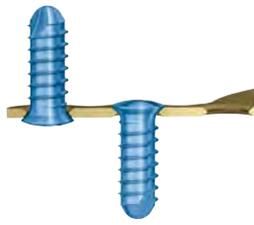


Fig 13
Reversible plate.



Fig 14
SplitFix.



Fig 15
SplitFix application 1.



Fig 16
SplitFix application 2.

The system also contains a variety of plate designs specifically made for mandibular sagittal split procedures: Straight and curved plates from 6 mm to 12 mm bar lengths with etched 1 mm lines (1.0 mm plate thickness).

The SplitFix plate, which was already available in the current orthognathic set was adapted and included in the new matrix platform: This plate has a slider which allows the surgeon to intraoperatively adjust the occlusion during plate fixation. The use of monocortical screw fixation is recommended for this indication.

Finally prebent 0.7 mm genioplasty plates with 4–10 mm offsets are included in the set. These plates have an etched midline to allow for easy centering of the distal segment.

All plates in the system are made of commercially pure titanium.

Lefort I maxillary osteotomy, bilateral sagittal osteotomies, and a genioplasty, all fixed with matrix orthognathic system used in a 19-year-old female with significant skeletofacial deformity including maxillary hypoplasia, mandibular excess, and laterognathia.

Case provided by Daniel Buchbinder, New York, USA



Fig 1a–c
Preoperative images.

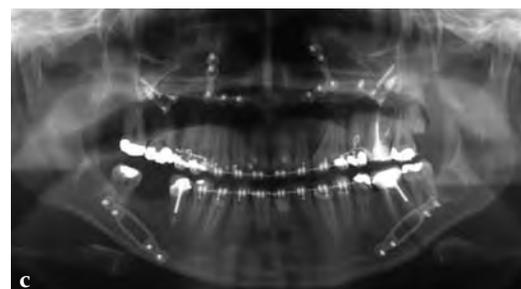


Fig 2a–c
Postoperative images.

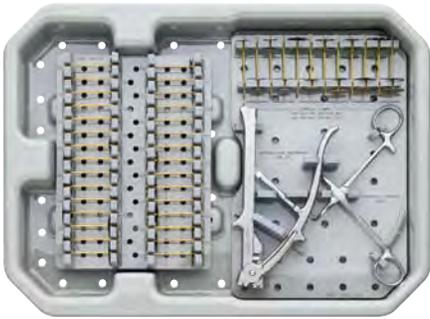


Fig 1
FlapFix system.



Fig 2
New application instrument.



Fig 3
Precrimping.



Fig 4
Cutting off the tube.

Application Instrument for FlapFix System

The FlapFix system is an innovative cranial clamping solution that allows surgeons to apply implants with a single instrument in a single, simple motion. The specially designed application instrument provides surgeons with the ability to affix cranial bone flaps quickly and with only one hand. The respective titanium implants come textured or smooth, in three sizes, and can be shipped sterile or nonsterile. They combine a low profile, an anatomical fit, and are designed to protect soft tissue.

Application instrument

The new application instrument is the only instrument needed to perform all aspects of craniotomy closure. With only a single hand action a clamp can be closed quickly and smoothly. This single instrument system means less complexity and a shorter application time for the surgeon.

It offers three functions combined in one instrument:

- Precrimping
- Tensioning to a secure fit
- Cutting off the tube

Precrimping

Precrimping allows the surgeon to hold the bone flap in place and—if necessary—reposition it before the final tightening. It is performed in a single, easy hand movement with a specially designed crimping side. One side of the instrument is etched with the marking “CRIMP” to clearly show where the implant needs to be inserted. The surgeon can lower the surface of the superior disk of all FlapFix implants by pressing the instrument handles together, allowing him to hold the bone flap in place during the final tightening.

Tightening, cutting, and releasing the tube

In order to be cut, the implants are inserted laterally into the gripping box of the instrument (“CUT” side) to prevent accidental depression of the dura. Once the tube is in the gripping box the handles are pressed together until implant is tensioned and cut is achieved. (The remaining tube is held inside the instrument gripping box only while the handles are compressed. When handles are released, the remaining tube will fall out from the gripping box.)

The instrument comes in an ergonomic design for either right- or left-handed operation. Further improvements over the current designs are:

- Stronger tensioning spring
- Alignment guide keeps implant held in gripping box to ensure smooth cuts
- Stop function inside the gripper box to minimize recoil after implant is cut
- Wider slot for easier introduction of the implant into instrument
- Blade interface and blade fixation with two screws, interchangeable blade

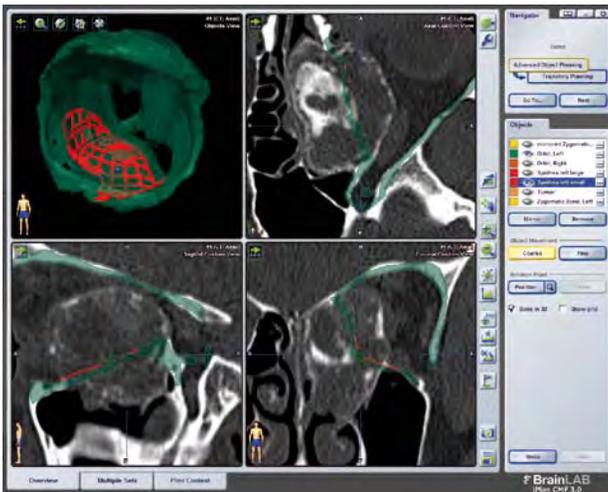


Fig 1
STL implant planning.

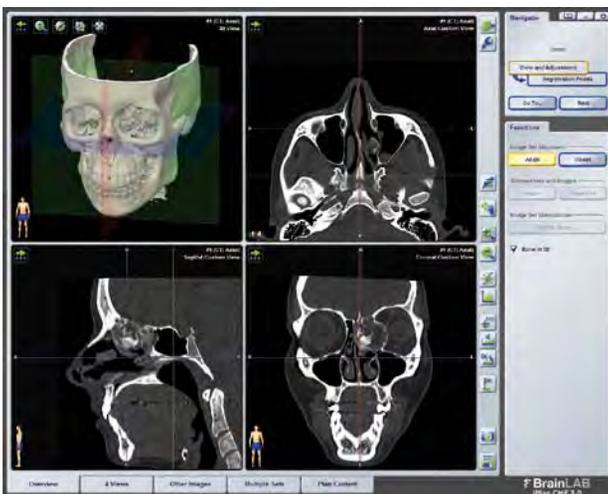


Fig 2
Custom orientation.



Fig 3
Cranial bone atlas segmentation.

iPlan CMF 3.0

Computer technology has been utilized in CMF surgery for some time. Besides the improved ways of accurate positioning of implants during the operation (“navigation”), two additional aspects in computer-assisted surgery (CAS) are of great importance: First, new technologies allow for a precise preoperative planning procedure; second, CAS serves as an unrivaled quality control instrument postoperatively with great teaching quality.

The newly approved planning software iPlan CMF 3.0 allows for extensive CMF planning and bridges the gap between preoperative planning and intraoperative navigation. Streamlined, time-saving functionalities and automated processes have been added to prior versions aiding the surgeon in the two most important aspects of his procedures: accuracy and time.

Among a variety of features are:

- Virtual simulation of the surgical treatment
- Automatic segmentation of structures based on an anatomical atlas
- Transfer of complete virtual plan into the OR without loss of data for intraoperative realization
- Import of preformed orbita reconstruction plates via STL
- Generation models for customized implants

Preparation: easy alignment of DICOM datasets

The first step in using iPlan CMF 3.0 is the upload of the patient’s DICOM data. However, before the actual planning begins, the dataset needs to be aligned correctly. The mid-sagittal and the Frankfort horizontal plane serve as reference points and mirroring planes. The alignment can be done with a “drag and drop” movement of the dataset with computer mouse. As an additional feature it is possible to display two sides of the patient in one view, allowing for comparison of the anatomical structures.

Time saving atlas-based automatic segmentation

Following the correct alignment the next required step in the procedure is the creation of reconstruction templates for the areas of interest. In current solutions this was a complex and as a result time consuming process for the surgeon requiring his precise outlining with numerous mouse clicks. With its new automatic segmentation feature, iPlan CMF 3.0 segments objects accurately within minutes. This feature is based on an anatomical atlas and allows for simultaneous selection of several objects at once.

Finally the “Smart Shaper” feature enables the surgeon to perform further manual manipulation of the objects in 3-D until the dataset fully matches meets his requirements.



Fig 4
Object mirroring.

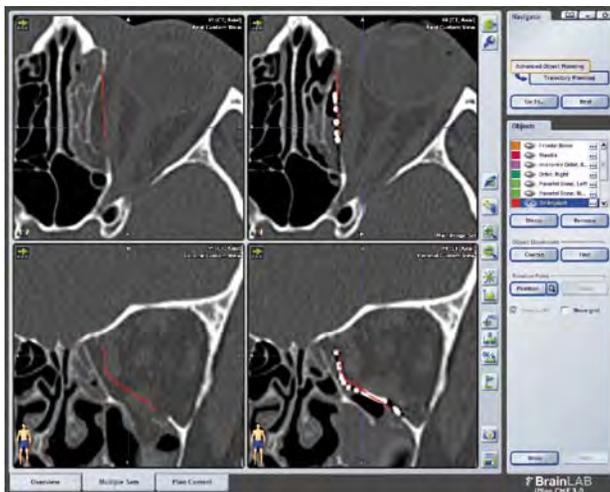


Fig 5
Postoperative quality control.

In addition to the enhanced efficiency in the planning process due to the significant time saved, the internal atlas also prevents pseudo-foramina which may happen to appear in areas with thin bony structures, ie, the orbit.

Mirroring of sides in unilateral defects

iPlan CMF 3.0 offers another feature which allows for easy mirroring of segmented objects along a defined plane. This is particularly versatile in cases with unilateral defects where the surgeon can use the anatomical structures of the non-affected side as a template to plan the reconstruction of the injured side: By a click of the mouse segmented structures can easily be mirrored along the mid-sagittal plane and overlay the defect giving clear landmarks in distances, relationships, and projections. The surgeon is then able to again manipulate and position the segments by hand until they align giving a precise prediction for the reconstruction. If older image data of the patient is available this would even be possible in cases where both sides of the facial bone structure are damaged.

Export and import of STL data for CMF planning

Naturally the surgeon's requirements for a planning tool do not end with a precise display of the anatomical structure itself, rather, it is of utmost importance to see if and how the chosen implants will help to achieve the desired reconstruction. To that end another important feature of this software tool is the ability to import STL data. This feature allows to import implants such as the preformed orbital plates (see "Preformed orbital plates" on page 11) into the patient's planning dataset. This aids the surgeon in checking the correct implant size that is required for the defect as well as defining its optimal position simply by moving it in the dataset on the screen.

At the same time, STL files can also be exported after the planning procedure is finished, ie, to utilize the data for rapid prototyping or the production of patient-specific implants eliminating the need to produce physical models beforehand.

The final operation plan can be transitioned easily into the navigation system without switching software applications, thus avoiding potential software incompatibilities and lost data. Lastly iPlan 3.0 can be used as an objective quality control instrument helping the surgeon to compare the postoperative result with the original plan by use of best-in-class image fusion technology.

Richard Baillot

THORAX/STERNUM

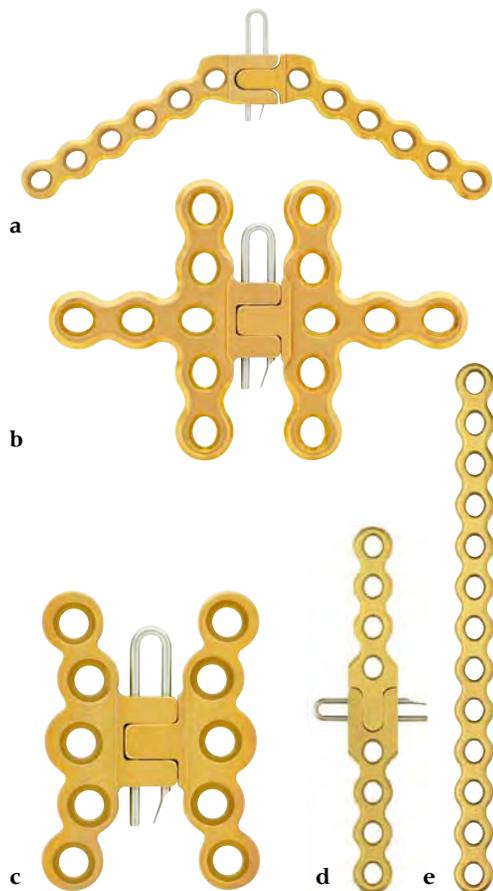


Fig 1a–e
 a Xyphoid plate
 b Double T-plate.
 c X-plate.
 d 8-hole straight plate.
 e 13-hole straight plate.

Primary Closure Plates

In addition to the existing selection of implants from the titanium sternal fixation system, a new series of plates was approved to address specific anatomical requirements: a xyphoid plate, a double T-plate, an X-plate, and an 8-hole straight plate. All of them have the same emergency pin as the existing implants. This pin holds the two segments of each implant together over the sternal osteotomy line. In case of emergency it can be removed by the surgeon allowing him to resplit the sternum and quickly reenter into the thoracic cavity.

All plates are intended for primary closure and plating, and are used with 3.0 mm locking screws. Bicortical fixation is recommended on each hemi sternum for the medial screws and for the lateral screws wherever possible.

Along with the implants new angled forceps were also approved. By surgeons' request these blunt-tipped instruments come with serrated tips for placement around lateral aspects of sternum and with angled arms to prevent over penetration and rotation

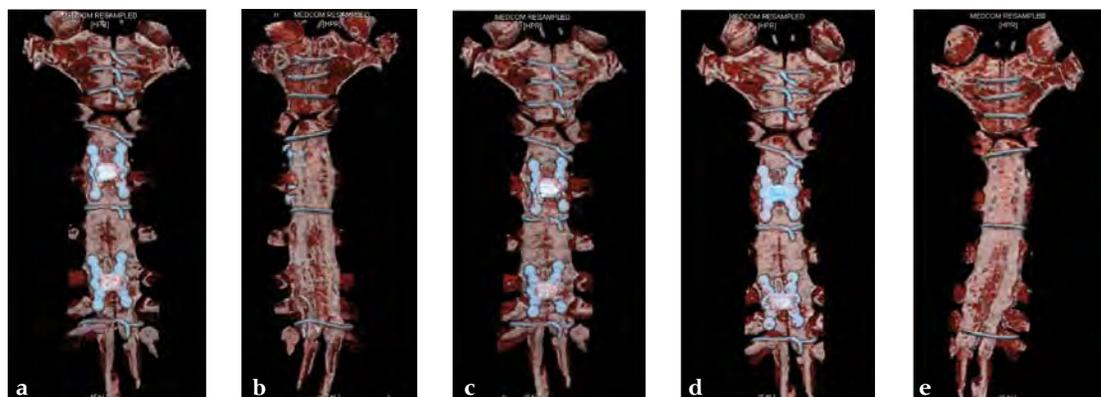
This system is intended to withstand the tremendous intrathoracic disruptive forces that patients can generate following open heart surgery and to diminish the incidence of nonunion and sternal instability often associated with deep sternal wound infection.

A randomized study is planned for next year to compare these plates to standard monofilament steel rewiring of the sternum.

The patient was treated with the primary closure plates following coronary artery bypass grafting. The sternotomy closure line can barely be seen following approximation.

