

AOTK System

Innovations

1 | 2013

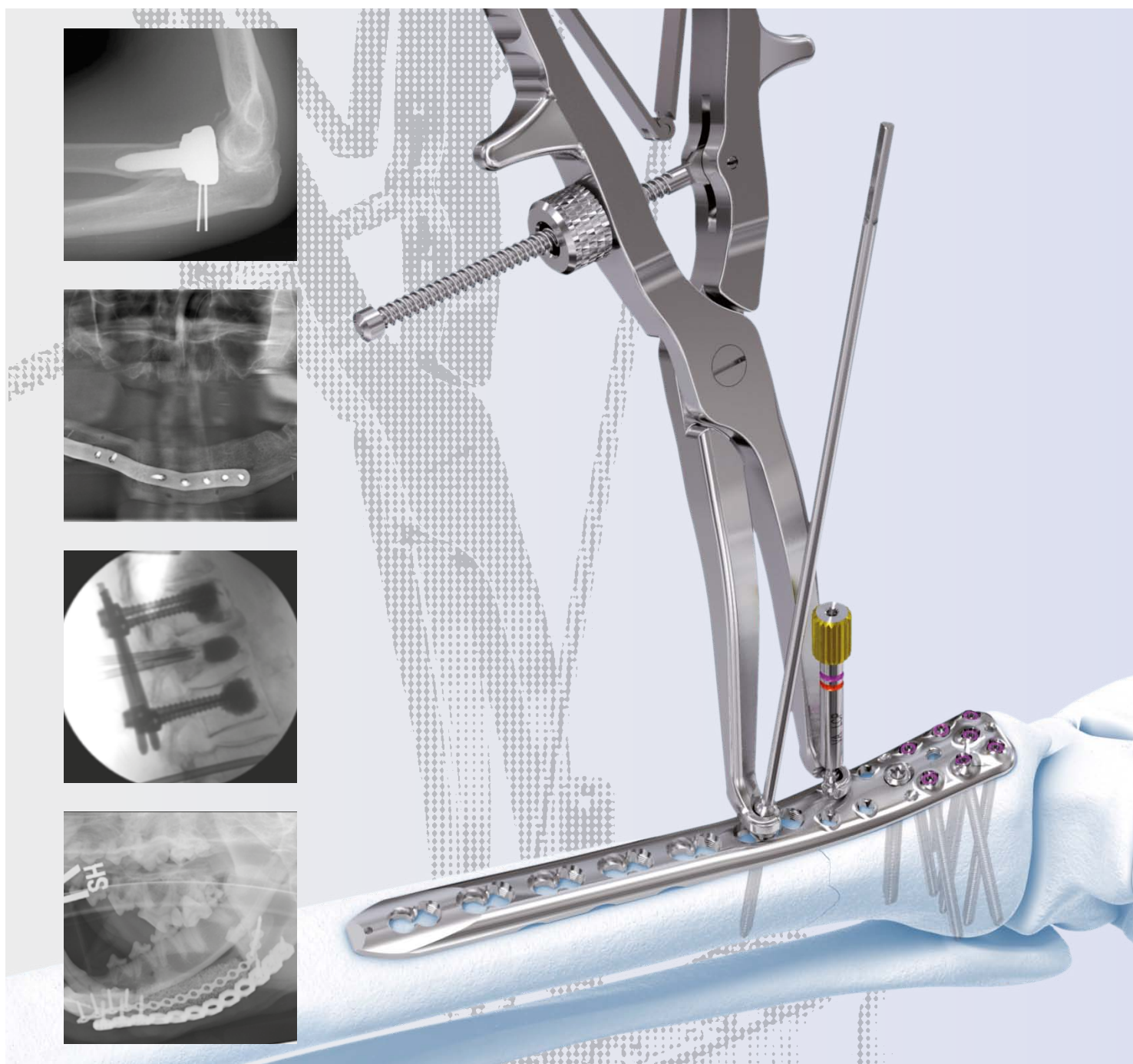


TABLE OF CONTENTS

EDITORIAL 1

TRAUMA, UPPER EXTREMITY 2

PHILOS Augmented
Radial Head Prosthesis System
Soft Tissue Bone Forceps

TRAUMA, LOWER EXTREMITY 10

VA-LCP Ankle Trauma 2.7/3.5 System
Expert Nailing System Instrumentation
Bridging Rods for External Fixation

THORAX 22

Matrix Rib System

CMF 24

News from AOTK CMF
Facial Shape System
Patient Specific Plates for the Mandible

NEURO 36

History of Neurosurgery in the AOTK System
MatrixNeuro Rigid Mesh and Bender
MatrixNeuro Ultra Low Profile (ULP)

SPINE 42

Synflate Vertebral Balloon System
ZERO-P ChronOS
News from AOSpine

VET 54

Locking Reconstruction 2.4 and Mini Plate 2.0 System
Locking Compression Plate 1.5 System

NEWS FROM THE AO INSTITUTES 60

ARI: PHILOS Augmented – which screws to augment and how?
AOCID: Focused Registries: collecting feedback to answer clinical needs
AOTK: TK Innovation Prize 2013

PORTRAIT 68

EDITORIAL

Dear reader,

The AOTK System's approach to the development of surgical techniques and products, together with the AO's industrial partner, marks an integral element of the organization's value to the medical community. Besides consisting of a large number of clinical experts in their fields, organized into various dedicated Expert Groups, we also take advantage of close collaboration with our internal partners, such as the AO Research Institute (ARI) and AO Clinical Investigation and Documentation (AOCID), to get a thorough preclinical and clinical assessment of technology that we mark as "AOTK approved". The philosophy to only introduce a new technique after it has undergone a rigorous quality control has been a key strength of the AO foundation and has long ago anticipated today's rigorous regulatory processes.

The AOTK strives to build on this strength, and further develops the tools we have at hand to offer a quality control process complementary to today's control systems. In this issue, you will find a report from ARI on how a first generation computer model has been developed to systematically investigate the influence of specific cement augmentation patterns when using the PHILOS plate in combination with bone cement. The respective surgical technique, which addresses fixation failure and secondary screw perforation in proximal humeral fractures (a common complication especially in elderly patients with osteoporosis) has this year received AOTK approval and is described in the Trauma section of this issue.

In the previous issue, we introduced the small standardized case series as a new format for the AOTKs to obtain clinical data as part of its workflow. After further modifications, these 'Focused Registries' are now a standard tool for all of our Expert Groups, helping them to gather data to assess the potential benefits of new techniques not only in terms of healing time and surgeon handling, but also socio-

economic data, which is becoming more important in today's health care environment. Read more about the Focused Registries in the 'News from AOCID' section.

The new Radial Head Prosthesis system offers a sound new treatment option for complex cases, helping to prevent proximal migration of the radius, or lateral elbow instability. It is also marks another step for the AO in the direction of arthroplasty.

The AO Foundation's increased activities in the field of neurosurgery have led to new course formats specifically developed for neurosurgeons, thus complementing the organization's offerings in its classic clinical areas. This focus is historically rooted in the AOTK System when it started to involve neurosurgeons at an early point in time to develop solutions for the fixation of cranial flaps. So, we are going back to review the origins of our Neuro Expert Group in this issue.

It is always a highlight to look at the exciting work from our veterinary colleagues, who like to refer to themselves as 'the oldest clinical division in the AO'. Find more about new CMF and Trauma solutions for animals, such as the Locking Reconstruction Plates for mandible and maxilla as well as the LCP system for radius and ulna fractures in canines.

As always we stress that none of the articles substitutes for AO's surgical techniques or teaching tools. You can obtain more information on these and our other devices from AO or the official technical guidelines. Please do not hesitate to contact us at any time. We welcome your feedback and involvement.

Yours faithfully,



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TRAUMA, UPPER EXTREMITY



Fig 1
Traumacem V+ is injected with a syringe and an adapter mating with the Perforated Locking Screw; 4 – 6 screws are augmented.

PHILOS Augmented

Fixation failure and secondary screw perforation account for a large proportion of the complications of proximal humeral fracture osteosynthesis. It is particularly frequent in elderly patients with osteoporosis [1, 2].

PHILOS (Proximal Humeral Internal Locking System) Augmentation addresses these complications by augmenting the PHILOS plate and screw fixation with Traumacem V+, a high-viscous PMMA cement (Fig 1). A small amount of Traumacem V+ (0.5 ml) is injected through a perforated locking screw, building a cloud around the tip of each screw (Fig 2). Four to six proximal screws are augmented to ensure good anchorage of the osteosynthesis in the humeral head.



Fig 2
The 3.5 mm Perforated Locking Screws feature a through-cannulation and three side perforations for cement application.



Fig 3
Traumacem V+ injected through the Perforated Locking Screw increases the surface area around the screw tip and interdigitates with the trabecular structure.

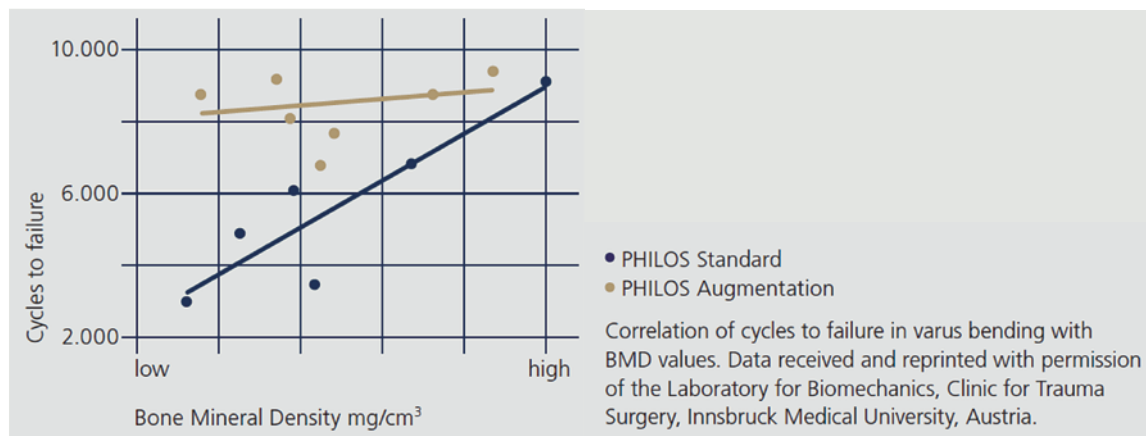


Fig 4
Correlation of cycles to failure in varus bending with bone mineral density (BMD) values.

Biomechanical principles

The Traumacem V+ clouds increase the surface area around the screw tips and interdigitate with the trabecular structure (Fig 3). This results in a more homogeneous distribution of the stresses at the interface between bone and screw, which enables the transmission of higher loads from the head fragment to the plate. Biomechanical studies confirm that the PHILOS Augmentation offers improved anchorage in low-density bone when compared with standard PHILOS fixation [3, 4] (Fig 4).

Features and benefits

The PHILOS Augmentation system offers a new and unique option to improve the fixation of osteoporotic proximal humeral fractures. It enhances the anchorage in low-density bone, as demonstrated in biomechanical studies. The add-on system allows intraoperative decision making regarding the use of the augmentation option. It enables the surgeon to follow his/her routine reduction and fixation procedure.

PHILOS Augmentation has been in clinical use since January 2013. The very positive user feedback and its biomechanical performance make PHILOS Augmentation a promising treatment option for patients with an osteoporotic proximal humeral fracture.

References

- 1 **Brunner F, Sommer C, Bahrs C, et al.** Open reduction and internal fixation of proximal humerus fractures using a proximal humeral locked plate: a prospective multicenter analysis. *J Orthop Trauma*. 2009 Mar; 23(3):163–172.
- 2 **Krappinger D, Bizzotto N, Riedmann S, et al.** Predicting failure after surgical fixation of proximal humerus fractures. *Injury*. 2011 Nov; 42(11):1283–1288.
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- 4 **Kathrein S, Kralinger F, Blauth M, et al.** Biomechanical comparison of an angular stable plate with augmented and non-augmented screws in a newly developed shoulder test bench. *Clin Biomech*. 2013 Mar; 28(3):273–277.

Case provided by Martin Jaeger, Freiburg, Germany

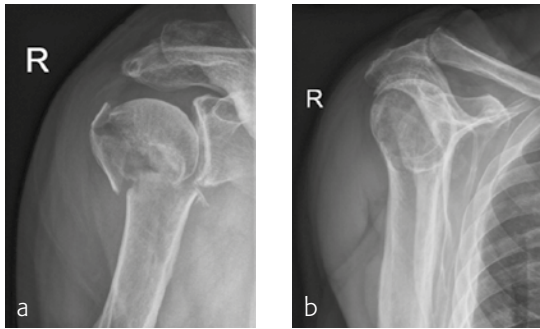


Fig 5a–b
Preoperative AP and lateral views.

Case 1: Fracture dislocation of the proximal humerus

An 82-year-old male patient presented with a fracture dislocation of his right proximal humerus after a fall at home. Examinations revealed a highly unstable valgus-displaced 4-part fracture of the proximal humerus with a disruption of the medial hinge. No neurological injuries were evident (Fig 5).

The patient was placed in supine position, having the shoulder on two shoulder supports. After closed reduction of the shoulder, ORIF was performed via an anterior deltopectoral approach using the PHILOS. Four screws were augmented with Traumacem V+ under fluoroscopic control. Initially the treated shoulder was immobilized in a sling for 2 days followed by a pain-adapted functional treatment (Fig 6).

The X-ray review at 3 months after surgery showed an anatomic reduction of the fracture, nicely formatted augmentation, no secondary loss of reduction, and range of motion of the arm reaching the horizontal plane (Fig 7).

Surgeon's comment

ORIF of proximal humeral fractures using an augmentation technique in addition to the PHILOS seems to be a promising concept. Varus-displaced fractures in osteopenic bone situations of the elderly seem to particularly profit from this technique. Up till now we have had no intraarticular misplacement of the cement and no secondary loss of reduction in these challenging fracture types.

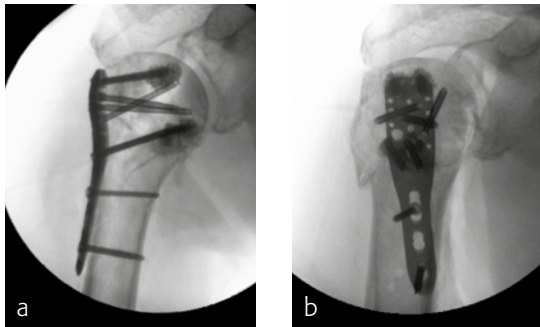


Fig 6a–b
Postoperative AP and lateral views.

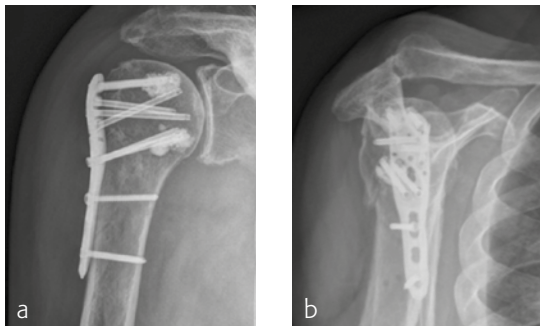


Fig 7a–b
AP and lateral views at 3 months follow-up.

Case provided by Franz Kralinger, Innsbruck, Austria

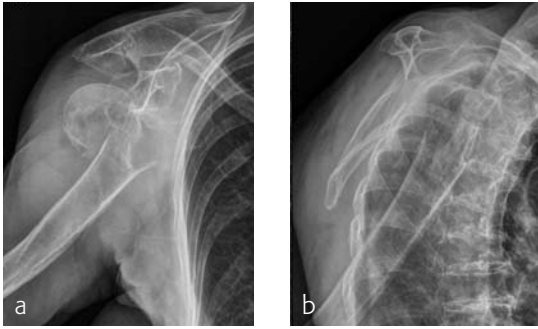


Fig 8a–b
Preoperative images.

Case 2: 91-year-old with osteoporosis

A 91-year-old female patient with osteoporosis had a dislocated 3-part proximal humeral fracture in her right dominant arm (Fig 8).

The fracture was treated with PHILOS augmentation and healed in anatomical position (Fig 9).

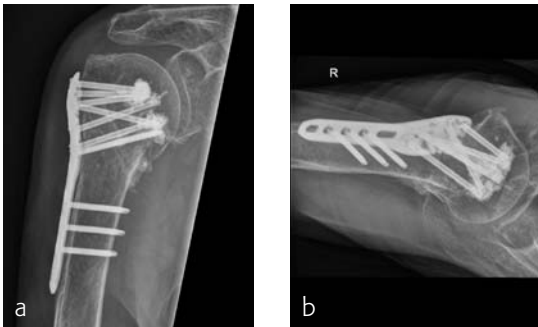


Fig 9a–b
Follow-up after 3 months.



Fig 1
The 2-piece modular design of the Radial Head Prosthesis system.



Fig 2
The round symmetrical heads.



Fig 3
Image showing the texture on the implant's stem.

Radial Head Prosthesis System

Treatment of complex radial head fractures remains challenging. While undisplaced fractures can often be treated nonoperatively, more complex and/or displaced fractures require some sort of surgical intervention. Displaced fractures are typically treated with ORIF. More comminuted fractures that cannot be treated with ORIF are either treated with radial head excision (stable fractures) or a radial head prosthesis (unstable fractures).

Current clinical literature, however, suggests that replacing the radial head with a prosthetic implant is a reasonable option in cases where the head has traditionally been removed. The main reasons are that radial head excision can lead to proximal migration of the radius and/or lateral elbow instability [1].

Design and benefits

The 2-piece modular design of the Radial Head Prosthesis system (Fig 1) offers 240 possible implant combinations to account for individual anatomic variances:

- A total of 24 implant heads are available in 2 mm diameter increments ($\varnothing$ 18 mm – 28 mm) and 4 head heights (standard height, +2 mm, +4 mm and +6 mm extension)
- A total of 10 implant stems are available in a short/straight version and a longer/curved version ($\varnothing$ 6 mm – 10 mm).

Side-loading

The side-loading feature facilitates in situ insertion and assembly of the prosthesis.

Round symmetrical head

The round symmetrical heads facilitate in situ placement and surgical technique (Fig 2). The heads are made of CoCr and feature a smooth head-neck transition to accommodate the annular ligament.

Textured stem

A photochemical etching process creates a texture on the implant stems (Fig 3). This textured titanium surface promotes bony ongrowth. The texture is etched and thus not an additive, which results in a uniform size for a uniform fit.

References

- 1 K  chle R, Habermann B, Hessmann M, et al. Indikation und Ergebnisse nach Radiuskopfprothesen. *Trauma Berufskrankh* 2003; 5:35–40

Case provided by Harry Hoyen, Cleveland, USA



Case 1: Sport injury

A 34-year-old very active male patient injured his elbow in a sporting activity (Fig 4). He suffered radial head and coronoid injuries (Fig 5).

He underwent surgical exploration through a lateral approach. The radial head was not amenable to fixation, so ORIF of the coronoid fracture with K-wires and radial head arthroplasty was performed. The lateral collateral ligament was repaired to the lateral epicondyle with an absorbable anchor (Fig 6).



Fig 4a–c
Preoperative images.

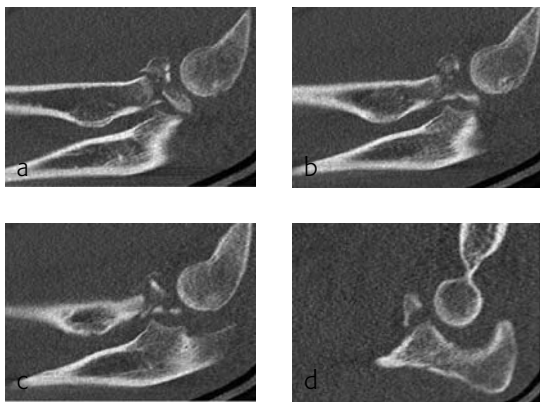


Fig 5a–d
Lateral reconstruction (2-D) of the radial head and coronoid injuries.