Case provided by Richard Baillot, Quebec, Canada

Fig 1a–e
 Primary obscure plates used in a patient following coronary artery bypass grafting. The sternotomy closure line can barely be seen following approximation.



Norbert Südkamp, Ralph Hertel, Martin Hessmann, Pol Rommens

TRAUMA UPPER EXTREMITY



LCP Hook 3.5

Simple olecranon fractures and osteotomies as well as avulsion fractures of the medial and lateral malleolus treated with tension-band fixation are often followed by complications, especially with minimal bone stock/poorly mineralized bone, such as loss of reduction, migration of K-wires, and hardware prominence.

The LCP hook 3.5 enables tension-band plating with use of 3.5 mm screws. The hooks aid fixation of small bone fragments and increase stability. Elongated LCP holes make the plate and its fixation more flexible and allow for controlled compression. The spring effect facilitates reduction and a stable tension-band technique. Its flexible one-third tubular plate design provides an anatomical fit and its low profile minimizes hardware prominence.

The LCP hook 3.5 was primarily intended for treatment of simple fractures of the olecranon and osteotomies of the olecranon for distal humerus fracture treatment creating compression with the long oblique 3.5 mm lag screw. But it has shown its benefits also in avulsion fractures of the distal tibia and fibula.

A 20-year-old construction worker fell from a 3 m height. He sustained a typical posterolateral impression and flake fracture of the talar dome.

Case 1 provided by Christoph Sommer, Chur, Switzerland

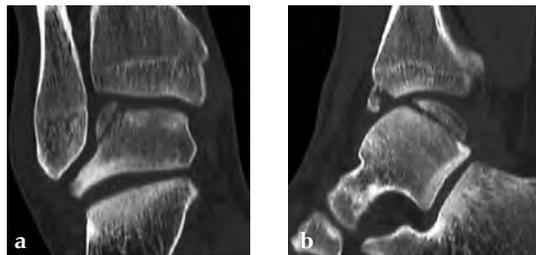


Fig 1a–b
Preoperative pictures.



Fig 2a–c

Reconstruction using a multiplanar osteotomy of the distal fibula, bone grafting and screw fixation of talus, stabilization of distal fibula using an LCP hook 3.5 with conventional screws and two separate lag screws.



Fig 3a-b
X-rays 3 months postoperatively showing excellent function and healing of fracture and osteotomy.

30-year-old male.

Case 2 provided by Norbert Südkamp, Freiburg, Germany



Fig 1a-b
Preoperative AP and lateral x-rays.

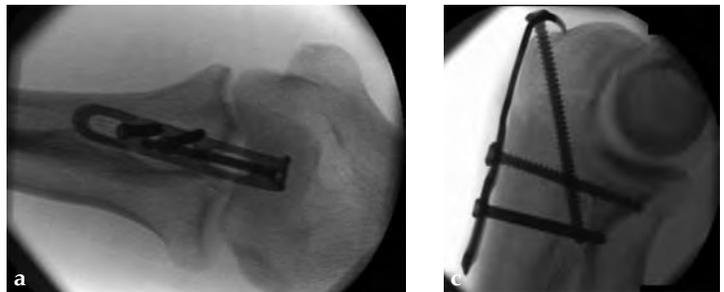


Fig 2a-c
Intraoperative images.

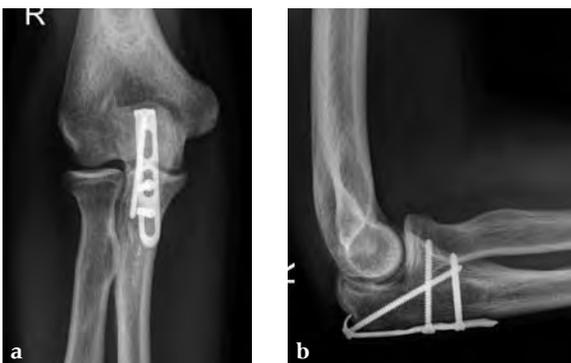


Fig 3a-b
X-rays 5 months postoperatively.



Fig 4a-b
Implant removal 5.5 months postoperatively.



Olecranon Osteotomy Nail

Comminuted articular distal humerus fractures often require a large access area for anatomical reduction of the joint surface and the metaphyseal area. In these cases an olecranon osteotomy is often performed for better visualization of the fracture area, allowing the tip of the olecranon and the triceps muscle to be moved out of the way. After reconstruction of the distal humerus, the olecranon is usually fixed with two K-wires inserted longitudinally down the ulna combined with a tension band in a figure-of-eight. Alternatively, a 6.5 mm cancellous screw with or without tension band is used. Complication rates after refixation of the olecranon have been described in up to 20% of cases. Typical complications are K-wire migration, prominence of implants requiring secondary operation for removal, loss of fixation especially in osteoporotic bone, increased fracture gaps, and nonunions. In addition, cancellous screws may toggle in the canal causing misalignment at the articular surface, leaving gaps or steps. A high reoperation rate has been reported in the literature. Similar complications have been described in olecranon fractures treated with cerclage wires or cancellous screws.

The olecranon osteotomy nail is indicated to treat simple olecranon fractures and osteotomies of the olecranon. The system enables pre-osteotomy implant insertion ensuring anatomical alignment and easy fixation of the olecranon osteotomy after distal humerus surgery. The set consists of one single nail, one single end cap, and a range of 2.7 mm screws with a threaded head.



The nail is inserted through a triceps tendon longitudinal split of approximately 1 cm. The entry portal is predrilled and the distal part of the nail is inserted at a position distal to the location of the osteotomy using an insertion handle. The implant is cross locked prior to creating the osteotomy. After the distal humerus is fixed, the osteotomized tip of the olecranon is brought back to its original position and an end cap is inserted through the predrilled hole in line with the nail, reducing the olecranon and creating compression across the osteotomy, ensuring an anatomical reduction/alignment. This procedure allows for a quick and easy realignment and fixation of the olecranon. The locking holes in the distal part of the nail are oblique to each other as well as to the anatomical axis of the ulna. This design prevents the nail from moving within the medullary canal to prevent toggling and ensures anatomical reduction of the olecranon fragment. Targeted locking minimizes the size of the incision. The threaded head of the locking screws sit flush with the surface of the ulna minimizing hardware prominence and soft tissue irritation.

Overall, the olecranon nail system provides more stable fixation with less overall fracture gap motion compared to alternative fixation techniques. Since the implant is inserted prior to the osteotomy, refixation of the olecranon at the end of the procedure is an easy and quick procedure.

A 75-year-old female pedestrian was hit by a car and sustained a 2° open fracture of the distal humerus and an additional pelvic ring fracture.

Case provided by Martin Hessmann, Fulda, Germany



Fig 1a-c
Preoperative x-rays and clinical picture.

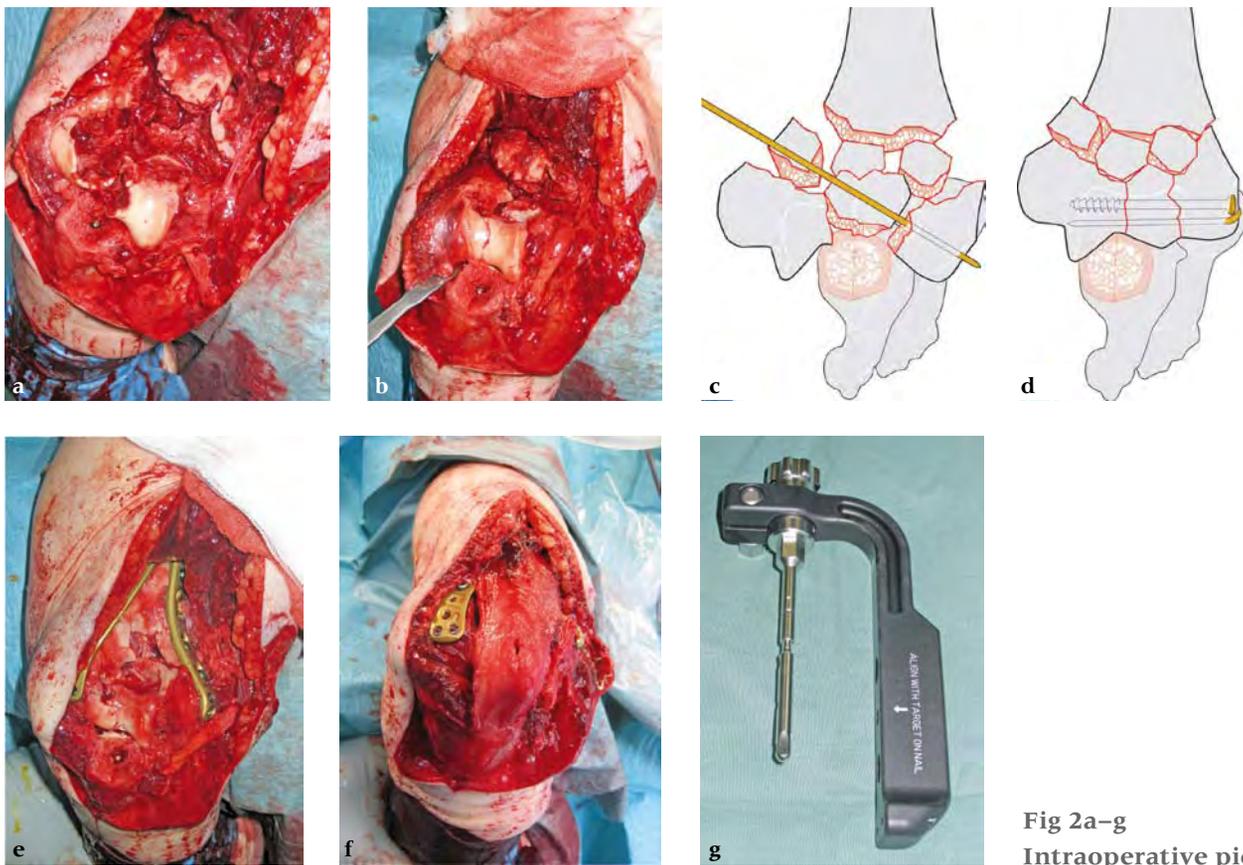


Fig 2a-g
Intraoperative pictures.

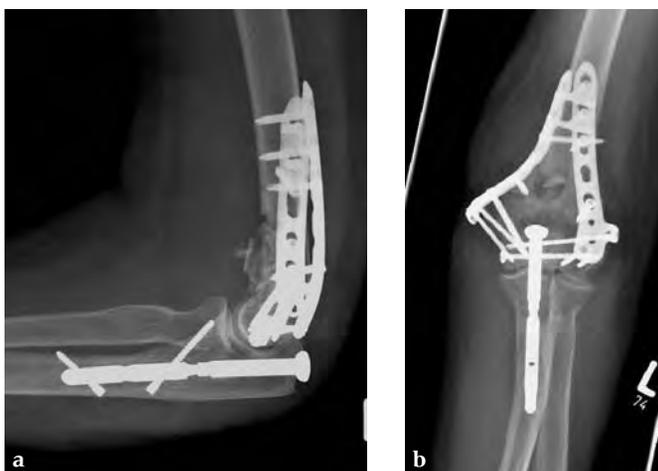


Fig 3a-b
X-rays 2 weeks postoperatively.



Shoulder Retractor Set

Surgical approaches to the shoulder can be challenging and require specific knowledge, skills and instruments. Difficult exposures may occur in stabilizing procedures, rotator cuff repairs and shoulder arthroplasty, especially for glenoid replacement.

A dedicated shoulder instrument set, consisting of retractors for the deltoid and the humerus in order to provide a better approach to the joint, is now available. These instruments facilitate the approach and are intended for general use in open shoulder surgical procedures and are essential for ease of implantation of the Epoca shoulder arthroplasty.

Intraoperative images provided by Ralph Hertel, Bern, Switzerland

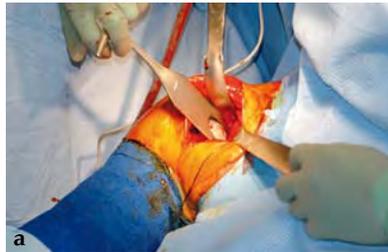


Fig 1a–c
a Glenoid exposure.
b–c Retractor.

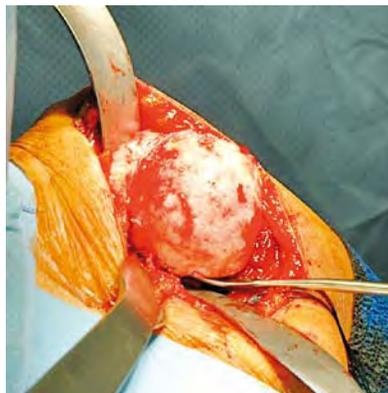


Fig 2
Retractor humeral head.

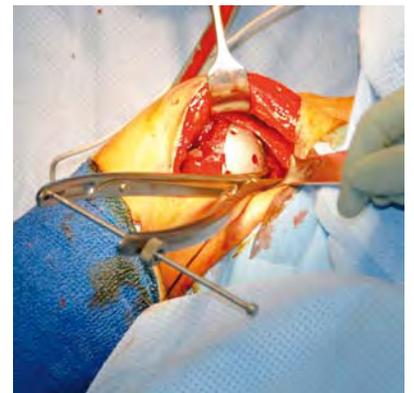


Fig 3
Shoulder spreader.



Expert Humeral Nail: End Caps for Locking Screws

The expert cannulated humeral nail is indicated for fractures of the proximal humerus, humeral shaft, malunions/nonunions, and impending pathologic fractures. It has a universal design for the right or left humerus, and for antegrade or retrograde insertion. The locking options include spiral blade locking (using the current spiral blade for humeral nail), standard locking (with 4.0 mm locking screws), and compression locking. The current locking end caps are compatible with all locking options. To accommodate this universal use, the current end cap also locked the most proximal screw causing the screw to bend slightly.

A new nonlocking end cap has been specifically designed for use with the locking screws only. This end cap has a shorter distal extension to allow clearance for the use of screws in proximal locking. They are available with 0 mm, 5 mm, 10 mm, and 15 mm extension. The new end caps are color coded for easy differentiation.

Jesse B Jupiter, Doug Campbell

TRAUMA HAND

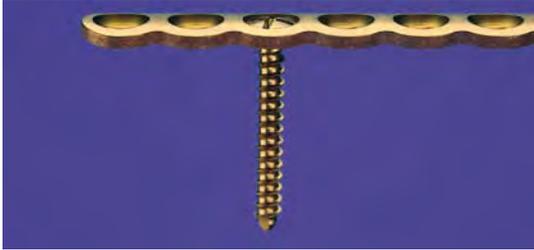


Fig 1



Fig 2



Fig 3
Precontoured for anatomical fit.

1.5 mm LCP Modular Hand System

The 1.5 mm LCP modular hand system is indicated for fixation of small bones and small bone fragments, including osteotomies, arthrodeses, replantations, reconstructions of small bones and small bone fragments, particularly in osteopenic bone.

The existing system has been updated. All plates now have a low profile to reduce soft-tissue irritation, locking compression plate (LCP) hole design for use with cortex or locking screws, and a cut-to-length feature to minimize inventory.

The coaxial combination holes in adaption plates allow the use of locking screws or cortex screws in the same round conical plate hole. Otherwise, the design of the well established plates has not been changed.

All plates and screws are available in implant quality 316L stainless steel and commercially pure (CP4) titanium and with or without short threaded drill guides preassembled.

All locking and cortex screws have a self-tapping tip to facilitate insertion and self-retaining StarDrive recess improving torque transmission and increasing resistance to stripping. They come in lengths from 6–24 mm.