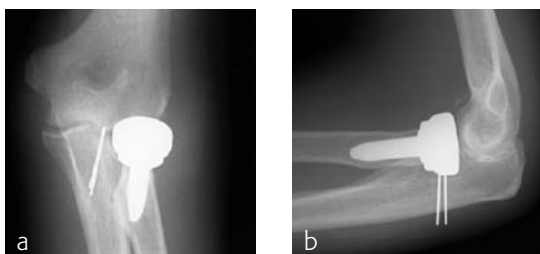


Fig 6a–b
Postoperative images.

Case provided by Harry Hoyen, Cleveland, USA

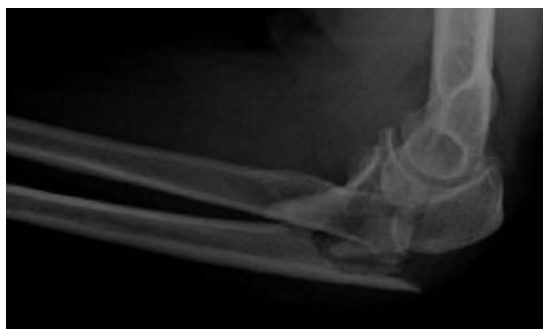


Fig 7
Preoperative images.

Case 2: Injury after a fall

A 63-year-old female patient sustained a proximal ulna and radial head injury after a fall (Fig 7). A reduction was performed and surgery recommended for fixation of the proximal ulna fracture and inspection on the radial head.

There was comminution within the coronoid segment with a distally extended fracture of the radial head. This type of injury is more stable with a long-stem prosthesis (Fig 8).



Fig 8a–b
Postoperative images.



Fig 1
Soft Tissue Bone Forceps (without Attachment).



Fig 2
The Soft Tissue Attachment is used with the forceps to protect the soft tissue and to give good purchase to securely maintain the reduction during the fixation of the plate.

Soft Tissue Bone Forceps

The Soft Tissue Bone Forceps (Fig 1) are a new instrument for use in reduction of distal radius fractures or reduction of distal radio-ulnar joint dislocations. Reducing distal radius fractures can be challenging, especially in osteoporotic bone, and requires good technique. Currently, reduction is achieved by generic bone clamps or by K-wires. Generic bone clamps, such as Weber clamps, require a second incision on the opposite side of the bone for bone-to-bone contact. This new instrument simplifies fracture reduction and eliminates the need for another incision on the dorsal side of the distal radius.

The forceps consists of two parts:

- Clamp, and
- Radiolucent J-shaped attachment (Fig 2).

The ball tip of the clamp fits into the holes of any of the distal radius plates and can be used to press the plates directly to the bone in the correct position (Fig 3). This further allows the user to temporarily fix the plate and hold the plate position and bone fragments in the reduced position during drilling and placement of screws (Fig 4).

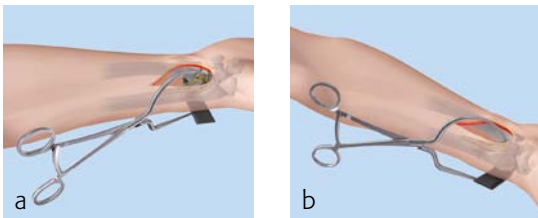


Fig 3a–b
The forceps are used to maintain the reduction by holding the plate in the correct position and pressing it slightly to the bone.

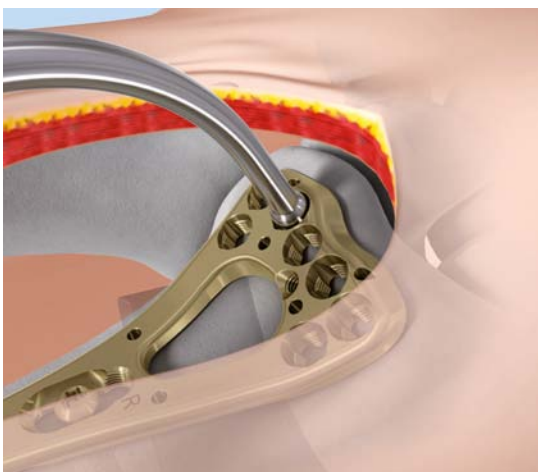


Fig 4
Showing how the forceps interact with the plate.

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TRAUMA, LOWER EXTREMITY

Variable Angle LCP Ankle Trauma 2.7/3.5 System

Treatment of complex ankle fractures when combined with poor bone quality can be challenging. A considerable rate of unsatisfactory results has been observed due to a loss of reduction, nonunions, and impaired function when using current plating systems. These plating options are sometimes also considered as being too thick, and may irritate soft tissues.

The new Variable Angle LCP Ankle Trauma 2.7/3.5 system was developed to overcome these shortcomings. The low-profile plates feature variable angle locking screw technology and offer more options for screw placement to address a wider range of fracture patterns and to accommodate varied patient anatomies. In addition, these anatomically accurate plate designs simplify minimal invasive plate insertion and indirect reduction techniques (push-pull applications). The plates are available in stainless steel and are primarily for the treatment of articular injuries.

The Variable Angle LCP Ankle Trauma 2.7/3.5 system comprises the following plates (Table 1a–b):

- VA-LCP Medial Distal Tibia Plates
- VA-LCP Anteromedial Distal Tibia Plates
- VA-LCP Anterolateral Distal Tibia Plates
- VA-LCP Distal Tibia T and L Plates
- VA-LCP Lateral Distal Fibula Plates.

Table 1a
Design features of the
plates.

VA-LCP Medial Distal
Tibia Plates



VA-LCP Anteromedial
Distal Tibia Plates



VA-LCP Anterolateral
Distal Tibia Plates



Design

Eleven 2.7 mm VA
holes in the head

Ten 2.7 mm VA holes
in the head

Eight 2.7 mm VA holes
in the head

Range

Lengths: 112–292 mm
Number of Shaft
Holes: 4, 6, 8, 10,
12, 14, and 16

Lengths: 112–292 mm
Number of Shaft
Holes: 4, 6, 8, 12,
and 16

Lengths: 82–292 mm
Number of Shaft
Holes: 4, 6, 8, 10,
12, 14, 16, and 18

VA-LCP Distal Tibia
T-Plate



VA-LCP Distal Tibia
L-Plate



VA-LCP Lateral Distal
Fibula Plates



Table 1b
Design features of the
plates.

Design

Three 2.7 mm VA
holes in the head

Three 2.7 mm VA
holes in the head

Six 2.7 mm VA holes
in the head

Range

Lengths: 72–90 mm
Number of Shaft
Holes: 4 and 6

Lengths: 72–90 mm
Number of Shaft
Holes: 4 and 6

Lengths: 79–235 mm
Number of Shaft
Holes: 3, 4, 5, 6, 7, 9,
11, 13, and 15

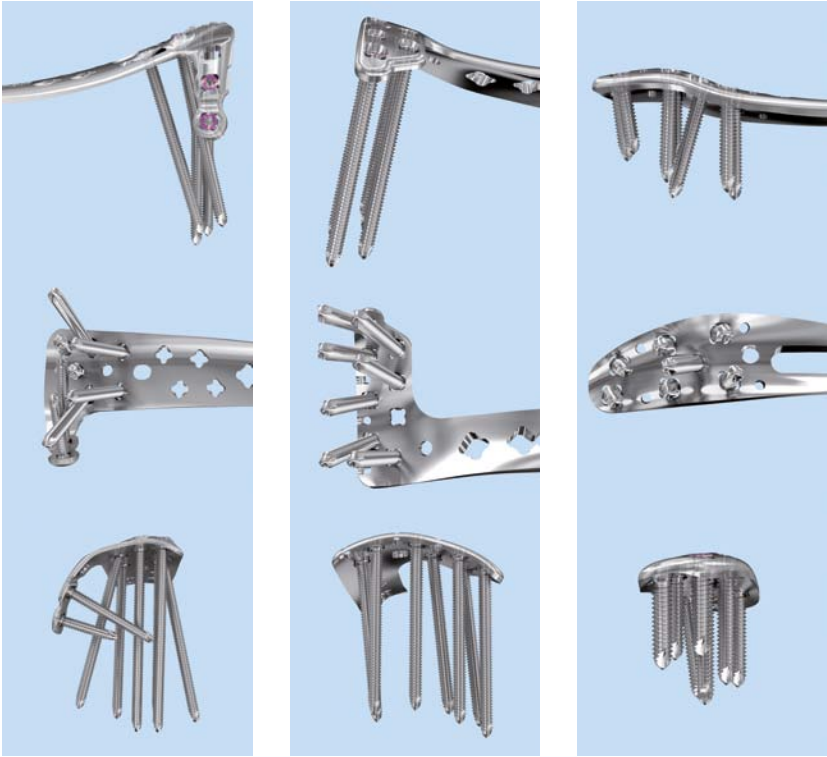
The Combi holes in the Variable Angle LCP plate shaft combine a dynamic compression unit hole with a variable angle locking screw hole. Due to the smaller sized and more numerous fixation options distally with 2.7 mm VA screws, the fixed-angle construct provides advantages for small metaphyseal segments where traditional screw fixation can be limited. The screw trajectories are optimized to support the distal articular surface. The multiple variable angle locking holes in the plate head accept 2.7 mm VA locking, 2.7 mm locking, 2.7 mm cortex, and 2.7 mm metaphyseal screws. The latter has a low profile screw head to avoid soft tissue irritations and can be used to pull the plate to the bone. Due to the numerous screw possibilities, it is important that the surgeon is familiar with which screws can be used in which plate holes. The system includes guide blocks for all plates (except T and L plates) for inserting screws in the plate head at nominal screw angles (Table 2). K-wire holes in the plate head and shaft tip accept K-wires up to 1.6 mm. They can be used to temporarily reduce articular fragments, and to confirm the location of the plate relative to the distal tibia and fibula.

VA-LCP Anteromedial
Distal Tibia Plates

VA-LCP Anterolateral
Distal Tibia Plates

VA-LCP Lateral Distal
Fibula Plates

Table 2
Nominal screw
trajectories.