Periarticular complex metacarpal fracture treated with 1.5 LCP modular hand system and 1.5 headless compression screw.

Case provided by Tom Fischer, Indianapolis, USA



Fig 1
Preoperative.



Fig 2a–c
Postoperative.





Headless Compression Screw extra small (HCS 1.5)

The headless compression screw (HCS) was first introduced in sizes of 2.4 mm and 3.0 mm. Now the family has been enlarged by an extra small version of 1.5 mm. Indications are fixation of intra- and extra-articular fractures and nonunions of small bones and small bone fragments, arthrodeses of small joints, osteochondral fractures, osteotomies, and avulsion fractures.

The HCS 1.5 works according to the same functional principle as for the existing 2.4 mm and 3.0 mm HCS: insertion, reduction and compression in separate steps. Controlled compression is achieved through a separate compression sleeve. The only difference is that the HCS 1.5 is not cannulated.

The shaft thread has a diameter of 1.5 mm and a head of 2.1 mm. The shaft thread length is progressive from 4–8 mm. The screw lengths advance from 8–26 mm in steps of 1 mm. A special compression sleeve is required for the HCS 1.5. An optional 1.8 mm drill bit for predrilling the head in hard bone is available.

Mechanical tests compared to the 1.5 mm cortex screw showed that the push-/pull-out performance is higher, torsion is about the same and maximum compression slightly higher for the same thread length when compared to the other HCS sizes.

Fig 1
1.5 mm headless compression screw.

A 22-year-old female with previous complex fractures of the base and head of the middle phalanx (proximal screws are from the previous fracture fixation) presented with a residual painful, deformed, and stiff DIPJ. Joint arthrodesis planned.

Case provided by Robert Farnell, Leeds, UK



Fig 1a–b
Preoperative
x-rays.

Fig 2a–b
X-rays 6 weeks postoperatively
showing a sound arthrodesis.
The arthrodesis was performed
using the longest available screw.
Note that despite this it has only
just crossed the arthrodesis site.

Per-Henrik Ågren, Andrew K Sands, Ian G Winson, Michael Castro, Les Grujic, Juan Bernardo Gerstner Garcés

TRAUMA FOOT AND ANKLE



Fig 1
Distractor.



Fig 2
Different shaped chisels.



Fig 3a–c
Bone harvesting set.

Orthopaedic Foot Instrument Set

The orthopaedic foot instrument set is intended to help in trauma and reconstructive surgery of the foot and ankle and consists of a distractor, trephines and extraction attachments, chisels and cartilage remover, and new handles.

The distractor enables easy and precise handling and tightening to achieve compression or distraction for better visualization and increased access while preparing joints or when reducing fractures in feet. The controlled ratchet for finger tightening or loosening allows for controlled, linear shifting. K-wire sleeves with holding mechanism for sizes of 2.0, 2.5, 3.0, and 4.0 mm allow the placement of K-wires in the desired thickness. Two extra K-wire holes increase versatility and increase stability (stable enough for talus and distal tibia). A rotating locking mechanism enables simple handling which also saves time.

Three different shaped chisels in two sizes (10 and 15 mm) are available for preparation of small joints of the foot for arthrodesis, eg, proper removal of joint cartilage and preparation of convex/concave shaped joints or other precise anatomical and indication specific (surgical) approaches.

The bone harvesting set for reconstruction of deformities consists of trephines and extraction attachment in seven assorted diameters (5.5–14 mm) for accurate local bone grafting for various anatomies.

Pictures provided by Per-Henrik Ågren, Stockholm, Sweden



Fig 1a–b
Distractor on supramalleolar tibial osteotomy.



Fig 2
Child with OCL treated with grafting and fixation with mini HCS 1.5.



Fig 1
Headless compression screw 4.5 mm, 50 mm length.



Fig 2
Screw 4.5 short.



Fig 3
Screw 4.5 long.



Fig 4
Headless compression screw 6.5 mm, 80 mm length.



Fig 5
Screw 6.5 short.



Fig 6
Screw 6.5 long.

Headless Compression Screw 4.5 mm and 6.5 mm

Fixation of small and large bone fragments require meticulous reconstruction of the articular surface while preserving the surrounding cartilage and soft tissues. In order to achieve stable fixation with primary bone healing, the application of suitable controlled compression is preferred to support a high clinical success rate. Standard screws are problematic in intraarticular applications and in areas with little soft tissue coverage. Protruding heads may damage the joint surface or irritate soft tissue. Therefore, an adequately sized lag screw would be beneficial, one that could be buried below bone surface, for example, in the knee, ankle and foot.

The headless compression screw (HCS) 4.5 and 6.5 function the same way as the existing HCS 2.4 and 3.0. The design of the HCS 4.5 and 6.5 is specifically adapted to treat fractures, osteoarthritis or deformities of small to large bones. The HCS 4.5 is primarily intended for the calcaneus, talus, metatarsus, distal and proximal tibia, distal femur, as well as proximal humerus. The HCS 6.5 may be used for all the above except the proximal humerus.

The headless compression screw 4.5 comes in lengths of 20–110 mm with short thread (shaft thread lengths 7–22 mm) and 30–110 mm with long thread (shaft thread lengths 12–44 mm).

The headless compression screw 6.5 comes in lengths of 30–150 mm with short thread (shaft thread lengths 16 mm), and 45–150 mm with long thread (shaft thread length 32 mm).

For the large size HCS the same instrumentation as for the existing HCS can be used. The only additional ones are the attachment for compression sleeve for powered screw insertion, drill bit for predrilling the near cortex, and sleeve for compression sleeve.

Case 1: 62-year-old white female with right stage II posterior tibial tendon insufficiency and II and III overload due to medial cuneiform first metatarsal joint instability treated with UCBL for 6 months after she complained of severe pain and increasing swelling.

Cases provided by Juan Bernardo Gerstner Garcés, Cali, Colombia



Fig 1a–d
Preoperative views and x-rays.



Fig 2a–c
Intraoperative views of medial displacement osteotomy of the calcaneus and transfer of the tendon of the flexor digitorum longus to the navicular, fixed with an interference screw. A fusion of the first medial cuneiform—metatarsal I, II, and III modified. Weil osteotomy was performed as well.

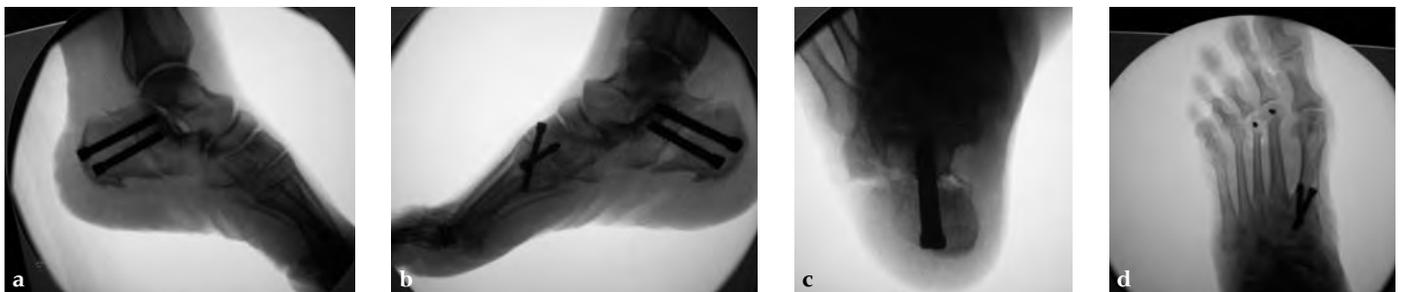


Fig 3a–d
Postoperative x-rays. The talar axis is aligned to the midshaft of the first metatarsal.



Fig 4
Postoperative view.

Case 2: 67-year-old white female.



Fig 1a-c
Preoperative images. Stage II of her left posterior tendon dysfunction and tarso/metatarsal, instability visible on x-ray.



Fig 2a-b
Immediately postoperative x-rays: a medializing calcaneal osteotomy was performed and fixed with two 6.5 mm HCS, a flexor hallucis longus transfer to her navicular is secured with an interference 7 mm screw and a lapidus procedure fixed with two crossing 4.5 HCS.



Fig 3a-b
Progressive weight bearing was permitted at 8 weeks and UCBL was advised until the fourth postoperative month.



Fig 1
Ankle arthrodesis 22.

LCP Anterior Ankle Arthrodesis

The LCP anterior ankle arthrodesis is indicated for arthrodesis of the ankle joint and distal tibia via an anterior approach. It is especially useful if a previous extensile approach was made for ORIF, making subsequent adjacent incision ill advised.

The plates are precontoured, have combination holes in the plate shaft and are available in 6-hole (100 mm) or 7-hole (116 mm) lengths. All holes accept 4.5 mm cortex, 4.5 mm shaft screws and 6.5 mm cancellous bone screws. The locking holes accept 4.0 mm solid, 5.0 mm solid or 5.0 mm cannulated locking screws. Two distal elongated DCU holes allow for greater screw angulation and better bone purchase. A proximal notch accepts the articulated tension device (to allow compression or distraction).

The plate is available in 316L implant quality stainless steel or commercially pure (CP4) titanium.



Fig 2
Ankle arthrodesis 29.



Fig 3
Ankle arthrodesis 31.

58-year-old male. Previous plafond fracture and ORIF through large anterior incision. Increasing pain not relieved by nonoperative preoperative workup revealing deep bony infection. The interim procedure was deep biopsy, curettage and placement of antibiotic self-dissolving beads. Generation IV antibiotics were given. The reimaging showed infection had gone.

Anterior approach through the same anterior incision with placement of anterior plate. Orthogonal screw was added for stability through the fibula into the talar body. Preserving fibula makes it easier for future reconstruction should that be possible (ie, placement of implant in the face of previous infection currently not recommended).

Case provided by Andrew Sands,
New York, USA



Fig 1a–b
Preoperative x-rays.

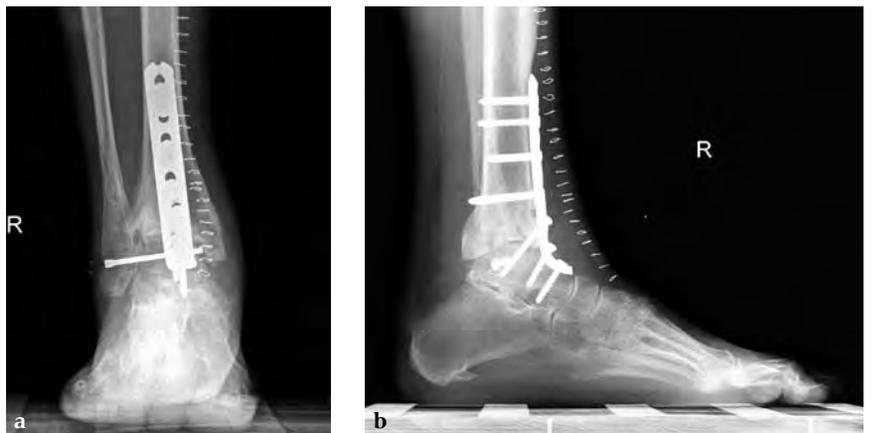


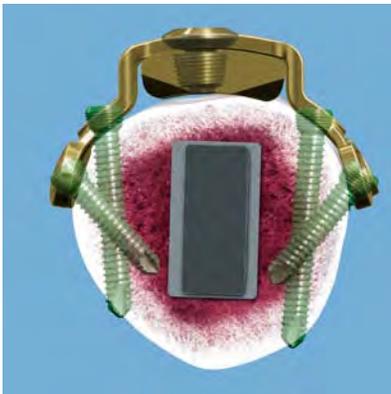
Fig 2a–b
Immediately postoperative x-rays.



Fig 3a–c
X-rays 6 months postoperatively.

Michael Wagner, Michael Schütz, Dean Lorich, Brent Norris, Sean Nork, Phil Kregor

TRAUMA LOWER EXTREMITY



3.5 Locking Attachment Plate

The 3.5 locking attachment plate is indicated for use with locking compression plates (LCPs) to augment the stabilization of fractures, including periprosthetic fractures and fractures in the presence of intramedullary implants in the femur, tibia, and humerus, particularly in osteopenic bone.

Periprosthetic fractures are increasing because of the aging of the population, more active old people, the development of endoprosthetics and an increase in the number of patients with long-standing implants. The incidence has been reported to be 1.5% for primary procedures and 4% for revisions [1]. Because of the prosthesis stem (or a nail) in the intramedullary canal it is not possible to insert screws bicortically as it would be needed. These fractures are mainly treated with cable systems and monocortical screws with the disadvantage of high invasiveness and the possibility of cutting into osteoporotic bone.

The 3.5 locking attachment plate which can be attached to an LCP offers an alternative to cables. With the possibility to insert 3.5 mm locking screws bicortically by avoiding the prosthesis stem a similar or even better mechanical stability than with cables can be reached with a less invasive procedure. The plate is attached to a base plate, in essence, widening that plate and its screw angle options to gain 3.5 mm screw purchase around a prosthesis or any device that may be blocking the intramedullary canal.

The fit of the plate has to be tested on five different patient sizes (CT data) and four locations on the femur. The inner radius of the plate is larger than the outer bone radius which enables fit even for large sized patients and if necessary the plate can be adapted onto the bone shape. If the bone diameter is small, the plate can be bent, and screw angulations increased for the screws to get hold in the cortex.

The plate is simple to use and the decision can be made intraoperatively (implants are available, both nonsterile and sterile packed). The threaded insert portion of the connecting screw is inserted into the base plate. Then the plate is placed on top and locked with the upper portion of the connecting screw.

The locking attachment plate can also be used to prevent lateral screw pull-out in osteoporotic bone irrespective of a prosthesis or an intramedullary implant.

Bibliography

Old AB, McGrory BJ, White RR, et al (2006) Fixation of Vancouver B1 Periprosthetic fractures by broad metal plates without the application of strut allografts. *J Bone Joint Surg [Br]*; 88-B (11).

A 78-year-old female sustained a periprosthetic fracture, Vancouver type C, 9 years after a total hip arthroplasty.

Case 1 provided by Klaus-Dieter Schaser, Berlin, Germany



Fig 1a-c
Preoperative x-rays.

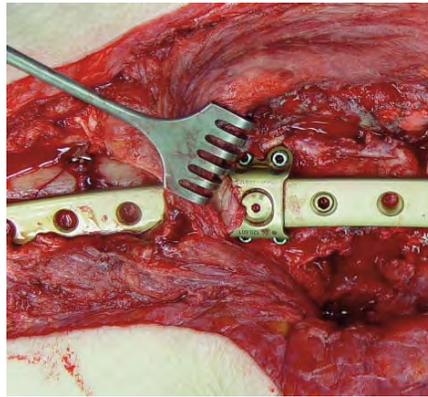


Fig 2
Intraoperative view.

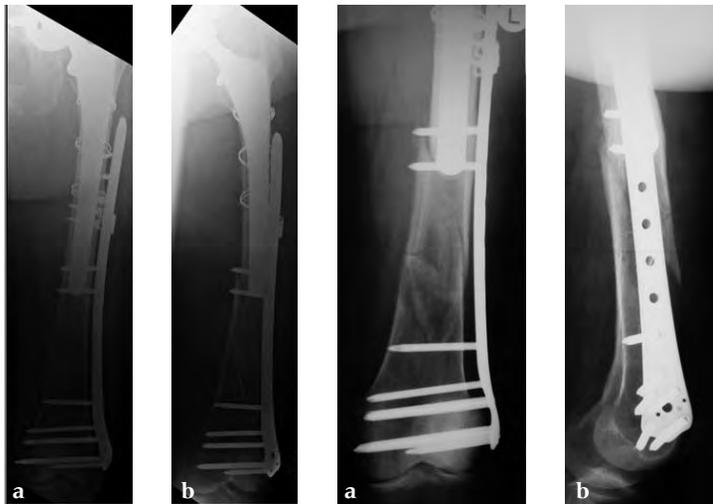


Fig 3a-b
X-rays 8 days
postoperatively.