Design features

The design features of some of the plates are as follows:

- VA-LCP Anteromedial Distal Tibia Plate: The anterior arm of the plate aids in capturing small articular bone fragments and has three 2.7 mm VA locking screw holes
- VA-LCP Anterolateral Distal Tibia Plate: The plate is designed to be placed more distally than the previous 3.5 mm LCP Anterolateral Distal Tibia Plate. It also provides more coverage in the distal anterolateral area. Screw angulations at nominal angle are targeted for Volkmann's triangle and the Chaput fragments
- VA-LCP Lateral Distal Fibula Plate: The plate contour is designed to provide plate contact at the distal tip and on the proximal end, which allows the plate to avoid 'rocking' on the fibular ridge. In cadaveric evaluations, the fibular ridge was found to be highly variable in both height and length. The under-contour bypasses the variability and assists in reduction by minimizing a valgus deformity if the plate is in contact with the ridge. The plate offers two syndesmotic slots that accept 3.5 mm low profile cortex or 4.0 mm cortex screws.

The design rationale for the Variable Angle LCP Ankle Trauma 2.7/3.5 system has paralleled the evolution of approaches to periarticular fracture care. With improved appreciation of the benefits of fracture configuration-guided surgical exposures, a greater variation of plating surfaces are now utilized. New plate contours are essential to optimize buttressing function and distal screw positions. The new complement of ankle plates provides ideally contoured plates for all common plate positions around the tibia and fibula. The new plate shape design has improved the distal fit of all of the plates, and minimal contour is necessary to obtain full surface plate bone apposition. The posterior tibial plate options provide excellent posterior buttress for posterior partial articular fragments, even via the posterolateral insertion portal.

One of the greatest advantages of the new plates is the VA feature that allows for targeting of specific fracture fragments. Additionally, the ability to self-direct these screw paths optimizes the ability to use these plates with other implants (both plates and intramedullary devices) and essentially solves the problem of screw interference/traffic from supplementary plate positions, which are commonly utilized for high energy fracture variants. These plates should be applied using traditional techniques. Additionally, while the VA option can be utilized, the nominal screw positions provide excellent screw distribution, good articular support, and optimal angular stability. The VA option should be reserved for situations where alternative screw positions are critical, especially in situations where optimal angular stability is desired.

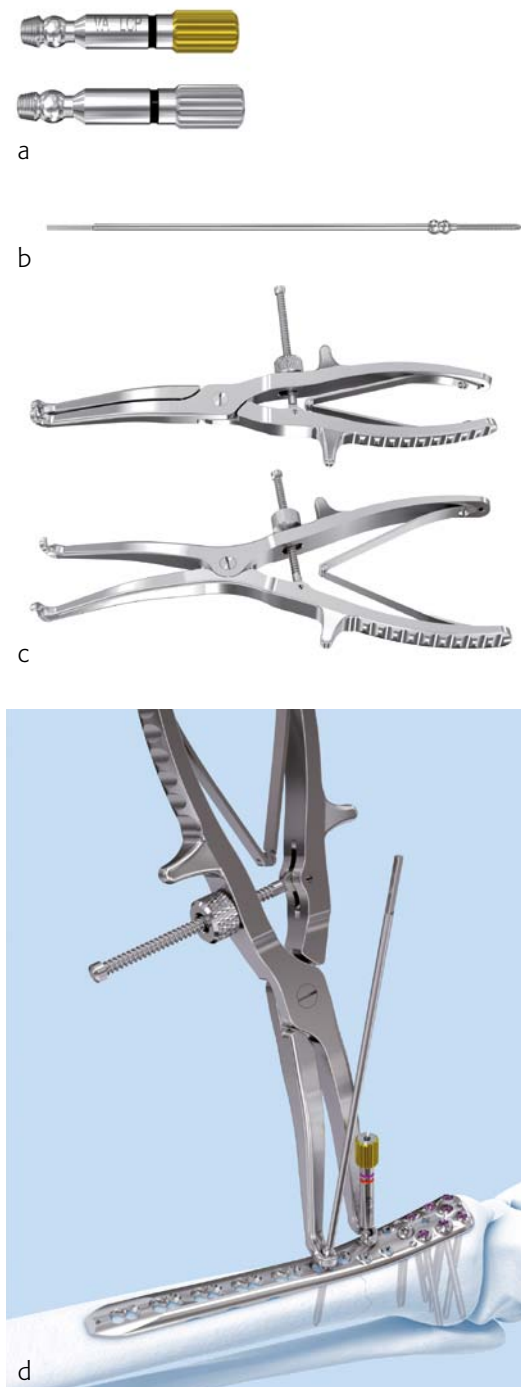


Fig 1
Distraction and compression system, consisting of Posts for VA Locking Holes (a), Compression Wire (b) and Distraction and Compression Forceps (c). The forceps with the spherical recesses can be used to generate compression or distraction via the balls of the inserted compression wires and posts (d). The forceps allows for final screw fixation after compression or distraction has been achieved.

Design features cont.

An essential benefit of the plating system is the option to have a fully self-contained system with a full complement of plates, screw types, and instrumentation; there is almost no need for supplemental hardware sets to be opened. The sets of the Variable Angle LCP Ankle Trauma system are modular to allow customized selection of implants, which also reduces inventory and overall costs by eliminating seldom-used implants.

The Variable Angle LCP Ankle Trauma system also comprises a compression and distraction system, which is an important tool for reduction (i.e. bringing a fibula out to length) or compression of a fracture through the plate itself (Fig 1).

Case provided by Mark Lee, Sacramento, USA

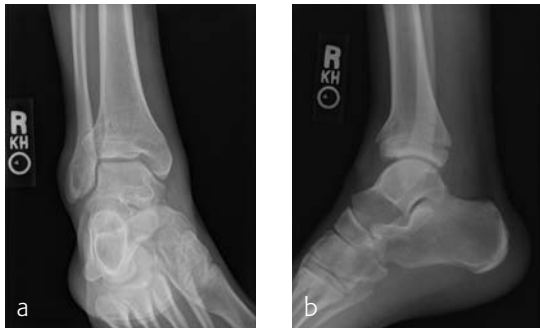


Fig 2a–b
AP and ML injury x-rays.

Case 1: Snowboarding accident

A 17-year-old male patient was involved in a snowboarding accident. This was a closed injury, and he was initially splinted for 10 days. His injury pattern demonstrated anterior articular impaction (Fig 2).

Surgeons performed an anterolateral surgical approach and distracted the joint using the distraction clamp and osteotome (Fig 3). The fracture was fixed with a VA-LCP Anterolateral Distal Tibia Plate (Fig 4–6).



Fig 3
Joint distraction using
distractor.



Fig 4
Plate application and
guidance of screws
over joint.



Fig 5
Screws directed above
the articular surface.



Fig 6a–b
AP and ML x-rays of the final fixation construct.

Case provided by Mark Lee, Sacramento, USA



Fig 7a–b
AP and ML injury x-rays.

Case 2: Scaffolding fall

A 61-year-old laborer fell 5 meters from scaffolding. This was a closed injury with severe soft-tissue injury (Fig 7–8). He required three weeks of joint-spanning external fixation prior to adequate resolution of edema.

Initial fixation was via a limited posteromedial exposure to buttress a posteromedial partial articular fragment (Fig 9). Following articular reduction and supplemental lateral column plate fixation via a limited anteromedial joint exposure, the VA-LCP Anteromedial Distal Tibia Plate was passed subcutaneous with subsequent percutaneous screw insertions into the plate shaft.

There was good maintenance of reduction at 5 weeks (Fig 10).

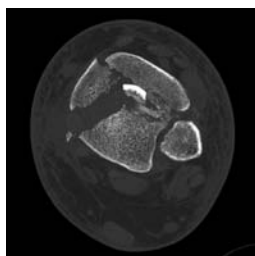


Fig 8
Evaluation of his computed tomography directed an anteromedial surgical exposure for optimal fracture articular exposure.



Fig 9a–b
Fixation.



Fig 10a–b
Images 5 weeks postoperative.

Case provided by Mark Lee, Sacramento, USA



Fig 11a–b
AP and ML injury x-rays.

Case 3: Horse fall

A 45-year-old patient fell from his horse, receiving a closed bimalleolar fracture/dislocation (Fig 11). Computed tomography demonstrated an additional anterolateral avulsion injury and syndesmosis dislocation. Osteosynthesis was conducted with a VA-LCP Lateral Distal Fibula Plate.

Push technique was required to achieve fibular reduction, and the syndesmosis was reduced and clamped with periarticular clamps (Fig 12). Postoperative x-rays at 4 weeks demonstrated good maintenance of reduction (Fig 13).

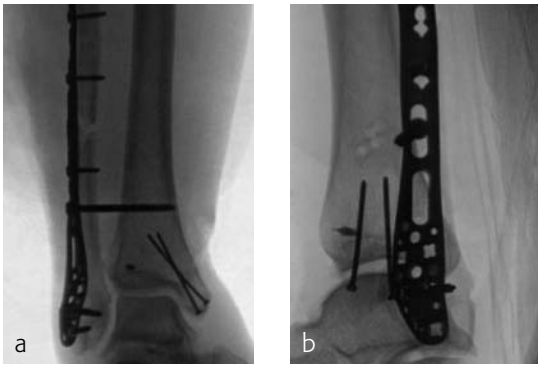


Fig 12a–b
Operative images.



Fig 13a–b
Postoperative x-rays at 4 weeks.

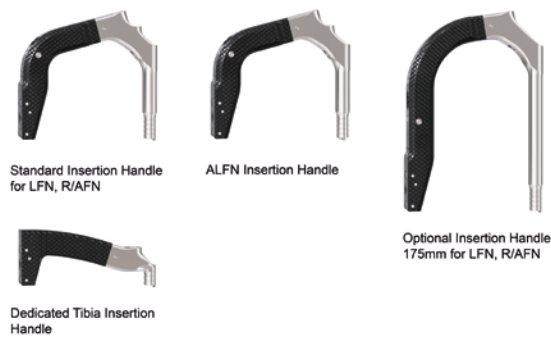


Fig 1

EX Nail Insertion Handles for the individual nails. There is an optional percutaneous insertion handle available for the LFN-EX and R/AFN-EX. (Note: In the US, the Standard Insertion Handle is used for the LFN-EX, R/AFN-EX, and Expert Tibial Nail. The shorter Dedicated Tibia Insertion Handle is optional for tibia procedures).