Fig 4a-b
X-rays 6 weeks postoperatively.



Fig 5a-d
X-rays 4 months postoperatively.

A 76-year-old female. Vancouver type C.

Case 2 provided by Michael Wagner, Wien, Austria



Fig 1a-c
Preoperative x-rays.



Fig 2a-c
X-rays immediately postoperatively. LCP distal femur and locking attachment plate.



Fig 3a-c
X-rays 1 year postoperatively.

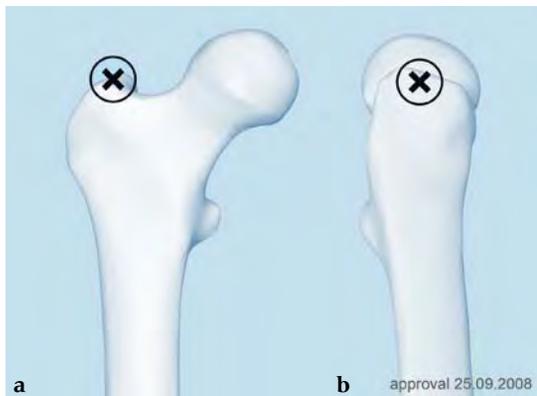


Fig 1a-b
Impingement on the lateral cortex.

Expert Asian Femoral Nail (A2FN)

The small statured/Asian anatomy was carefully assessed via CT scans and MRI data in terms of morphology and size, to assess the fit of nails to the intramedullary canal of the small stature/Asian patient. It was discovered that current femoral nails do not offer an optimal fit for small stature/Asian anatomy. Generally, the medial lateral bend of current nails is disproportionate, the proximal design of the nails is too long and challenges the surgeon to deliver locking or recon screws into the femoral head without having too much proximal protrusion of the nail itself. The lateral aspects of the nail may cause impingement on the lateral cortex of the small stature/Asian patient.



Fig 2a–b
Expert A2FN.

The A2FN has accommodated all these different aspects. In the proximal region of the nail, the relationship between the locking elements and the proximal nail end has been decreased to negate protrusion in the small stature/Asian patient. Optimum positioning of the recon screws has been accounted for and the length of the proximal end of the nail has been decreased to negate protrusion in the shorter patients. The entry point is at the greater trochanter (5°) as this approach is preferred in Asia. The locking options are identical to the AFN except for an additional anteromedial (25°) locking hole for more axial stability. The end cap has a longer unthreaded part for easier insertion. A special guide wire with hook engages with the end cap to facilitate a secured way through soft tissue. The nail comes in diameters of 9–14 mm and in lengths of 280–460 mm. The nail is cannulated and available in a left and right version.

Dynamic 4-point bending test of Expert A2FN and AFN according to ASTM showed that the stress curve of the Expert A2FN is about 5% superior to that of the AFN. Dynamic strength of the Expert A2FN is about 30% above that of the AFN.

22-year-old Asian male with multiple injuries after MVA at 160km/h—the car finally “stopped” in a front yard.

Case 1 provided by Michael Schütz, Brisbane, Australia

Besides severe upper limb injuries, maxillofacial injuries, a lateral compression pelvic ring injury, and pulmonary contusions, the patient sustained a 32-C3 femur fracture right.

After initial stabilization with an external fixator, the femur was nailed in a closed fashion stabilized with an AFN2 in static mode. The accurate length of the injured femur was contemplated from the uninjured leg.

9-month follow-up demonstrates that that the fracture is uniting.



Fig 1
Scene of the accident.



Fig 2a–b
X-rays following the accident.



Fig 3a–b
Initial stabilization.



Fig 4a-b
Postoperative x-rays.



Fig 5a-c
Follow-up x-rays.

A 76-year-old female underwent right total knee replacement 5 years ago and left total knee replacement 4.5 years ago.

Case 2 provided by Merng Koon Wong, Singapore, Singapore



Fig 1a-b
Immediately post knee replacement x-rays. Note the anterolateral bow of the femur shaft.



Fig 2a-b
Immediate post TLIF x-rays of lumbar spine.

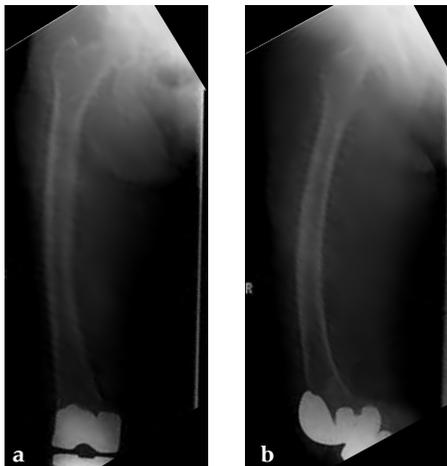


Fig 3a-b
Right femur x-rays 3 weeks before midshaft femur fracture. Note the very obvious anterolateral bow and the thickened lateral cortex in the lateral midshaft cortical bone, which may indicate a stress fracture.

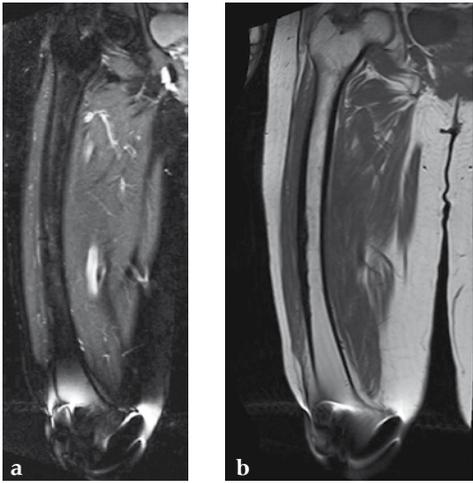


Fig 4a–b
MRIs of the right thigh 1 week before fracture. No edema to indicate stress fracture.

The patient underwent left L5S1 minimally invasive TLIF with pedicle screws 2 years ago for left lumbar 5th radiculopathy. At the same time she was put on fosamax for osteoporosis.

Three weeks prior to her last admission, she complains of recurrent right thigh pain for which epidural analgesics were administered for presumed radiculopathy, however preliminary x-rays and even MRI of the thigh were also taken in view of her primary complaint regarding her right thigh. These investigations did not indicate the possibility of impending bisphosphonate related femur fracture. It is clear from the radiographs that she has an obvious anterolateral bow of her femur.

Based on the negative MRI thigh and positive MRI lumbar spine of multiple levels of spinal stenosis, the patient underwent epidural analgesic injection. Patient sustained right femur midshaft periprosthetic fracture the next day after her epidural injection with no trauma.



Fig 5a–b Midshaft fracture right femur. Notice the fracture decrease the emphasis on the anterolateral bow of the femur.

Insertion of A2FN as patient may be suffering from a stress fracture related to long term (2.5 years) bisphosphonate use. My rationale against a plate is because bisphosphonate related fractures will heal extremely slowly. In our experience even despite bone grafting union may need up to 2 years. In that time, a plate will fail in less than a year even if the patient is only allowed very minimal weight bearing.

Patient was allowed and achieved immediate weight bearing and in 6 weeks callus is seen at the fracture site.



Fig 6a–b Immediately postoperative x-rays of right femur. Note despite the increased in curvature compared to other nails in the market, there is still noticeable malreduction at the fracture site.



Fig 7a–b
X-rays 6 weeks postoperatively.



Fig 1
Normal handle.

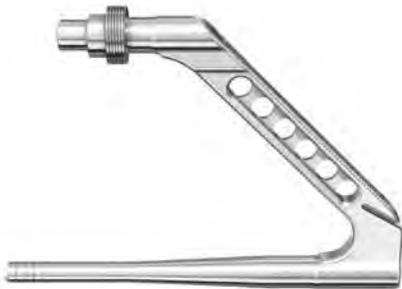


Fig 2
New handle for obese patients.



Percutaneous Insertion Handle for LFN and R/AFN for obese patients

For soft tissue clearance in very obese patients, the standard insertion instruments may be too short, as the barrel of the standard insertion handle measures only 44 mm in length. Therefore, a longer barrel for the percutaneous insertion handle was designed with an increased length of 144 mm. The added length necessitates a longer mating connecting screw and a longer 5.0 mm hexagonal screwdriver to engage the LFN/R/AFN locking mechanism.

Because of its length a more proximal skin incision than is typically used is required. By concentrating on a more proximal skin incision in this obese population one might avoid the necessity of lengthening the skin incision and deep soft tissue dissection with the existing jig.

This additional handle should not be used on a normal nonobese patient as the added length of the arm may impinge on the soft tissues making the insertion more difficult.

3.5 LCP Posteromedial Proximal Tibia Plate

The 3.5 mm LCP posteromedial proximal tibia plate is a precontoured plate to maintain buttress and reduction of posteromedial proximal tibia fragments, including fractures of the proximal, distal, and metaphyseal areas of the tibia.

The system consists of six anatomically precontoured plates (1, 2, 4, 6, 8, or 10 shaft holes) with a range of six lengths (72–186 mm). The low-profile plate head limits soft-tissue irritation. The plate head features three locking holes and one slotted locking hole for ease of plate positioning. The 3.5 mm LCP holes in the shaft enable fixation of posteromedial fragments with locking or nonlocking screws. The one slotted locking shaft hole assists plate positioning.

The plates are available in both titanium and stainless steel.

The set is compatible with the 3.5 mm small fragment system.

A 33-year-old male was involved in an altercation and suffered a gun shoot wound to his knee.

Initially taken for incision and drainage and then ORIF. Patient placed in a floppy lateral position with the effected lower extremity externally rotated (opposite hip and shoulder bumped up about 30–40°) allowing exposure of the posterior medial knee. A posterior medial and an anteromedial incision were used to repair the fracture with a 6–7 cm skin bridge.

Postoperative healing was uneventful and the patient had no complications.

Case provided by Brent Norris, Tulsa, USA

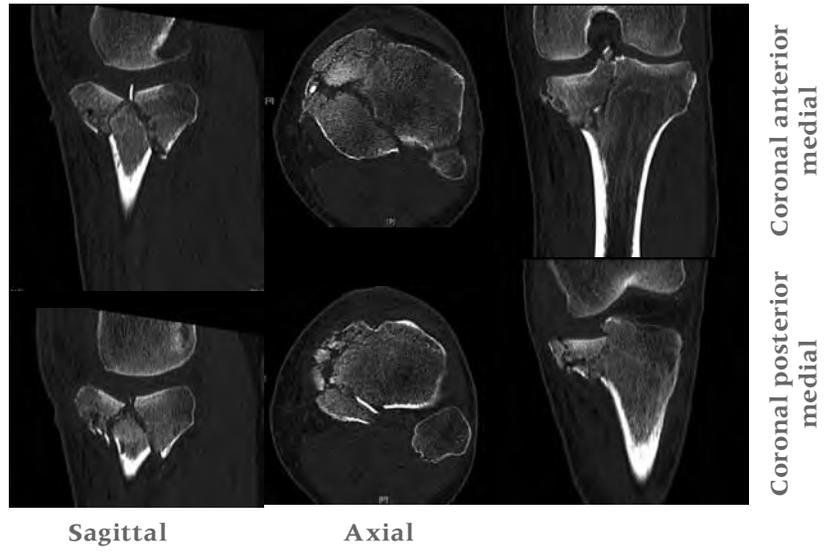


Fig 1

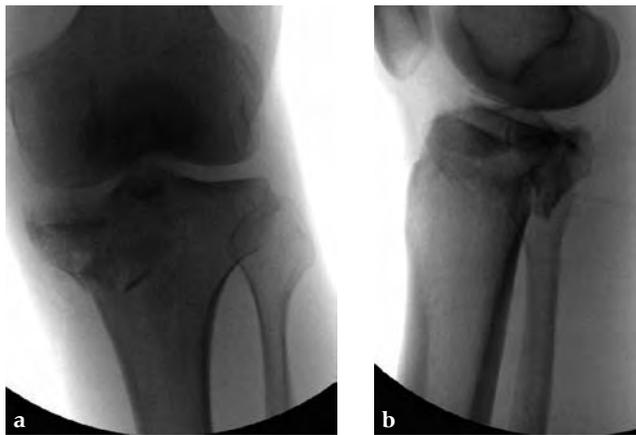


Fig 2a–b
AP and lateral x-rays preoperatively.

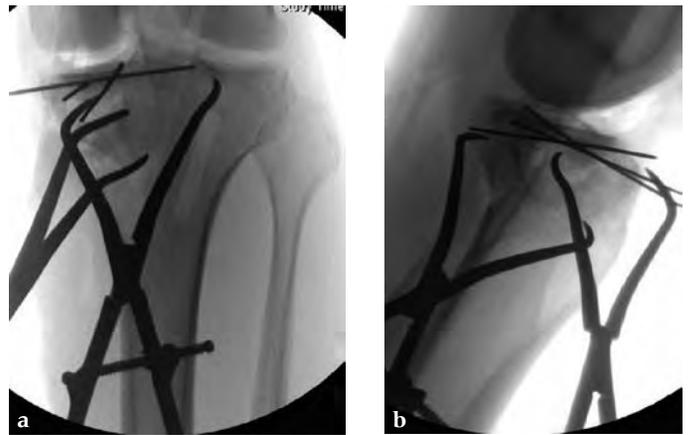


Fig 3a–b
AP and lateral x-rays intraoperatively.

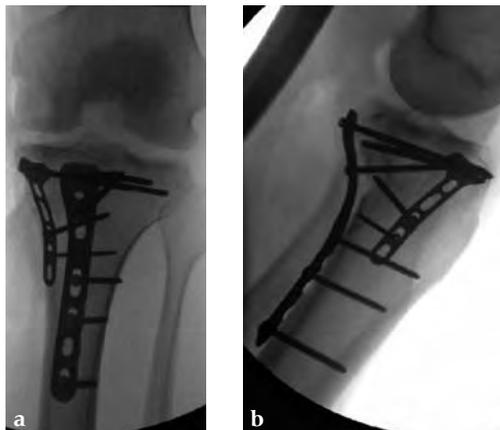


Fig 4a–b AP and lateral x-rays immediately postoperatively.



Fig 5a–b
X-rays 6 weeks postoperatively.



Fig 6a–b
X-rays 3 months postoperatively.



3.5 mm LCP Low Bend Medial Distal Tibia

The 3.5 mm LCP low bend medial distal tibia is indicated for fixation of simple and complex intra- and extraarticular fractures and osteotomies of the distal tibia. Due to the wide variability of the distal tibia, the existing plate does not always match the anatomy, especially but not only, in small stature patients.

The design of the 3.5 mm LCP low bend medial distal tibia focuses on the relationship between the distal plate tip and the medial malleolus. A lower head height (minus 1.96 mm) compared to the current 3.5 LCP medial distal tibia increases contact with the crest of the medial malleolus. The shaft twist is more gradual and has a higher bend distance of 70 mm compared to 44 mm in the previous implant (measured from where the twist begins to the distal tip). The larger radius of curvature (R125 compared to R58) and the higher starting point leads to a smoother transition. It has the same screw hole configuration and pattern as the existing plate, except for the articulated tension device hole which was removed.