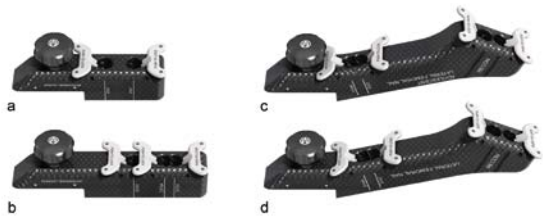


Fig 2

Radiolucent aiming arms with cam locks for R/AFN-EX retrograde (a) and antegrade (b) locking, Adolescent LFN-EX (c), and LFN-EX (d).



Fig 3

Due to the radiolucency of the insertion handle, visualization of the bony anatomy is improved.

Expert Nailing System (EX Nail) Instrumentation

The Expert nailing system range of implants is state-of-the-art, with several built-in features that optimize anatomical design and improve locking options, both equally important for successful treatment with intramedullary nailing. However, a thorough review of existing nailing instrumentation has revealed several clinical challenges: difficulty in determining the correct entry point, complexity in obtaining adequate fracture reduction, limited bone visibility due to metallic instruments, limited readability of measuring devices, and loss of screws in soft tissues during insertion. The need for a large number of instruments, which are not compatible with all nail types, makes inventory control a problem for hospitals. The new Expert nailing system (EX Nail) Instrumentation has been developed to address these issues and to optimize functionality, ergonomics, user-friendliness, durability, and ease of cleaning.

The new EX Nail Instrumentation is intended to be used with the Expert Lateral Femoral Nail (LFN-EX), Expert Adolescent Lateral Femoral Nail (ALFN-EX), Expert Retrograde/Antegrade Femoral Nail (R/AFN-EX) and Expert Tibial Nail (TN-EX) and is comprised of the following instruments:

- Radiolucent Insertion Handles and Aiming Arms
- Opening Instruments, Wire Guides, and Protection Sleeves with Handle
- Intramedullary Reduction Tool with T Handle
- Screwdrivers / Interlock Screwdrivers
- Measuring Devices
- Scalpel Handle
- Connecting Screw for Insertion Handle
- Cutter for the Expert Tibial Nail
- Handle (large) with Quick Coupling
- Combined Hammer 500g
- Driving Cap for Insertion Handle.

Some of the instruments are described in more detail in the following paragraphs.

Radiolucent Insertion Handles and Aiming Arms

Use of metallic instruments limits the surgeon's view during fluoroscopy, resulting in difficulty visualizing the fracture and the proper positioning of the locking mechanisms in the bone. The new insertion handles have an increased radiolucent area (Fig 1). Together with the radiolucent aiming arms (Fig 2), the visualization of the relevant bony anatomy on intra-operative x-ray images is improved (Fig 3). The new aiming arms have built in retention mechanisms and cam locks, which allow true-locking of the protection sleeves to decrease the risk of accidental loosening of the parts during the procedure.

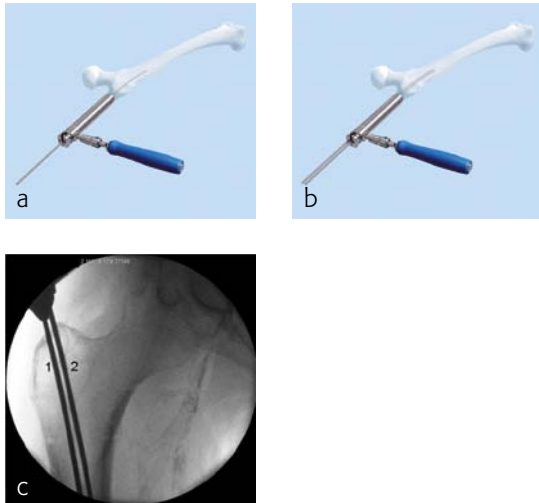


Fig 4a–c

Wire guide with offset holes to insert a parallel K-wire with a defined linear offset (a-b). The wire guide can be rotated in the protection sleeve and locked into four set positions with 90° axial offsets. This guide aids the insertion of a K-wire at the correct entry point (c) when the first wire has been placed in an offset position.

Wire guide

Finding the correct entry point and path of the K-wire by trial and error can be cumbersome and frustrating. The new wire guides have a center hole and one or two offset holes. If the initial K-wire has not been inserted through the proper entry point, a second K-wire can be correctly placed in reference to the first wire through one of the offset holes (4 mm and/or 6 mm from the central hole) of the instrument (Fig 4). Color-coding limits the possibility of mismatching the instruments.

Intramedullary Reduction Tool

Achievement of proper reduction, especially in femoral fractures, can be very challenging. A long reduction tool (Fig 5) has been developed, which has an anatomical curvature and a pointed fingertip to aid in fracture reduction.

The EX Nail Instrumentation has been developed based on surgeons' needs in order to make the nailing procedure easier and more straightforward, to reduce OR time, and to improve results. The compatibility of the EX Nail Instruments also helps to reduce inventory and facilitates the OR set-up for a variety of procedures.

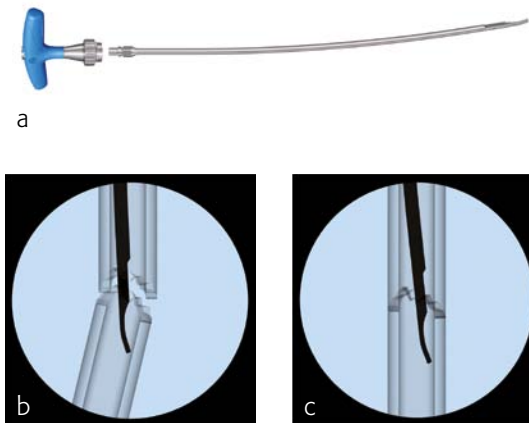


Fig 5a–c

Cannulated reduction tool with flat curved tip (a). The instrument allows for an easier reduction (b–c) and reduces the amount of required x-rays. This will be beneficial in reducing OR time and x-ray exposure.



Fig 1
Bridging Rod.

Bridging Rods for External Fixation

The Bridging Rod is available as a stand-alone component, and can be used for delta ankle, tibia plateau, and distal tibia frames (Fig 1, Fig 2). The use of a bridging rod effectively elevates the limb, may help reduce the occurrence of pressure ulcers, and allows for access to the wound without painful manipulation of the limb.

The Bridging Rods are available in four sizes:

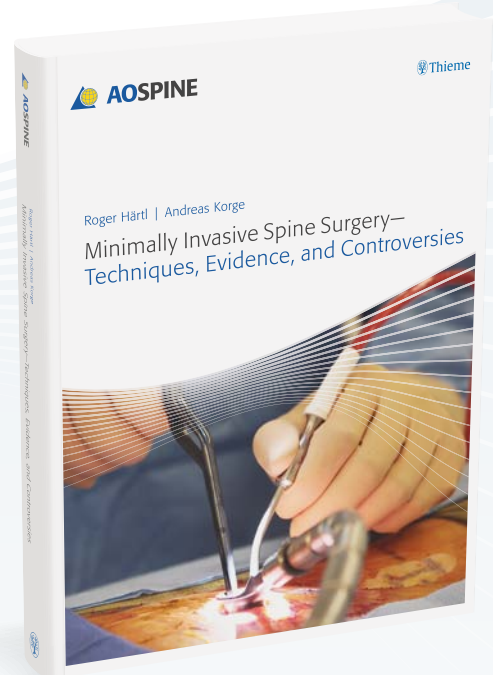
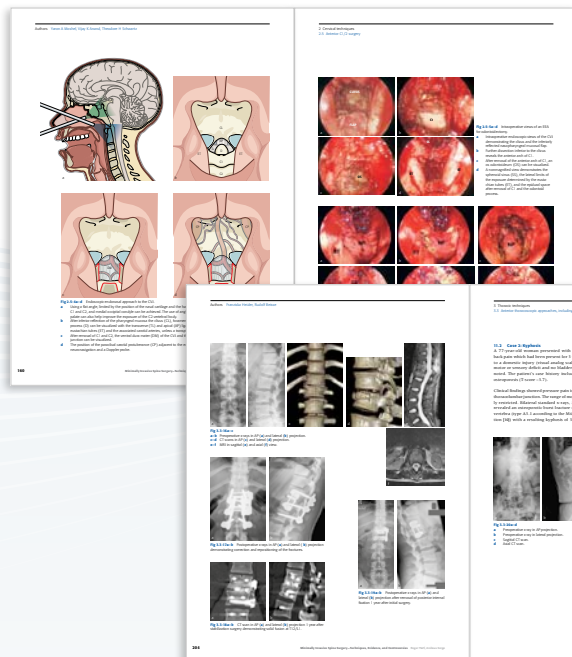
JDE Description:

- 110 mm Carbon Fiber Bridging Rod, 190 mm Short
- 110 mm Carbon Fiber Bridging Rod, 190 mm Long
- 110 mm Carbon Fiber Bridging Rod, 220 mm Short
- 110 mm Carbon Fiber Bridging Rod, 220 mm Long



Fig 2
Frame with Bridging Rod.

Minimally Invasive Spine Surgery— Techniques, Evidence, and Controversies



Minimally Invasive Spine Surgery—Techniques, Evidence, and Controversies is the most comprehensive book of its kind, and includes more than 500 pages of surgical techniques, illustrations, case images, tips and tricks, and research, providing an invaluable tool for spine surgeons around the world.

Each technique is fully examined:

- The pros and cons of each is objectively reviewed
- Its spectrum of indications and contraindications is summarized
- Historical and modern day controversies relating to each technique are discussed
- Uniquely, chapters in the text are further supported by an evidence-based section summarizing research studies, analysis, and conclusions into each technique from peer-reviewed journals.

The book includes brief historical introductions on each technique and the surgeons that explored and founded its methods, their early (sometimes self-made) instrumentation, right through to today's current best-practice, and provides an interesting, informative, and topical instruction on minimally invasive surgery and its increasingly encouraging results for spine-patient care.