Cadaver tests showed that the low bend design, especially the metaphyseal bend, has a better fit on the average tibia.

The plate has a left and right version and is available in stainless steel and titanium. It comes in lengths from 4 holes (109 mm) up to 14 holes (239 mm).

75-year-old male, post motor vehicle collision with ipsilateral split depression lateral tibial plateau fracture.

Case provided by Matthew Graves, Jackson, USA



Fig 1a-d
AP and lateral x-rays preoperatively and postoperatively.

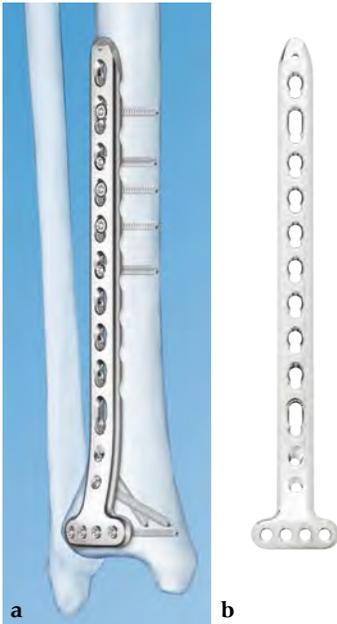


Fig 1a–b
Posterior T-plate.

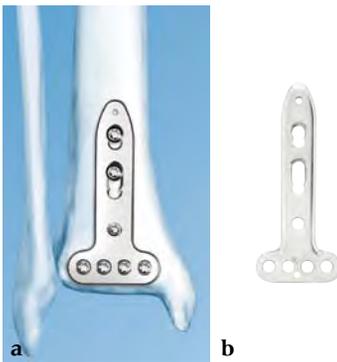


Fig 2a–b
Anterior and posterior T-plate, short.

31-year-old male with a 2.5-year history of a distal tibial nonunion/malunion with three previous surgeries. Significantly compromised soft-tissue envelope anteriorly.

Case provided by Phil Kregor, Nashville, USA

3.5 LCP Distal Tibia T-Plate

The 3.5 mm LCP distal tibia T-plate is indicated for fixation of fractures, osteotomies, and nonunions of the distal tibia, especially in osteopenic bone. The system consists of short T-plates for anterior and posterior lateral placement and long posterior T-plates for posterior lateral placement only. It is advantageous for the fixation of short distal tibial articular/small distal metadiaphyseal segments where other approaches may be compromised due to soft-tissue concerns (traumatic wounds, muscle flap coverage, or tenuous skin). It is also an option when concomitant posterior bone grafting is required.

The T-plates come in a 3-hole (64 mm) and 5-hole (90 mm) version. They are intended for anterior and posterior placement. The plates are anatomically shaped to match the anterior and posterior distal tibia. The plate is 1.5 mm thick. It features four distal, rafting locking screws with a 5° proximal screw angle, one locking strut screw, and one elongated hole in the shaft which assists with placement.

The posterior T-plates are available in 8-hole (132 mm), 12-hole (184 mm), and 16-hole (236 mm) lengths and should only be placed on the posterior aspect of the distal tibia. The plates are anatomically shaped to match the posterior distal tibia. The plate edges have been rounded for a smoother, less prominent implant. The plate has two locking strut screws to prevent collapse, four distal, rafting locking screws, and one proximal and one distal elongated hole to aid in positioning. The design provides angular stability similar to a blade plate while maintaining ease of insertion.

The plates are part of the small fragment LCP system, and are available in stainless steel.



Fig 1a–b
Preoperative x-rays.



Fig 2
Intraoperative x-ray.



Fig 3
Postoperative x-ray.

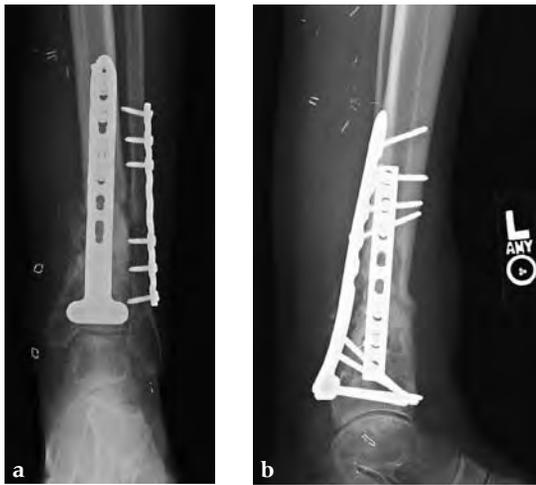


Fig 4a–b
X-rays 6 months postoperatively.

Removal of the intramedullary nail followed by posterior iliac bone grafting and plate fixation of both the fibula and tibia. A posterolateral approach was used to approach both the tibia and the fibula. The posterior locking T-plate was used for fixation of the tibia.

Some residual varus deformity of the tibia remains, but clinically the patient is full weight bearing and has returned to work after 4.5 months.



2.7/3.5 mm LCP Lateral Distal Fibula

The 2.7/3.5 mm LCP lateral distal fibula is an anatomically designed plate for the treatment of fractures, osteotomies, and nonunions of the metaphyseal and diaphyseal region of the distal fibula, especially in osteopenic bone.

The plate has an anatomically precontoured head and a low-profile design. It comes in right and left versions with lengths from 3 holes (73 mm) up to 15 holes (229 mm) and is available in stainless steel.

Metaphyseal fixation can be achieved by five coaxial distal locking holes in the plate head which use threaded interface to rigidly fix locking screws. These combination holes also accept standard cortex screws. Overall the plate head can either take 2.4 mm cortex screws, self-tapping (6–40 mm), 2.4 mm locking screws, self-tapping (6–30 mm), 2.7 mm cortex screws, self-tapping (6–55 mm), or 2.7 mm locking screws, self-tapping (10–55 mm). A recess in the top of distal holes seats cortex screw heads to minimize cortex screw prominence. Also the locking screw heads are recessed. Four K-wire holes in the plate head accept 2.0 mm K-wires for provisional fixation.

For diaphyseal fixation the combination holes use the threaded side to hold locking screws at predetermined fixed angles, and the DCU side for conventional plating with nonlocking screws. An elongated combination hole holds the plate to the bone while allowing plate position adjustments. Plates with six or more holes have two elongated combination holes. The plate shaft accepts 3.5 mm locking screws, self-tapping (10–95 mm), 3.5 mm cortex screws, self-tapping (10–150 mm), and 4.0 mm cancellous screws with full or partial thread (10–100 mm).

The T8 and T15 StarDrive, 2.5 mm hex recess in the screws provides optimum torque transmission.

Case 1: 55-year-old male fell off a horse and sustained an open pronation abduction ankle fracture dislocation.

Cases provided by Matthew Graves, Jackson, USA



Fig 1a-c
Preoperative pictures.

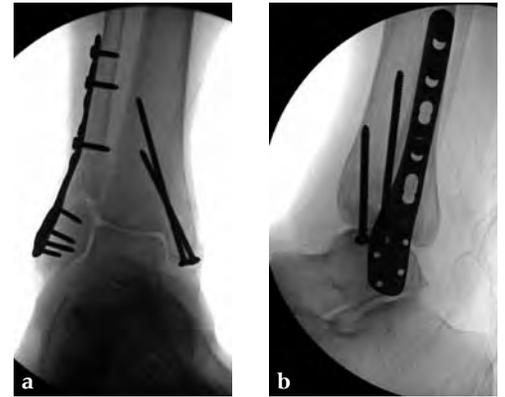


Fig 2a-b
Postoperative x-rays.

Case 2: 80-year-old morbidly obese female. Post motor vehicle collision with open proximal third tibial shaft fracture, closed lateral malleolar fracture and fibular neck fracture, and distal tibiofibular syndesmotismal disruption with ankle capsular injury.



Fig 1a-c
Preoperative x-rays.



Fig 2a-d
X-rays 3 months postoperatively.

Alberto Fernandez dell'Oca, Dankward Höntzsch

TRAUMA MIO



Fig 1
Cerclage passer.



Fig 2
Cerclage tunneling device.



Fig 3
Cable passing tube.

Cerclage Passer

The technique for the application of cerclage wires and cables used today is rather invasive and associated with massive soft tissue damage. In contrast to this, minimally invasive surgical techniques aim to reduce the soft tissue damage by using instruments which leave minimal footprints. As a result, better preservation of the blood supply and therefore faster healing times can be expected. This benefit is very important especially for elderly patients, because suboptimal preconditions like osteoporosis, cardiovascular diseases or diabetes may be present. Besides the application in combination with periprosthetic fractures, cable or wire cerclages are used often for additional or temporary fixation. The application of a cerclage can also be very helpful for fracture reduction.

The cerclage passer enables minimal invasive passing of wires or cables. It has dividable forceps and is available in two sizes (23 mm and 30 mm diameter).

The system includes the respective cerclage tunneling device (mainly for passing fascia on the linea aspera of the femur), trocars for cerclage passer forceps to protect them from filling up with soft tissue material, the cerclage passer forceps in two sizes, and for those who do not use wires but cables, a cable passing tube with a length of 400 mm, sterile packed, single use. First the cable passing tube passes the forceps and second with this tube the wire can pass around the bone. The crimp or olive at the beaded end of the cable allows no direct passage through the cerclage passer.

The system makes cerclage passing easy and minimally invasive. The learning curve is very short. The system has been successfully used very often (almost daily) by those who have it. These surgeons now like to have this helpful tool.

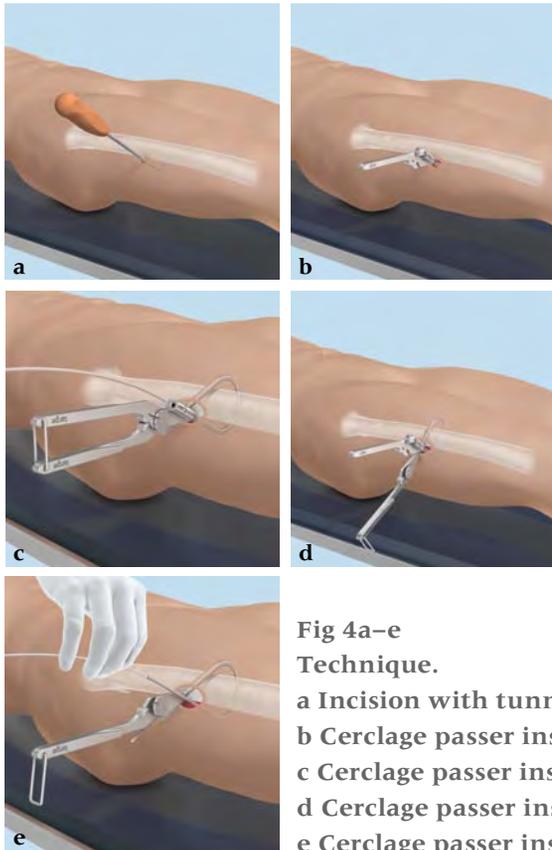


Fig 4a–e
Technique.

a Incision with tunneling device.

b Cerclage passer insertion 1.

c Cerclage passer insertion 2.

d Cerclage passer insertion 3—insertion cable passing tube.

e Cerclage passer insertion 4—cable.



Cerclage Twister

The cerclage twister enables minimally invasive twisting of 0.8–1.5 mm wires/cables. It minimizes wire/cable breakage by prevention of overload, makes reproducible twists due to tension control and enables reduction and fixation in one step. It has a long cannulated shaft that also works with obese patients. The twister can be completely disassembled for easy cleaning.

Fig 1



Fig 2
Twisting.

Dankward Höntzsch

TRAUMA POWER TOOLS



Fig 1
Trauma recon system.



Fig 2
Power module.



Fig 3
Battery charger.

Trauma Recon System

The trauma recon system (TRS) is a pistol-shaped, battery-driven power tool designed for traumatology indications but also applicable for orthopaedics. The range of application covers trauma (long bones), eg, plate osteosynthesis or intramedullary nail osteosynthesis and endoprosthetics, eg, total knee or hip replacements. It is especially helpful for knee surgery regarding balance, torque, and the possibility to fine tune the speed. It contains one handpiece, a lid, a power module (nonsterile), and a universal battery charger II, as well as various drill, ream, and saw attachments.

The TRS provides high power (180 W/13 Nm) but weighs little. The test result feedback demonstrated high satisfaction in reaming, cuts in sawing, and speed for drilling and reaming. A mode selector switch for each application provides for optimal performance. It features a Li-Ion battery technology which is very long lasting. The battery capacity is displayed on an indicator. The power module is self-testing and has a service indicator lamp.

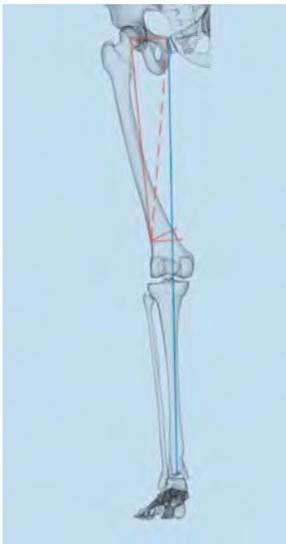
The distinctive feature of the TRS is that the power module contains of motor, battery, and control unit in one piece and can be taken out during processing (all electronics are non-sterile). Consequently, longer life expectancy and fewer repairs are expected. In other power tools, only the battery is nonsterile. For the sterile handling, no change in procedure is required.

The universal battery charger II features four charging bays for TRS/Colibri/battery power line (BPL) batteries. Condition check and refreshing of Colibri/BPL batteries is possible, as well as condition check of the TRS power module. The charger is IEC 60601-1 compliant, ie, it may be used in the operating room (OR) (nonsterile field).

A complete range of ream, drill, and saw attachments covers most fields of applications, eg, a very short saw attachment for more accurate cutting. The attachments are color-coded (blue drill, red ream) for better differentiation by the OR personnel. A predetermined mode ensures to achieve the best possible performance, eg, increased drill speed. A keyless chuck with new locking mechanism prevents opening when running reverse.

Philipp Lobenhoffer

TRAUMA OSTEOTOMY



Osteotomy Guiding Device

The success of lower-limb osteotomies depends on accurate correction of the mechanical axis and stable fixation during consolidation. Exact realignment of the leg requires precise resection of a bone wedge. The high precision reduces the risk of under- or overcorrection which is what improves the quality of an osteotomy and their durability (knee arthroplasty can be delayed or avoided completely).

The osteotomy guiding device (OGD) is applicable for every closed-wedge osteotomy on long bones in lower limbs that require removal of a bone wedge with correction angles from 4° to 20° . It is made up of a frame with a fixed positioning arm and a calibrated handle. The pivoting angular arm can be adjusted on the handle at a selected angle or measured with a caliper (millimeter). K-wires, which are inserted into drill sleeves located in the positioning arm and in the pivoting arm, define the bone wedge. The preoperative determined correction angle alpha is adjusted on the handle with respect to the osteotomy depth. The depth gauge is specifically designed for use with the OGD as use of a standard screw measuring device would result in false measurements.