Number of pages: **508**

Number of illustrations and images: **711**

Number of cases: **35**

ISBN: 978-3-13-172381-9 e-ISBN: 978-3-13-172441-0

Publication date: **December 2012**

Retail price: **EUR 139.99 / USD 159.99**

Available from <http://ebookstore.thieme.com> and www.thieme.com

Between them, Roger Härtl and Andreas Korge bring together many years and a broad range of state of art spine-care experience from the USA and Europe. While generously offering their own expertise to the reader, the editors are joined by 74 of the world's leading spine professionals, to provide an incredibly detailed and up to date description of minimally invasive spine surgery.

"This is a beautifully produced and comprehensive coverage of all techniques in minimally invasive spine surgery. I strongly recommend it to all current and up-and-coming spine surgeons."
John K Webb FRCS, Co-founder and first President of AOSPine

Michael Bemelman

THORAX

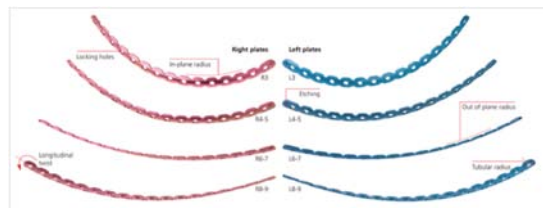


Fig 1
Matrix Rib Plating System. For more information please refer to AOTK Innovations Magazine issue 2009.

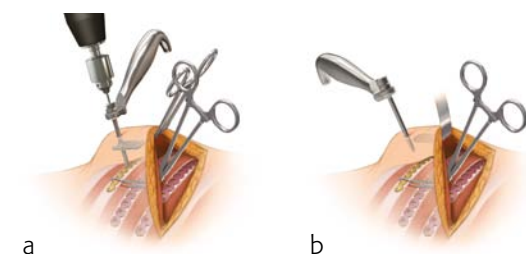


Fig 2a–b
a Minimally Invasive Plate Osteosynthesis with plate holding forceps, trocar with universal handle, and angled tissue retractor forceps.
b Upright forceps and trocar with universal handle.

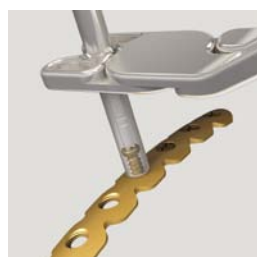


Fig 3
Angled tissue retractors clamped to the trocar cannula.

Matrix Rib

Although some rib fractures are treated with pain management and bracing, as well as endotracheal intubation and mechanical ventilation, if necessary, some patients could further benefit from surgical stabilization (osteosynthesis). The potential benefits of surgical stabilization of fractures include reduced duration of mechanical ventilation support, shortened ICU stays and hospitalization, better secretion management through efficient coughing, and minimized chest wall deformities resulting from trauma [1, 2].

Furthermore, studies have demonstrated increased morbidity in patients with rib fractures after blunt trauma, not only in elderly patients, but in those as young as 45-years-old presenting more than four rib fractures. These severe injuries increase the risk of adverse outcomes, including in-hospital mortality [3–5].

The Matrix Rib Fixation System (indicated for the fixation and stabilization of rib fractures, fusions, and osteotomies of normal and osteoporotic bone), was developed in 2009 under the guidance of cardiothoracic and plastic surgeons within the CMF branch of the AOTK System (see Fig 1). Now, the Thorax Surgery Working Group, also within the AOTK System, has continued the development of the system, which focuses on implants and instruments to provide a minimally invasive plate osteosynthesis solution for rib fixation.

Minimally Invasive Plate Osteosynthesis instrumentation has been developed to support less invasive approaches for rib fracture stabilization by extending their reach without the need to extend incision size in challenging access areas (eg, higher rib levels and subscapula fractures).

Specifically devised for this procedure, large Plate Holding Forceps (Fig 2a) aid to initially secure the plate to the fractured rib. An upright version of the forceps improves visibility while its ball tip design, centered in the plate screw hole, helps to hold the plate-rib construct in place.

A trocar with universal handle and its related instruments such as a cannula (Fig 2a and b) and a 2.2 mm threaded drill guide for Matrix Rib locking plates, are intended to be used in combination with the appropriate size drill bit with stop for a safe drilling when reaching the rib's second cortex. The drill guide can be threaded to the locking plate through the cannula to ensure a perpendicular entry and precision in terms of concentric drilling in the plate hole. This benefits later screw insertion, especially for the second and third screws, where there is no longer a margin for plate mobility to adjust centering. The angled tissue reduction forceps (Fig 2b) can be clamped to the trocar cannula (Fig 3), allowing soft tissue manipulation and improved visibility.

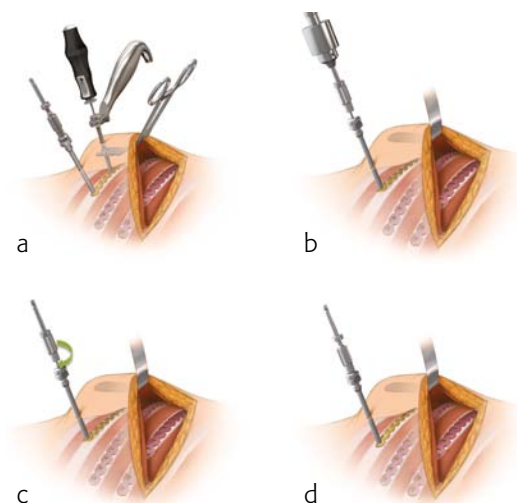


Fig 4a–d

- a Threaded Reduction Tool instrumentation.
 b Threaded Reduction Tool attached to a powertool.
 c–d Threaded Reduction Tool through drill guide tightening reduction nut for fracture reduction.

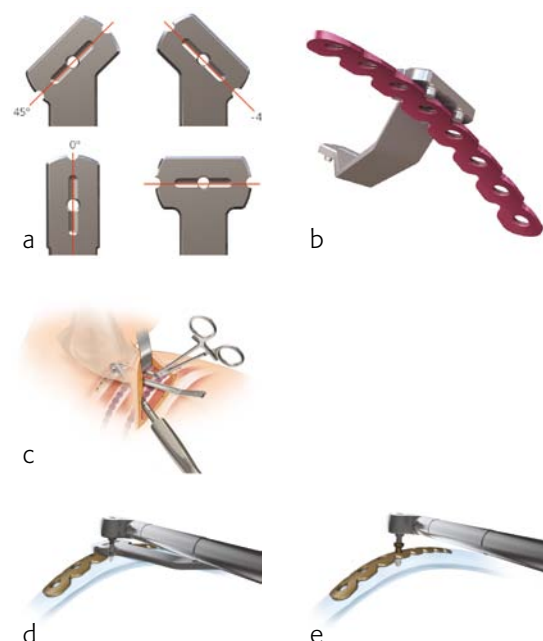


Fig 5a–e

- a Drill guide with flat head and multiple angle options.
 b Drill guide with flat head aligned to the plate.
 c Drill guide and 90° screwdriver.
 d–e The 90° screw screwdriver/drill.

Alternatively to reduction forceps, the new Threaded Reduction Tool (TRT) (Fig 4a) is a useful instrument to nicely reduce and hold the rib as well as distract fractures through a small incision. It can be attached to a power tool with AO coupling (Fig 4b). Introducing it through the trocar drill guide, which is itself threaded to the plate, it allows to engage the rib thanks to its self-drilling end with a maximum insertion stop of 15 mm (instructions reflected in the technique guide must be followed to limit the insertion to patient's rib thickness and to avoid injuries). Once the power tool has been removed, rib fracture reduction is achieved by tightening the TRT reduction nut (Fig 4c and d). Later, a 2.9 mm locking screw can be inserted in the same screw hole after TRT removal. A limitation for using this tool is the bone quality of the patient.

Drill guides with multiple angle options and flat head (Fig 5a) were designed to allow engaging and holding the desired plate hole (Fig 5b), as well as to perform a controlled drilling. Dedicated drill bits to be used with the 90° screw driver handle (Fig 5c) have limited drilling depth to ensure a safe drilling (Fig 5d). This concept used with the 90° screw driver blades with self-retainer features (Fig 5e) aids reaching inaccessible fractured areas, including the end holes of the rib plates, thanks to the notches at both ends of the guiding groove.

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NEWS FROM AOTK CMF



Daniel Buchbinder has already been heavily involved with the AO Foundation and AOCMF prior to his successful appointment as the new Chair of AOTK CMF.



Daniel and Robin Buchbinder

Innovation key to success says new AOTK CMF Chair

Daniel Buchbinder has become the new Chair of the AOTK CMF, officially taking over the role from respected former Chair Edward Ellis III. Daniel already has a strong association with the AO Foundation, dating back to 1985, with previous involvement as member of the education committee for AONA, Chairperson AONA CMF in 2004, AOCMF webmaster, AOCMF Surgery Reference General Editor, and more recently as Chair of the Mandible Expert Group (later FTREG) and member of the AOTK (CMF). Shortly after his term began, Daniel outlined his future goals as Chair.

“Firstly, I would like to recognize my predecessor’s accomplishments. Edward Ellis III is one of the brightest surgeons I have had the pleasure to work with. He proactively encouraged and challenged both the medical members and engineers of the AOTK (CMF) groups to come up with innovative solutions for the clinical problems we face in CMF surgery. He has always been very supportive, and readily made himself available to all members of AOTK at all times. He will definitely be a tough act to follow.”

“Regarding my main goals as Chairperson, I would like to first spend some time getting to know the members and projects of the various Expert Groups. We will of course have to prioritize the projects to match up with the development resources available but I strongly believe in innovation as a key to the success of any enterprise. I plan on formally re-instituting the brain storming sessions in each of the groups and will encourage all members of the AOCMF community to get involved and use the portal to encourage the submission of ideas for implants, instrumentation, and techniques. I would also like to see more cross specialty exchange of ideas, as the clinical problems we face in CMF surgery are really not all that different from those faced by our colleagues in the other clinical divisions.”

“One of the biggest challenges will of course be resource availability for the development of new implants and techniques. I strongly believe that everyone involved understands the importance of the work of the TK System and that without innovative new products, techniques, and education, one cannot maintain the status of industry leader. This is also important as the vision of the AO Foundation is excellence in the surgical management of trauma and disorders of the musculoskeletal system, and this is best achieved with innovative implants and surgical techniques.”