Pictures provided by Philipp Lobenhoffer, Hannover, Germany

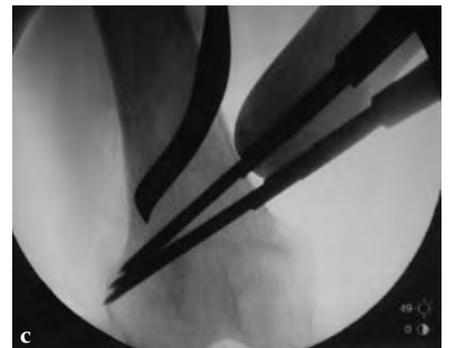
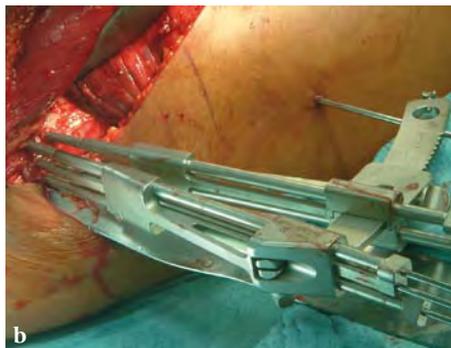
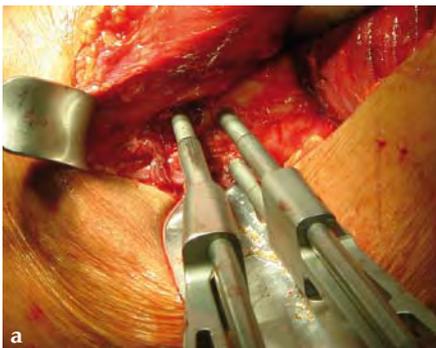


Fig 1a-c
Use of the OGD.

Richard Reynolds, Teddy Slongo

TRAUMA PEDIATRIC



Fig 1 ALFN
Fig 2 Nail with insertion handle.

Adolescent Lateral Entry Femoral Nail: 9 mm and 10 mm Diameters

The adolescent lateral entry femoral nail (ALFN) is intended for use in adolescent and small stature adults depending on the persons' weight, body size, physiological development, neurological development, and neuromuscular coordination. The ALFN is indicated to stabilize fractures of the femoral shaft, subtrochanteric, ipsilateral neck/shaft, and impending pathologic fractures, as well as nonunions and malunions of the femur. The ALFN can also be used to stabilize corrective osteotomies in bone dysplasia, such fibrous dysplasia where femoral deformity is an issue.

The ALFN is cannulated and was until now available with a 8.2 mm shaft diameter and a proximal diameter of 11 mm. To the existing nail extra shaft diameters of 9 mm and 10 mm have been added to accommodate the adolescents that are too heavy for the 8.2 mm nails, or very tall and slender. All nails come in lengths of 240–400mm in 20 mm increments.

The 9 mm and 10 mm nails are also indicated for small stature adults who may have a large canal, measuring for a 9 or 10 mm nail, but their greater trochanter cannot accommodate the 15 mm opening drill bit used with the LFN's (which start at 9 mm). Surgeons can now treat the patients with a 9 or 10 mm nail and only have to open the canal with a 13 mm opening drill bit.

3.5 mm and 4.5 mm Curved Narrow LCP and Curved Broad LCP

The 3.5 mm and 4.5 mm curved narrow and curved broad LCP are indicated for fracture fixation or internal fixation after bone lengthening of diaphyseal and metaphyseal areas of long bones in pediatric and young adolescent patients, and are especially designed for the antecurvature of the diaphysis of the femur.

The plates were developed because the current straight plates, and the 4.5 mm broad curved plates do not fit as the femoral bow (antecurvature) of a pediatric and small stature anatomy and bone size differs from adult size and anatomy. As minimally invasive submuscular plating becomes increasingly used on paediatric patients, the new plates fit much more anatomically, especially for the treatment of complex fractures or after bone lengthening.

This system is offered with the MIPO instrumentation, for minimally invasive insertion and is available in both titanium and stainless steel. The plates are available in lengths of 10–22 holes for both 3.5 mm and 4.5 mm narrow, 10–30 holes for the 3.5 mm broad, and 12–26 holes for the already existing 4.5 mm broad.

Although these plates were developed for paediatric usage AO also approved the plates for use in adults of particularly small stature, eg, Asian stature.

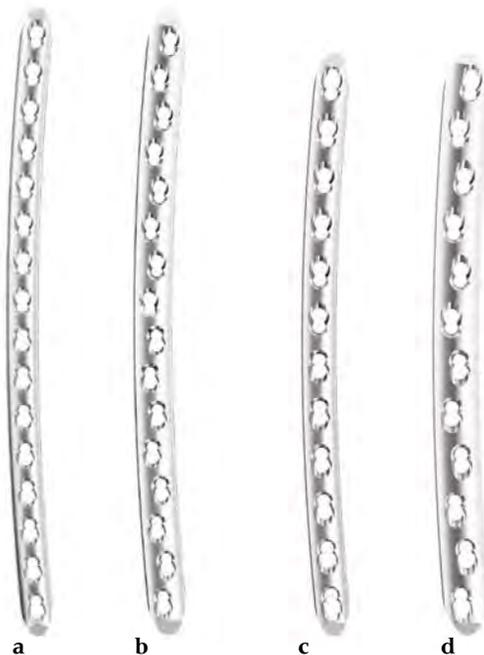


Fig 1a–d
a 3.5 Curved narrow LCP.
b 3.5 Curved broad LCP.
c 4.5 Curved narrow LCP.
d 4.5 Curved broad LCP.

22-year-old man with 7 cm posttrauma shortening.

Case provided by Theddy Slongo, Bern, Switzerland



Fig 1a-c
Lengthening with MEPHISTO.

The case example demonstrates the improved anatomical fit of the plate in comparison to the straight plate.



Fig 2a-b
Lengthening after 1 month.

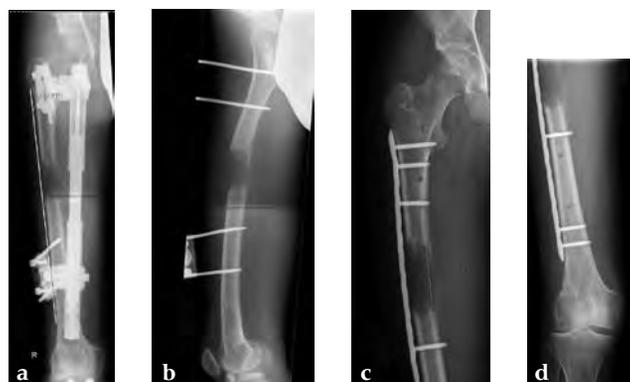


Fig 3a-d
7 cm lengthening. Changing to internal fixation.



Fig 4a-b
There is a perfect fit of the plate to the antecurvation of the femur. The proximal fragment is a little in flexion.

24-year-old female



Fig 1 a-b
• 4 cm shortening fibular hemimelia.
• LODOX.
• Lengthening with MEPHISTO.



Figs 2 a-c
a-b After 4 cm lengthening a straight plate was used, but the fit was not good.
c The difference between a curved plate and straight plate is visible.

Jeffrey Watkins, Michael Kowaleski

VETERINARY



Horse with degenerative joint disease of the proximal interphalangeal joint (narrowed joint space and periosteal new bone formation).

Case provided by Jeffrey Watkins, Tamu, USA

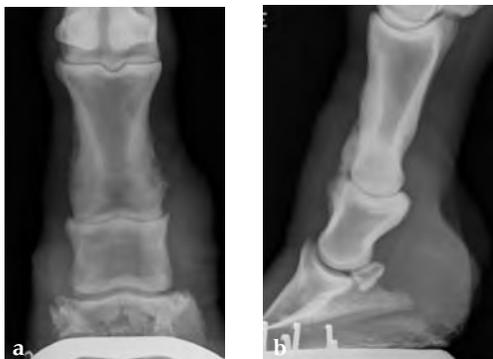


Fig 1a–b
Preoperative x-rays.

4.5 mm LCP Narrow and Broad with Stacked Combination Holes

The 4.5 mm LCP narrow and broad with stacked combination holes is indicated for long bone fractures, and joint arthrodesis for horses, as well as metaphyseal fractures.

Osteoarthritis of the interphalangeal (PIP) joint is a common cause of lameness in horses; therefore, PIP joint arthrodesis is performed with the goal of eliminating motion of this joint. To achieve arthrodesis for treatment of degenerative joint disease of the PIP joint this plate has an extended centre section that spans the joint space. The stacked combination hole is necessary to prevent impingement on the extensor process of the distal phalanx. This is a common procedure in western performance horse—they seem to be prone to developing degenerative joint disease of this joint as a result of the type of activities in which they are engaged. The lameness prevents them from engaging in their intended use, and is often debilitating. With arthrodesis, a high percentage (up to 75% in the forelimb and 90% in the hindlimb) are able to return to their intended performance activity.

Compared to the standard locked plate design the toenail design at one end of the plate was eliminated and the most distal hole changed from a combination hole to a stacked combination hole. These changes allow the plate to be placed as close to the joint as possible. The two proximal combination holes face the same way (to achieve compression across the joint) and the gap between the stacked combination hole and the first combination hole was lengthened so that it matches the 4.5 mm narrow DCP (to span the joint).

The 4.5 mm narrow LCP comes in length of 3–16 holes and the 4.5 mm broad LCP in 6–18 holes. The implants are made of 316L stainless steel and fit in the large fragment plate set graphic case.

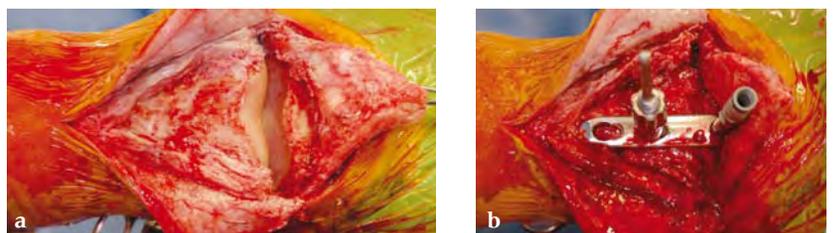


Fig 2a–b
a Complete loss of articular cartilage.
b Use of the push-pull device to position the plate and allow proper positioning of the screw in the middle phalanx.

Compression across the joint was achieved by placing the abaxial transarticular 5.5 mm cortical screws in lag fashion, then using the cortex screw in the load position of the proximal combination hole. The screws on either side of the joint are 5.0 mm locking screws—the most distal screw is placed first, then the cortex screw is used to provide dynamic compression and the final locking screw is placed.



Fig 3a–b
X-rays 2 weeks postoperatively.



Fig 4a–b
Excellent bone union/arthrodesis with minimal additional new bone formation 3 months postoperatively.

Bibliography

Knox PM, Watkins JP (2006) Proximal interphalangeal joint arthrodesis using a combination plate-screw technique in 53 horses (1994–2003). *Equine Vet J*; 38:538–542.

3.5 mm LC-DCP and LCP

The 3.5 mm LC-DCP regular and broad as well as the 3.5 mm LCP are indicated for the treatment of long bone and metaphyseal fractures.

The 3.5 mm LCP has the standard locked plate design with two changes to allow the plate to be placed as close to the joint as possible: The toenail design was eliminated at one end of the plate and the most distal hole changed from a combination hole to a stacked combination hole. The 3.5 mm LCP will be available in lengths of 2–22 holes.

The 3.5 mm LC-DCP and 3.5 mm broad LC-DCP have a toenail on one end, and a rounded end at the other end. The most distal hole was changed from a DCU hole to a rounded hole. The 3.5 mm LC-DCP comes in lengths of 2–20 holes and the 3.5 mm broad LC-DCP in 7–22 holes.

All plates are made of 316L stainless steel and fit in the small fragment plate set graphic case.



Fig 1a–c
a 3.5 mm LC-DCP regular.
b 3.5 mm LC-DCP broad.
c 3.5 mm LCP.

A 4-year-old Gordon setter suffered a road traffic accident and sustained multiple pelvic fractures.

Case provided by Michael Kowaleski, North Grafton, USA



Fig 1a–c
a–b Preoperative x-rays.
c Oblique view obtained to rule out extension of fracture into the acetabulum (hip joint; the fracture did not extend into the hip joint).



Fig 2a–b
X-rays immediately postoperatively. A 7-hole 3.5 mm LC-DCP was applied; two screws were inserted into the sacral body to improve fixation strength in the cranial ilial segment (this bone is quite thin; note that the screws #1 and #2 are quite short, screws #3 and #4 are the sacral screws and are much longer, the fracture is between screws #4 and #5. (The opacity on midline in the x-rays is a urinary catheter.)



Fig 3a–b
Very nice healing and normal function 3 months postoperatively.

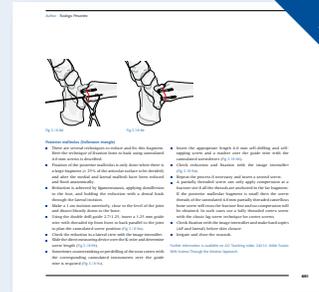
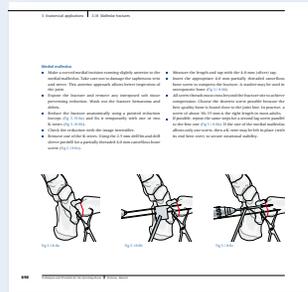


Anvil for Bending Pliers

The anvil for bending pliers for the clamp rod internal fixator (CRIF) assists with contouring of the 3.0 mm and 5.0 mm rods. Acute bends of 10–15 mm radii can be created. The rod is held securely, preventing slippage during bending. Deformation marks on the rod are minimized. The anvil is made out of hardened stainless steel and works with the existing bending pliers.

Amber Parkinson, Cristina Lusti

NEWS FROM AO EDUCATION, PUBLISHING/FACULTY SUPPORT MEDIA



Release in July 2010

Number of pages: 728
Number of figures and illustrations: 1,190

For more information and ordering please visit
www.aopublishing.com

Techniques and Principles for the Operating Room

Matthew Porteous, Susanne Bäuerle

This completely new book, *Techniques and Principles for the Operating Room*, is a valuable tool for the operating room personnel and for residents starting their careers in orthopaedic trauma care. The book is divided into three sections: (1) operating room principles which cover the different aspects of operating room management for ORP; (2) the AO Principles of fracture management; and (3) a detailed guide to performing certain common procedures with an emphasis on the use of the surgical instruments.

The classic and well established techniques are stressed but the most recent advances in operative fracture care are highlighted. These include the increasing importance of relative stability, biological fixation, minimally invasive techniques, and the correct use of locking head screws and the locking compression plate. Section 3—*anatomical applications*—describes the use of different fixation techniques in common fractures. Each procedure is described in a step-by-step way designed to assist ORP and junior residents while assisting surgery.

"I am convinced that all staff working in the operating room will make use of this well written and well illustrated book to the benefit of the patient."

Thomas P Rüedi, MD, FACS

Founding and Honorary member of AO Foundation

Emanuel Gautier

PRINCIPLES OF BRIDGE PLATING

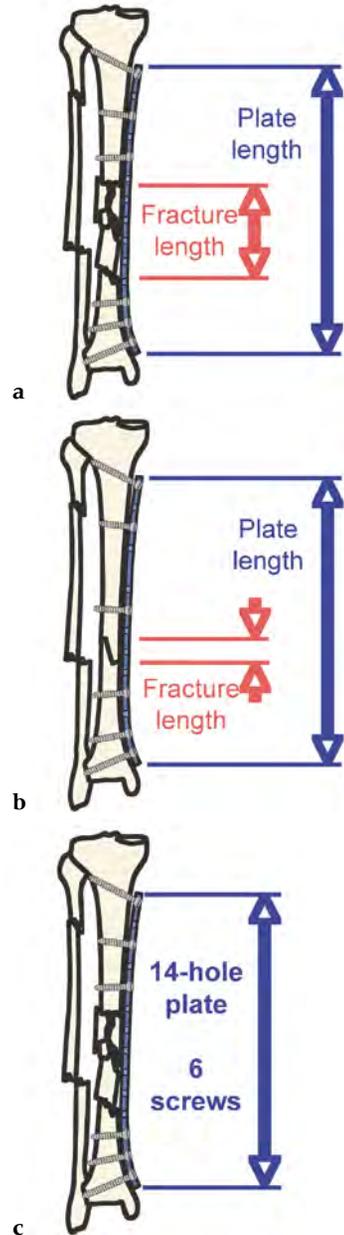


Fig 1a–c

Plate span ratio and plate screw density: In comminuted fractures the plate length should be 2 to 3 times higher than the overall fracture length (a). In simple fractures this ratio should be raised to a value of 8 to 10 (b).

The use of plates for internal fixation gains more and more importance and acceptance due to the introduction of new implants offering the possibility to lock the screw head with the plate. With this new plate generation, different fixation concepts can be considered and in addition the indication for plating is spread out to the diaphyseal segment of bone. For proper application of the implants—and to avoid technical or mechanical complications—a thorough understanding of the basic concepts of fixation, the bone biology, and biomechanics, remains of outstanding importance.

Reflections useful for the adapted use of plates and screws in internal fixation

More or less all implant systems used in internal fixation consist of two main elements—a longitudinal element for the load transfer from one main fragment to the other and a transverse element to assure the coupling of the implant system to bone (Table 1). When comparing internal fixation with intramedullary nails or internal fixation with plates, some major differences appear. Using an intramedullary nail for a diaphyseal fracture the mechanical concept is more or less independent from the fracture pattern—simple fracture, wedge fracture, comminuted fracture. In addition, the position of the nail, the length and diameter of the nail as well as the position of the locking bolts are more or less given and standardised by the local anatomy of the broken bone segment as well as the implant design.

In contrast to nailing, plating offers two different fixation concepts—splinting and interfragmentary compression. Comminuted fractures are best treated using a splinting technique, because local bone and soft tissue devascularization can be minimized; while in simple fractures the application of interfragmentary compression can be considered as a stabilization tool.

Plate position is chosen mainly according to the local anatomy and the surgical approach chosen. But, depending on mechanical demands, the plate position can be altered (tension side, compression side). In addition, the length of the plate itself, the number and the relative position of screws which need to be inserted, as well as the type of screws

Technique	Orientation of elements and mechanical function	
	Longitudinal load transfer	Transverse coupling
External fixation	Bar	Schanz screw
Nailing	Nail	Locking bolt
Plating	Plate	Screw

Table 1



Fig 2a–c
Minimal requirements for internal fixation using plates: Example of plate fixation of a humeral shaft fracture using a minimal number of screws showing the undisturbed course of bone healing—postoperative x-ray (a), situation at 3 months (b), and 6 months (c).

(standard cortical screws or locking head screws, mono- or bicortical screws, self drilling or self tapping screws) remain under debate. Thus, a lot of additional decisions have to be taken by the surgeon when planning and performing plate osteosynthesis. It is also evident that plating is intellectually and technically much more demanding than nailing (Table 2).

The three following main factors influence the stability of the fixation and the loading conditions of the plate-bone construct: The overall length of the plate, the overspan length of the plate, and the number, position, and design of the screws.

Length of the plate

Utilizing the newer minimally invasive techniques of indirect reduction, subcutaneous or submuscular plate insertion and splinting as a stabilization concept, the plate length can be chosen to be very long without the need for additional soft-tissue section and devascularization.

Theoretically the plate can equal the whole length of the broken bone. But, at least the minimal length of the internal plate can be determined by means of the two factors: The plate span width and the plate screw density. Plate span width is defined as the quotient of the plate length and overall fracture length. Empirically we find that the plate length should be two to three times higher than the overall fracture length in comminuted fractures and eight to ten times higher in simple fractures. The second factor is the plate screw density which is the quotient formed by the number of screws inserted and the total number of plate holes. Empirically we recom-

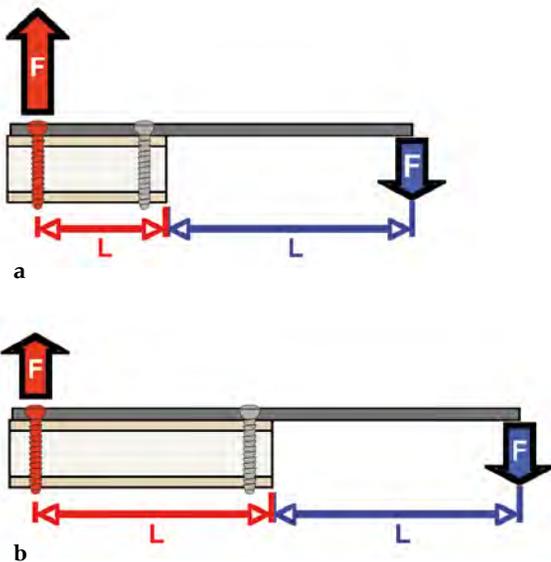


Fig 3a–b
Influence of lever arm on pull out of screws; A short plate creates higher pull out of the screw (a) compared with a long plate (b).

Characteristics of fixation and implants	Nailing	Plating
Concept of fixation	Mainly splinting	Splinting Compression
Load transfer	Locking	Locking Friction
Position	Intramedullary	Tension side Compression side
Insertion	Intramedullary	Open MIPO
Length	Whole length of bone	To decide
Dimension	Inner diameter of bone	In relation with bone and bone segment
Number of screws	Minimum 0 Maximum 6	Minimum 4 Maximum ?
Position of screws	Given by nail design	To decide
Design of screws	Bicortical ASLS	Monocortical Bicortical Self tapping Self drilling Standard cortical Locking head

Table 2

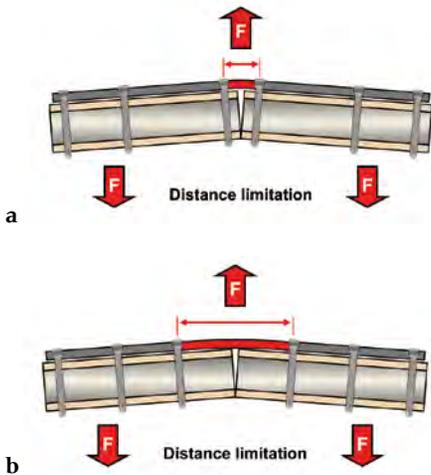


Fig 4a–b
Decreasing the implant deformation and strain over a short segment by increasing the distance between the innermost screws—as long as the overall plate angulation remains unchanged due to a distance limitation of the opposite bone cortex.



Fig 5a–c
Submuscular splinting of a simple femoral shaft fracture with sound bone healing. X-rays taken postoperatively (a), 4 months (b) and 3 years (c).

ment values below 0.5, indicating that less than half of the plate holes are occupied by screws, eg, six screws in a 14-hole plate (Fig 1a–c).

Number of screws

From the mechanical point of view, two screws (monocortical or bicortical) on each main fragment, is the minimum number of screws needed to keep the plate-bone construction stable (Fig 2a–c). Unfortunately, such a construction will fail if one screw breaks due to overload or when the interface between bone cortex and screw is threatened due to bone resorption with subsequent screw loosening. Thus, for safety reasons we recommend a minimum of three screws in each the proximal and the distal main fragment.

Adjusting the plate-screw density to a maximum value of 0.5 the plate length should not be chosen below a 12-hole plate for treatment of a diaphyseal fracture. But, to increase the leverage of the screws the use of a 14- to 22-hole plate would even be better.

Effect of plate length on screw loading

The length of the plate and the position of the screws modify the loading conditions of the screws. Increasing the length of the plate decreases the pullout force acting on the screw due to an improvement of the active lever arm of each screw (Fig 3a–b). This argument points to the use of long plates (nearly as long as the bone itself).

Effect of plate length and screw position on plate loading

When using the concept of interfragmentary compression in a simple fracture pattern, load sharing conditions between plate and bone are present and in this way the screws in the middle of the plate can be inserted as close as possible to the fracture. When using the concept of splinting in a simple fracture pattern, the middle plate segment is bent over a short distance enhancing the local strain within the implant. To avoid high implant strain, the innermost screws should be spread apart, which increases the length of the plate segment bending, thus decreasing the implant strain. This protects the plate against fatigue failure (Fig 4a–b). Figures 5a–c show a clinical case stabilized according to the previously described principles.

In the case of comminuted diaphyseal fractures, the plate spans over the fracture like a non-gliding splint. A longer distance between the two screws adjacent to the fracture is dictated on the one hand, by the fracture pattern itself and on the other hand, for mechanical reasons, by the spreading out of the innermost screws thus decreasing the implant loading—but only when there is a distance limitation on the opposite cortex. Without distance limitation the deformation of each plate segment in the middle depends on the acting bending moment. Each plate segment is deformed according to the external loading condition—thus, the overall deformation is much higher and the implant strain can become high and critical, as in the situation where it is bridging a small gap with a short plate segment between the two innermost screws (Fig 6a–c).

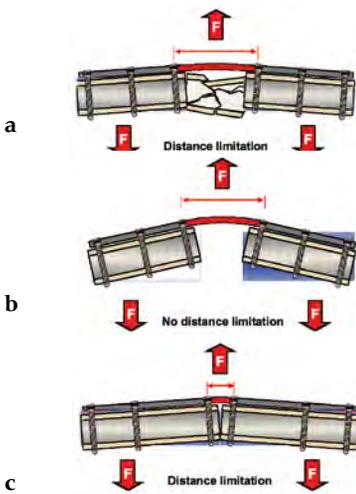


Fig 6a–c
Comminuted diaphyseal fracture leading to low implant strain. Deformation and angulation limited by partial contact of intercalated fragments at the opposite cortex (a). Without distance limitation plate angulation is not hindered (b) and can equal the critical strain values of a simple fracture with only a small gap between the fragments and screws close to the fracture (c).

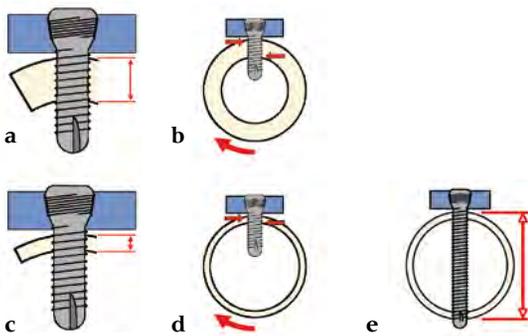


Fig 7a–e Screw lengths:
Screw threads need to engage in bone cortex over a certain distance to assure sound anchorage of plate. Normal cortex is sufficiently thick to allow good anchorage. Even a monocortical screw can withstand the torque acting between two fragments and thus loading the screw-thread-bone interface (a, b). Thin cortex in osteoporosis (c). Even low interfragmental torque can damage the screw-bone interface with subsequent loosening and instability (d). Use of bicortical screws improves working length of the screws (e).

Appropriate screw selection

The selection of the screws is dependent on the bone quality, cortical thickness, and external loading conditions of the bone segment. We have the choice between monocortical and bicortical screws, self tapping and self drilling screws, as well as standard and locking head screws. The use of locking head screws has advantages where bad bone quality is found as screw loading is no longer only pure pullout but also bending, altering the loading condition at the interface bone-screw thread. The choice between self tapping and self drilling screws should be made according to the anatomy of the segment. Self tapping screws can be used as bicortical screws, whereas self drilling screws should exclusively be used as monocortical screws because the stick-out length for anchoring in the opposite cortex is too long which increases possible harm to the soft tissues on the opposite cortex. In very osteoporotic bones, which typically present a thin cortex or a bone segment under high torsional loading, the use of bicortical screws is mandatory to enhance the working length of the screws and to avoid torsional displacement of the fractured fragments (Fig 7a–e).

Effects of the internal fixator concept on bone healing

Using plates as internal fixators with locking head screws has the advantage that a certain distance is present under the implant. This enables the cortex underneath the plate to form bone callus allowing faster and stronger bone healing.

Take home messages for plating:

- Splinting is a sound stabilization principle for fixation of comminuted fractures.
- Splinting can be used for stabilization of simple fractures—when, on the one hand, a long plate is used to improve the lever arm of each screw, decreasing the screw pullout and, on the other hand, the two innermost screws are spread apart leaving at least two to three plate holes unoccupied at the fracture site to decrease plate loading.
- Interfragmentary compression remains a sound stabilization tool for fixation of simple fractures under the prerequisite of careful soft tissue section and handling.
- The use of locking head screws is advantageous from the biological point of view. Such an internal fixator does not compress the periosteum and thus reduces the amount of avascularity of the bone cortex adjacent to the plate. In addition callus formation is possible in the gap between plate and bone cortex.
- Monocortical screws should only be used in case of good bone quality and sufficient cortical thickness, as well as in bone segment not loaded with high torque.
- Self drilling screws are exclusively used as monocortical screws in the diaphyseal bone segment to avoid harm to the soft tissue due to the long sticking out length of a bicortical self drilling screw.

Tobias Kastenberger, René Attal, Michael Blauth, Gerhard Pierer, Thomas Bauer

FIBULA PRO TIBIA PROCEDURE COMBINED WITH EXPERT TIBIA NAIL AND ANGULAR STABLE LOCKING SYSTEM IN A DEFECT FRACTURE OF THE TIBIA

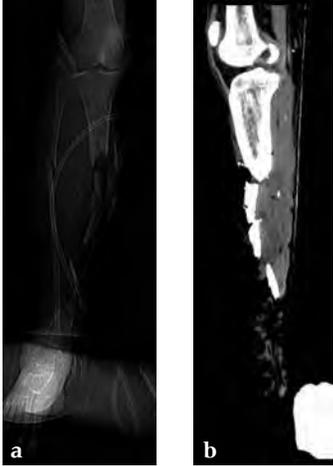


Fig 1a–b
Initial CT scan.



Fig 2
Initial picture on day of accident.



Fig 3a–c
a Skin necroses demarcated.
b–c Consolidated soft-tissue situation.

Bone defect fractures of the tibia are challenging and can be treated in several ways. Common options like the Ilizarov procedure and a segmental transport over intramedullary nails are limited to a maximum bone defect length of 18–20 cm according to the literature.

We report on a 19-year-old female polytraumatized patient involved in a collision with a truck as a motorcyclist. At the scene normal sensibility of the injured right leg and a normal vascular status were documented. After initial haemodynamic stabilization and substitution of the lost blood components the clinical assessment included a whole body MSCT and an angio-CT scan of the right leg to evaluate the vascular situation.

The patient presented a third degree open fracture of the right lower leg with subtotal loss of tibial bone substance of 21 cm without arterial injury. According to the classification of Gustilo and Anderson the injury was classified as IIIB. Other injuries included skin abrasions of the head and face, a fracture of the nose, left sided haemothorax and a multi-fragment 1° open fracture of the lateral femur condylar on the left side. The injury severity score (ISS) was 19.

The initial surgical treatment focused on preservation of as much preexisting bone and soft tissue as possible and the maintenance of sufficient blood supply using an external fixator to bridge the loosened bone. To avoid infection radical wound debridement combined with jet lavage were accomplished. One week after trauma an extended skin necrosis developed resulting in a mesh grafted autogenous skin transplantation.

After several debridements and jet lavages of the wound and bone defect wound closure was achieved using a free myocutaneous latissimus dorsi flap 2 weeks after the accident.

During the hospital stay pneumonia and flap revision prolonged the patients' course. Several weeks after the accident and consolidated soft-tissue situation the reconstruction of the tibial bone defect was planned using a three-step procedure.

First a massive amount of cancellous bone was taken out of the ipsilateral posterior iliac crest in prone position.