Edward Ellis III (right) is heartily thanked for his contributions as Chair of AOTK CMF by AO Foundation President Jaime Quintero (left) at this year's Trustees Meeting in Lima.

"I look forward to working with Maria Velasco and Claas Albers from the AOTK System, my fellow TK Chairs Tim Pohlemann (AOTrauma) and Robert McGuire (AOSpine), and the other members of the AOTK Executive Board. I will do what I can to follow the strong examples of my predecessors but look forward to drawing on my own skills and experiences to provide my own contribution wherever I can."

Experiences and highlights from former Chair Edward Ellis

Outgoing AOTK (CMF) Chair Edward Ellis said his eight years in the role gave him a world of unique experiences and highlights.

"Perhaps the most fulfilling aspect of my time with the TK System was building networks and friendships with the individuals with whom I have been able to serve. The AOTK (CMF) has experts from all over the world in oral and maxillofacial surgery, otolaryngology, plastic surgery, and ophthalmology, and in recent years we have even had the chance to include thoracic and neurosurgery. The contact I have had with individuals in non-CMF specialties such as orthopedics, spine, and veterinary have also made me appreciate the skill and knowledge of these individuals. Working with the producers to realize new products and techniques has also given me a great appreciation for the dedication, hard work, and resource commitment that is required of them for the entire AOTK System to function."

Sharing his vision for the future, Edward said he saw continued evolution, with working groups and (potentially) EGs that will continue to evolve as the need arises.

"There will be continued emphasis on cost savings in years to come but I believe that virtual meetings will become more prevalent, and new technology will lead to new possibilities in everything we do."

"Additionally, AOTK will become more involved with safety and efficacy issues as governmental oversight increases. This has the potential of slowing the process down a bit, but with the dedication of the individuals within the AOTK System (doctors and producers), I am confident that the business of safe and efficacious product development will continue."

Daniel Buchbinder, Carl Peter Cornelius, Max Heiland, Frank Wilde, Michael Yaremchuk

CMF

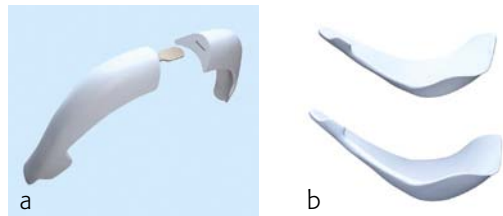


Fig 1a–b

- a Facial Shape System: chin implants, square shape with metal connector.
- b Malar implants, shell (above) and enhancer (below).

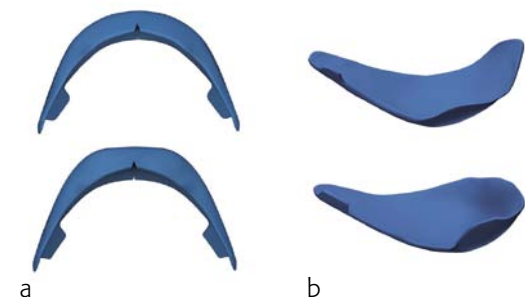


Fig 2a–b

Silicone sizers for implants.

- a Chin, round (above) and square (below).
- b Malar, shell (above) and enhancer (below).

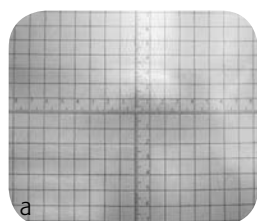


Fig 3a–b

- a Cutting board with measuring references.
- b Positioning instrument.

Facial Shape System

Facial implants, including malar, chin, and for other facial regions, are used to add or restore contour irregularities and/or proportion to the face, for aesthetic (enhancement) or reconstructive (correction of deficiencies) purposes. Traditionally, these implants were made of silicone with resulting overlying soft tissue deformities due to capsule formation around the implant. Hence, there was a need for another material, such as porous polyethylene, to address this clinical issue and improve surgical outcomes.

The new Facial Shape System (Fig 1) consists of flexible implants designed for augmenting the contours of the craniofacial skeleton. These implants are made of an inert, nonresorbable and biocompatible material (high density polyethylene). They are preshaped to restore several facial anatomical areas minimizing the need for intraoperative contouring. When necessary, the implants can easily be trimmed with a scalpel or high speed burr. A variety of sizes and shapes support different clinical needs. The semi flexible nature of the material allows the implant to conform to underlying bone during fixation, and its porous structure supports fibrovascular ingrowth for host incorporation rather than encapsulation.

The refined implant surface facilitates insertion. Registration tabs assist positioning in terms of verifying symmetry. Furthermore, by submerging them for several minutes in hot sterile saline (over 70 degrees C) manual contour is possible to obtain the desired form, which will be maintained after cooling. Since Facial Shape must be placed directly on the recipient bone, adequate subperiosteal exposure is important to allow visualization of anatomical landmarks and proper placement. Implants are provided sterile and are for single-patient use (nonresterilizable). It is important to prevent contamination through surgical clothing or powder from surgical gloves, and when using intraoral incisions, proper aseptic techniques are highly recommended.

In order to achieve successful implantation, careful preoperative planning should reflect the patient's desires, evaluate the skeletal dimensions, and analyze both the skeleton and the soft tissue envelope. Sizers made from silicone (Fig 2) were developed exclusively to help select the most appropriate implant. The sterilizable and reusable cutting board (Fig 3a) with measuring references aids when carving, measuring, and photographing the implants. A positioning instrument (Fig 3b) helps to introduce the implant and immobilize it during fixation. Titanium screws from the matrix midface set can be used for this purpose in the appropriate length: self-drilling in 6 mm and 8 mm, self-tapping in 10, 12 and 14 mm, and emergency self-tapping in 6, 8, 10, 12 and 14 mm as required. Screw fixation eliminates any gaps between the inner surface of the implant and the surface of the facial skeleton.

Porous polyethylene implants should not be used, either for load-bearing applications or as a structural support to bone, in cases where active or latent infection is present, in inadequate coverage of healthy vascularized tissue, or in systemic disorders with limited blood supply implications.

Anatomical Shapes

The implants are available in two anatomical shapes:

- Chin implants
- Malar implants.

Chin implants

Chin implants (Fig 1a) are used to increase the anterior projection of the chin. They may be used to treat isolated small chins (microgenia) or together with mandible angle implants to camouflage small lower jaws (micrognathia).

The adequacy of chin projection should take into account several variables including the patient's sex, the effect of occlusion on lower lip position, the thickness of the chin pad, and the depth of the labiomental fold. When these variables are not considered, implant augmentation may result in a chin that is unnatural and too large, particularly in women. Chin augmentation with certain shaped implants can create unnatural chin contour. Implants that augment only the chin point produce an abrupt, protruding chin rather than a jaw-chin continuum. Extended one piece implants do not always match the contour of the native mandible. Particularly when placed through small intraoral incisions, minimal inaccuracies in placement or asymmetries in the mid-aspect (chin point) of the native mandible may result in gross distortions and irregularities in the more lateral aspect of the chin.

A flexible titanium connector (Fig 1a) in between both polymer segments introduces a three-part assembly for better anatomical fit, allowing the implant to merge imperceptibly with the native deficient mandible. This solves some of the issues previously mentioned. Depending on patient's needs, there are two shapes for the chin: round and square, with different size options. Registration tabs have been developed as part of these implants to assist positioning.

Case provided by Michael Yaremchuk,
Massachusetts, USA

Case: Facial Shape system, chin implants, square shape



Fig 4a–b

- a Preoperative images.
- b Postoperative images.

Malar implants (Fig 1b)

The malar area is the most projecting part of the midface skeleton. It is what is commonly referred to as “cheekbone”. Prominent malar bones are considered attractive. Hence, the malar area is frequently augmented with implants. Certain implant designs do not mimic the contours of the midface skeleton and could result in an unnatural midface, which actually detracts from malar definition and projection. The lack of anthropometric and cephalometric landmarks precludes the availability of normative data making analysis and augmentation of the malar area largely subjective. Regularly, a deficiency in cheek prominence is part of a more generalized deficiency in the midface skeleton. For that reason, malar implants are often used in combination with other implants. Clinical experience has shown that when malar projection is deemed inadequate, malar augmentation is most effective when it recreates the contours of a normal skeleton with prominent anterior projection.

Malar implants of the Facial Shape System mimic and conform to the skeleton avoiding impingement of the infraorbital nerve. They are also designed with registration tabs to assist placement and symmetry. The medial tab lies on the lateral aspect of the infraorbital rim and the lateral tab on the superior edge of the zygomatic arch. In any case, when a different orientation is preferred, they can be removed with a scalpel or burr. To better accommodate the patient’s anatomy, there are two styles: shell and enhancer, each in different sizes.



Fig 1a–c

Typical examples of patient specific mandible plate designs (along fibular segments for bony reconstruction).

- a Continuity defect of the ramus angle: body – Hemimandibular Plate.
- b Anteroateral continuity defect: symphysis and body bilaterally – Mandibular Arch Plate from angle to angle.
- c Entire mandible defect apart from condylar processes – Full Mandible Arch Plate.

Patient Specific Plates for the Mandible

Mandibular defects can be the consequence of segmental resection of the mandible due to malign/benign tumors, maxillofacial trauma caused by ballistic or avulsion injuries, multifragmentation, and end stage osteoradionecrosis (ORN). Reconstruction of the mandible is indicated for functional restoration, psychological recovery, and social reintegration of patients suffering from such defect conditions. In large wide-spanning defects covering more than the extent of a hemimandible, it is a first-line goal to rebuild the bone continuity along the base of the mandible. In smaller defects, a so called “functional” reconstruction of the former dentoalveolar process is paramount so as to carry dental implants in the future. Whenever possible, in determining the suitability and length of a bone or bone-containing flap, both the supporting mandibular infrastructure as well as a neoridge should be reconstructed to recreate an ideal intermaxillary relationship with a matching bed to achieve a dental implant-based functional prosthodontic rehabilitation and optimal facial esthetics.

To meet with these criteria it is important to reproduce the curvilinear shape and vertical height of the native mandible. The workhorse bone flap for this purpose is the fibula flap, which is wedge-osteotomized and folded into the required form. So far, the geometric assembly of the fibular segments was essentially determined by the configuration of manually bent reconstruction plates. These plates served as the vehicle to align the bony elements intraoperatively. In other words, the bony reconstruction was constrained by the accuracy of plate contouring and the adaptability at its inner side.