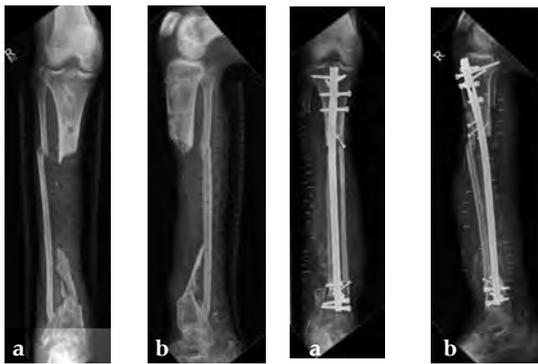


Fig 4a–b

Fig 5a–b

After turning the patient to supine position the tibia shaft was stabilized using an ETN anchored with ASLS in the residual proximal and distal fragments.

The third step was the vascularised bone grafting. In this case vascularised ipsi- and contralateral fibulae were used to replace lost bone and coat the implanted nail.

The ipsilateral osteotomized fibula and the contralateral free and splitted fibula were transferred and impacted into the medullary canal. The substance defect between ETN and coating fibulae was filled using large amounts of cancellous bone grafts from ipsilateral posterior iliac crest.

Efforts were made to maintain the original length of the right lower extremity which was limited by the shrunken soft tissue. Nevertheless a side difference of 4 cm remained.

The rehabilitation of the patient included physical therapy and full weight bearing of the left lower extremity but only partial weight bearing with at least 10 kg for 6 weeks on the left leg. Rehabilitation followed and slowly increasing weight bearing on the left side until full weight bearing was conducted.



Fig 6
Implantation of the fibula with cancellous bone from iliac crest.

Six months after this procedure and following rehabilitation, removal of 4 screws in the proximal fragment was done to dynamize the ETN and to further stimulate bone growth and hypertrophy of the fibulae.

X-ray follow-up showed that the cancellous bone graft was partly resorbed but the solid bone union was achieved after incorporation of the fibula graft. The patient was fully weight bearing and pain free with a stable soft-tissue envelope.

At the moment the patient is using one crutch helping her to hold balance and is wearing a special shoe to compensate the length difference.



Fig 7a–d
X-ray control after nail dynamization.

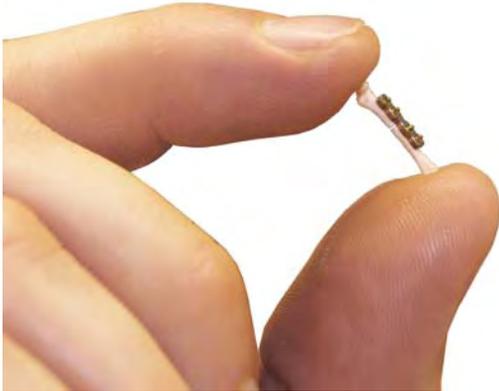


Fig 8a–f
Eight months postoperatively.

Romano Matthys, Reto Nützi

PRODUCT-RELATED RESEARCH RESULTS FROM AO RESEARCH INSTITUTE (ARI)

Research Implant System (RIS)



In 1999, Prof Stephan Perren mentioned important genetic studies which would profit enormously if it were possible to transform human internal fixation techniques to the mouse. The mouse was and still is the only animal which allows, eg, knockout techniques to be applied in modern bone healing research.

To downsize and still maintain the function of variable, standardized degrees of internal stabilization was a challenging and—as it turned out—a demanding task.

Today we are proud that we have solved the task of providing a locked plate fixation which also allows applying compression technique. A locked nail without mechanical play similar to today's ASLS is also part of RIS. The micro external fixator rounds the system off. The complete system was developed by the Innovations Group of the AO Research Institute in collaboration with a new generation of Swiss watch makers and researchers worldwide. According to a recent AO Board of Directors' decision the research implant system is promoted by the AO Foundation as a "non-profit" support for bone healing research worldwide.



Fig 1
Basic instruments and consumables.

The system fulfills the following requirements:

- Standardized, selectable flexibility of fixation of osteotomies and fractures
- Compression plate fixation
- Reliable surgery, minimal tissue damage
- Minimal mass and strength allowing free ambulation
- Made of medical implant materials
- Available as one research kit

The fully developed system enables defined and reproducible fixation techniques for studies of bone reaction in research in small rodents like mice and also rats.



Fig 2
MouseFix.

The system consists of:

1 Locked microplates

1.1 MouseFix (developed in collaboration with AO Research Institute and Queensland University of Technology, Institute of Health and Biomedical Innovation (IHBI))

Stabilization of osteotomies or fractures of the femur with a conventional bridging osteosynthesis or by interfragmentary compression as preferred.

Possible osteotomy size from 0.25 up to 3.50 mm.



Fig 3
RatFix.

1.2 RatFix (developed in collaboration with AO Research Institute)

Stabilization of the Femur with a conventional bridging osteosynthesis.

Possible osteotomy size from 0.25 up to 6 mm.

2 Intramedullary tightly locked nails

2.1 MouseScrew (developed in collaboration with the University of Saarland Homburg, Trauma Department and Institute for Clinical, Experimental Surgery)

Stabilization of a closed fracture of the femur with an intramedullary tension screw.

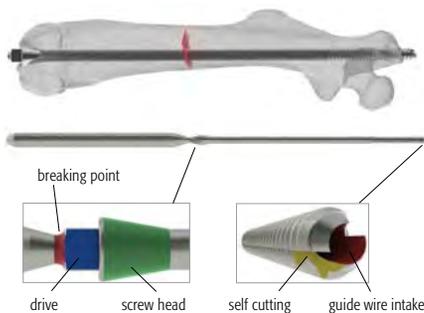


Fig 4
MouseScrew.

2.2 Locked MouseNail (developed in collaboration with the University of Saarland Homburg)

Stabilization of a closed fracture of the Femur with a tightly locked nailing osteosynthesis.

Possible osteotomy size from 0.25 mm up to 2 mm or closed fracture.



Fig 5
Locked MouseNail.



Fig 6
Locked RatNail.

2.3 Locked RatNail (developed in collaboration with Kitasato University)

Stabilization of a closed fracture of the Femur with a nailing osteosynthesis.

Possible osteotomy size from 0.25 mm up to 6 mm or closed fracture.



Fig 7
MouseExFix.

3 External fixation

3.1 MouseExFix (developed in collaboration with University of Ulm, Institut für Unfallchirurgische Forschung und Biomechanik)

Stabilization of the Femur with an external fixator.

Possible osteotomy size from 0.25 up to 2.50 mm.

In-vivo adjustment of the stiffness possible.



Fig 8
RatExFix.

3.2 RatExFix (developed in collaboration with Beth Israel Deaconess Med Ctr/Harvard Medical School)

Stabilization of the femur with an external fixator.

Possible osteotomy size from 0.25 up to 6.00 mm.

In-vivo adjustment of the stiffness possible.



Fig 9
RatDis.

3.3 RatDis (Distractor) (developed in collaboration with University of Basel, Klinik für wiederherstellende Chirurgie)

Stabilization of the Femur with an external distractor.
Distraction distance up to 15 mm at a pitch of 0.5 mm.

Current users are research labs, universities, pharmaceutical companies, and the like. A constantly increasing worldwide user network has been created and has evolved. Exchange workshops have been held in Brisbane in 2008 with participants from Japan, Australia, and Switzerland, and recently in Hornbach with participants from Germany, Australia, and Switzerland.

If you are interested, a specialized team at the AO Foundation can provide you with these standardized research implant systems, customized solutions and a design and consulting service. For further information please contact us at info@RISystem.org.

Alfred Niederberger, Johann Fierlbeck

INNOVATION WORKSHOP



The goal of the Innovation Workshop is to seek, evaluate, and implement innovative solutions for the surgical fixation, correction, and regeneration of the human skeleton and its soft tissues. Embedded in a university environment, the Innovation Workshop appeals to inventors from clinics and Research and Development institutes, who are interested in realizing their ideas.

This workshop enables fast, simple, and interdisciplinary implementation of ideas into prototypes and their evaluation.

The concept

A continuous close contact between surgeons and engineers is a fundamental need for the design and development of new innovative implants, instruments, and methods. For this reason, the institution is located on the campus of the Paracelsus Medical University (PMU) close to the Federal Hospital of Salzburg. All development steps from idea searches, sketches, and drawings, and the manufacturing process itself, are performed by the small team of Synthes engineers on site. Therefore the Innovation Workshop is divided into four areas:

1. The meeting room where the clinicians can discuss their ideas with each other and/or the Innovation Workshop team.
2. Two fully equipped engineering workplaces, running state-of-the-art computer-aided design and computer-aided manufacturing software.
3. The manufacturing area including modern computer numerical controlled (CNC) shape cutting technologies as well as conventional techniques and a 3-D printer.
4. The anatomy laboratory where the prototypes can be applied on full-body specimens under “real-life” conditions. The anatomy lab is therefore equipped with a modern C-arm scanner, a radiolucent table, arthroscopy, and a wide variety of Synthes instruments.





This infrastructure together with a very slim organizational structure enables the workshop team to realize new ideas in a short time.

Besides the main goal to offer innovative surgeons a platform for collaboration, the Innovation Workshop also serves as a service provider to support the Synthes Product Development Centers and the Expert Groups of the TK System in their activities. The Innovation Workshop can boost the development process, especially in the early ideas phase of new projects.

The team

A small team performing all the necessary steps towards creating a new prototype will save time, accelerate the process, and ensure that the right solution for the surgeons' needs is provided. Therefore the team consists of only two engineers, Johann Fierlbeck and Alfred Niederberger, and apprentice Josef Wallinger.

The ideas process

The Innovation Workshop team can easily be contacted directly or through Synthes. Depending on the idea, concept, or the clinical problem, the team will collate the information on the topic and will either work directly on the idea or hand it over to the development centers (eg, when a similar project is already running or being prepared). All steps after a functional prototype have to run through the development processes. The workshop in Salzburg is designed to accelerate the ideas process up to when a project can be started. According to regulatory guidelines custom made products and instruments for clinical use are not part of the Innovation Workshop business activities.

Contact

Synthes Innovation Workshop
c/o Paracelsus Medical University
Strubergasse 21
5020 Salzburg, AT

Johann Fierlbeck
Phone: +43 662 82 75 12 540
Mobile: +43 664 819 6681
fierlbeck.johann@synthes.com

Alfred Niederberger
Phone: +43 662 82 75 12 541
Mobile: +43 664 819 6682
niederberger.alfred@synthes.com



E Ellis III

TK NEWS PORTRAIT



Fig 1
Richard Hopper.



Fig 2
Seattle Children's Hospital in spring.

Dr Richard Hopper is the Chief of the Division of Plastic Surgery and Surgical Director of the Craniofacial Center at Seattle Children's Hospital, and Service Chief of Craniofacial Plastic Surgery at Harborview Medical Center. Both hospitals are level one regional care centers for the Northwest, with a catchment area one-quarter of the landmass of the country with a population of 9 million people. He is Associate Professor in the Division of Plastic Surgery at the University of Washington and is the fellowship director for the fellowship program in craniofacial surgery.

Although born in the UK, Richard spent most of his childhood and youth in Canada where he went to school in Newfoundland and Toronto, Ontario. He completed his plastic surgery residency and Master of Sciences thesis at the University of Toronto, and his craniofacial fellowship at New York University Medical Center under Dr Joseph McCarthy. He has been in Seattle since 2001 with a clinical practice that focuses on the surgical treatment of cleft lip and palate, craniosynostosis, rare and severe birth deformities of the bones and soft tissues of the face, and adult and pediatric facial craniofacial trauma. His research interests include outcome studies for complex craniofacial procedures, bioengineering of cranial defect implants, and device design for cleft and craniofacial care.

Richard has been on AO faculty since 2003. He has also chaired two courses and has partnered with CFEG chairman Scott Bartlett from Philadelphia in developing the curriculum for the AO CMF challenges courses in distraction osteogenesis.

He lives by Lake Washington in Seattle with his wife of fourteen years, and twin daughters. In his spare time, he enjoys skiing, home construction, and cycling. Having adopted the local habits from Seattle he can always be easily persuaded to have a cup of coffee or two.

Richard joined the AOTK (CMF) as medical member in April 2009. Before that he had already helped the TK System in setting up the Experts Symposia on craniofacial distraction osteogenesis.

NEWS FROM THE TK OFFICE



Claas Albers



Karsten Schwieger

As of 2010 Claas Albers has taken over the role of Head of TK Office. Claas looks back on 5 years in the TK System in which his main task was the setting up and the management of the CMF TK System. His primary goal is to achieve the highest level of support from the TK Office for the various groups in the TK System to ensure their most effective project work and close collaboration with internal and external partners.

Karsten Schwieger, formerly Program Leader Biomedical Services at the AO Research Institute, joined the TK Office with responsibility for project screening and innovation mining. This also implies standardization of (bio-)mechanical testing to generate comparable data over time.

Hazards

Great care has been taken to maintain the accuracy of the information contained in this work. However, AO and/or a distributor and/or the authors and/or the editors of this work cannot be held responsible for errors or any consequences arising from the use of the information contained in this work. Contributions published under the name of individual authors are statements and opinions solely of said authors and not of AO.

The products, procedures, and therapies described in this work are hazardous and are therefore only to be applied by certified and trained medical professionals in environments specially designed for such procedures. No suggested test or procedure should be carried out unless, in the user's professional judgment, its risk is justified. Whoever applies products, procedures, and therapies shown or described in this work will do this at their own risk. Because of rapid advances in the medical sciences, AO recommends that independent verification of diagnosis, therapies, drugs, dosages and operation methods should be made before any action is taken.

Although all advertising material which may be inserted into the work is expected to conform to ethical (medical) standards, inclusion in this work does not constitute a guarantee or endorsement of the quality or value of such product or of the claims made of it by its manufacturer.

Legal restrictions

This work was produced by AOTK and AO Education, Dübendorf, Switzerland. All rights reserved by AO Foundation, Switzerland. This work contains works protected by copyright, trademark and other laws. Prohibited are in particular any commercial use as well as any copying of the work. It is prohibited to make this work or any parts thereof available on any Intranet or on the Internet or to create derivative works based on the works contained in this work.

Restrictions on use

The rightful owner of an authorized copy of this work may use it for educational and research purposes only. Single images or illustrations may be copied for research or educational purposes only. The images or illustrations may not be altered in any way and need to carry the following statement of origin "Copyright © by AO Foundation, Switzerland".

Some names, instruments, treatments, logos, designs etc. referred to in this work are also protected by patents and trademarks or by other intellectual property protection laws (eg, "AO", "ASIF", "AO/ASIF", "TRIANGLE/GLOBE Logo" are registered trademarks) even though specific reference to this fact is not always made in the work. Therefore, the appearance of a name, instrument etc. without designation as proprietary is not to be construed as a representation by AO that it is in the public domain.

For further information please contact:

AO Foundation
TK Office
Clavadelerstrasse 8
CH-7270 Davos Platz
Phone: +41 81 4142-471
Fax: +41 81 4142-290
aotk@aofoundation.org

Editors:

Univ-Prof Dr Tim P Pohlemann
Chairman of the TK System
tim.pohlemann@uniklinikum-saarland.de

TK Office
Philip Schreiterer (Trauma)
philip.schreiterer@aofoundation.org
Florian Beutter (Spine)
fbeutter@aospine.org
Claas Albers (CMF)
claas.albers@aofoundation.org

Number of copies: 11,700

Issued: July 2010

Photos and illustrations courtesy of Synthes partners and authors
Copyright © 2010 by AO Foundation, Switzerland