Virtual surgical planning using preoperative CT DICOM datasets of the defective CMF region, and the donor region from where the bone flap will be harvested, provides a detailed outline of the bony framework (eg, an autogenous neomandibular section consisting of an array of fibular segments).

The innovative milled patient specific mandible reconstruction plates represent a paradigm shift in mandibular reconstruction, since these individualized plates complete the virtual work flow in computer assisted surgery. The optimal assembly of the bony segments is no longer compromised by manually bent plates causing secondary dislocation, since there is no leeway space in between the bone surfaces of the segments and the inner side of the plate.

With patient specific plates for mandibular reconstruction, the design of the bone flap now becomes the prevalent parameter because the plate is fabricated to exactly fit to the bony surfaces. This eventually means that the bony framework dictates the reconstruction, which allows for more conformity with the original anatomy, augmenting accuracy. To transfer the surgical plan into surgery, cutting guides and repositioning templates, both for resecting and contouring the bone

flap, are prefabricated with Selective Laser Sintering (SLS) from polyamide. Patient specific plates are conclusively brought into alignment with native mandible and the neomandibular segments by using drill guides integrated in the resection or cutting templates. By using the drill guides, the plate holes can be targeted exactly to the holes drilled into the bone without a temporary in situ application of the reconstruction plate.

The design of the bony segments and the overall framework is defined in an interactive planning session between the surgeon and a medical engineer. In oncologic surgery, a primary reconstruction is preceded by a virtual tumor resection for exact matching of the defect and the bony restoration. In secondary reconstruction, it will often be necessary to reposition collapsed bony remnants and to level their cut edges in order to define the real extent of the preexisting defect. Patient specific plates for the mandible have the versatility to bridge almost all defect patterns in the mandible (Fig 1). After exarticulation of a condyle, they are even compatible with the Matrix Mandible condylar head add-ons as a joint component for temporary replacement. The cutting guides, templates, and the patient specific mandibular reconstruction plates can be supplemented with stereolithographic (STL) models of the mandible, displaying the defect and the composed fibular segments as either a hybrid or as separate items. In the separate format, the models are an ideal instrument for double-checking. The defect size and the correct placement of the patient specific plates for the mandible are controlled by inserting the STL fibular segment assembly in situ. On a side table, the fitting of the real fibular segments into the defect of the STL model can be assessed.

Prior to planning, all clinical decisions are made by the surgeon in terms of resection lines, need for reduction of bony remnants, condylar processes, choice of bone or bone containing flap, dental rehabilitation, and plate profile to achieve adequate stability of the construct. One of the manifold options is to insert a stand-alone patient specific mandibular reconstruction plate, which is supplemented with matching bone grafts secondarily (eg, following postoperative radiotherapy).

Provided by Carl Peter Cornelius, Munich, Germany



Fig 2
Intraoral findings at patient's presentation: mixed ulcerous and leukoplakia-like tumor lesion (approximate size 3 cm x 6.5 cm) over the top of the right mandibular alveolar process extending from the premolar region back into the retromolar field. Biopsy: squamous cell carcinoma.

Case: Computer assisted mandibular reconstruction using fibula flap

A 58-year-old male patient had oral cancer (T4n0m0) infiltrating the alveolar process and the anterior border of the ascending ramus (Fig 2). The treatment plan involved resection, bilateral neck dissection (levels I to III), and primary mandibular reconstruction with a right osteomyofasciocutaneous fibula flap.

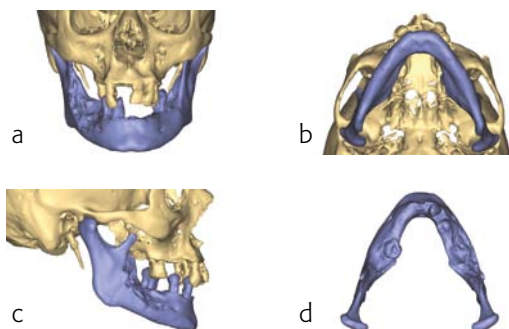


Fig 3a–d
A 3-D CT reformatted image: tumor infiltration and destruction of the upper border cortices of the right mandible.

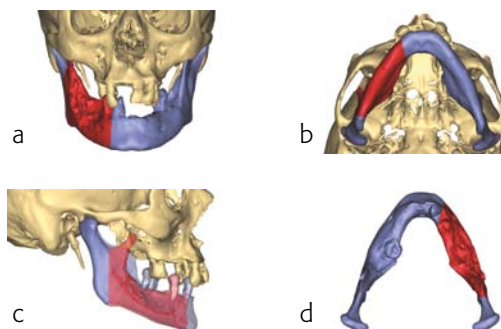


Fig 4a–d
Virtual surgical planning: removal of tumor infiltrated bone by segmental resection with vertical osteotomies in mid ramus and in immediate postcanine region.

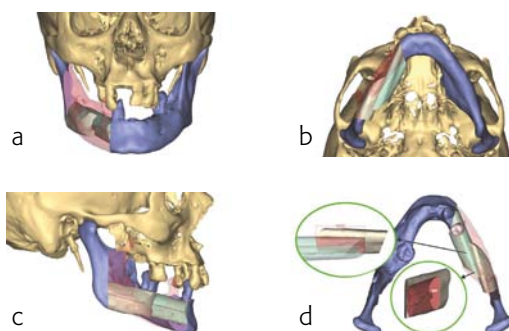


Fig 5a–d
Virtual mandibular reconstruction: rebuilding the mandible within the confines of the continuity defect using 2 fibular segments.

At this stage, future dental implant insertion requires an alveolar process in a lingual shift position. To this end, the anterior segment is aligned with a medial offset. The posterior segment, which replaces the angle/anterior ramus region, is arranged with an overlapping zone. The inner cortex of the posterior segment in the area of intersection is trimmed to keep the restoration within the bounds of the original width of the angle. This results in a sort of “bayonet connection”. The basal border of the mandibular body is not built up, since it is not functionally relevant.

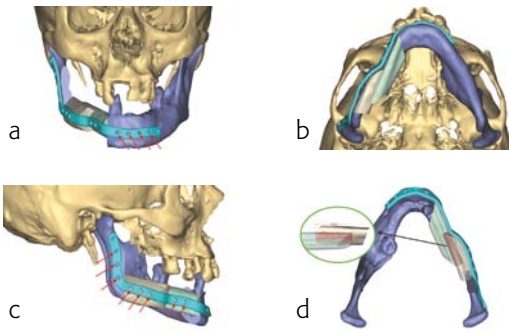


Fig 6a–d
Virtual application of the patient specific plate for mandibular reconstruction.

With the design of the bony framework being ready, the reconstruction plate is molded to the geometry of the outer surface of the neomandibular division. The plate profile (thickness 2.0 or 2.5 mm) is chosen and the plate screw hole pattern is customized. Relative to the osteotomy sites, the fibular segment configuration, and the adjacent native bone, the number, position, and angulation (up to 15°) of the plate screw holes is specified with respect to overall stability. A defined screw hole position facilitates accessibility for screw insertion and avoids interference with nerves, tooth roots, osteotomy interfaces, and existing/future implants.

Note: In contrast to a milled plate, a succinct set of abrupt bends or edges in a massive reconstruction plate is hardly bendable by hand. The screw length is preselected and screw convergence or tip collision (eg, in the symphyseal area) is precluded.

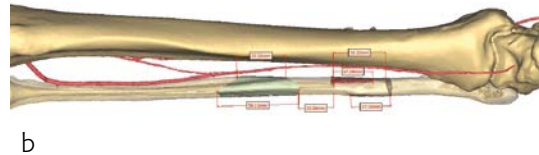
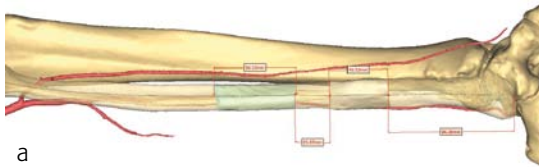


Fig 7a–b
Virtual 3-D reformatted bones of the right lower extremity. Lateral (a) and anterior (b) aspect with peroneal vessels, and transfer of the color-coded segments as used for the mandibular reconstruction.

To allow the soft tissue/vascular pedicled segments to shift into the “bayonet” assembly, a bone portion in between the segments has to be discarded. The inner cortex of the posterior segment needs appropriate trimming. The most distal cut along the fibula is placed about 5–6 cm above the ankle joint to preserve its stability.

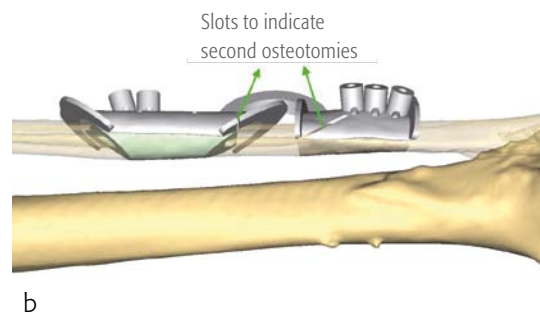
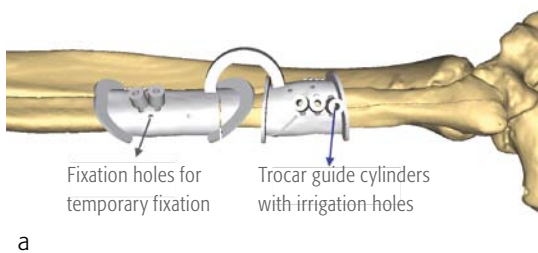


Fig 8a–b
Design of fibular cutting guides with slots and flanges to angulate the ends of the segments.
a Lateral view.
b Posterior view.

To target the screw holes for fixation of the milled patient specific mandible reconstruction plate, the guide is equipped with hollow cylinders for mounting of a trocar and predrilling. The cylinders have small openings at their base for cooling irrigation, when they are used after introducing the metal trocar drill guide. The templates are temporarily fixed to the fibula with monocortical 2.0 mm screws during the segmentation and drilling.

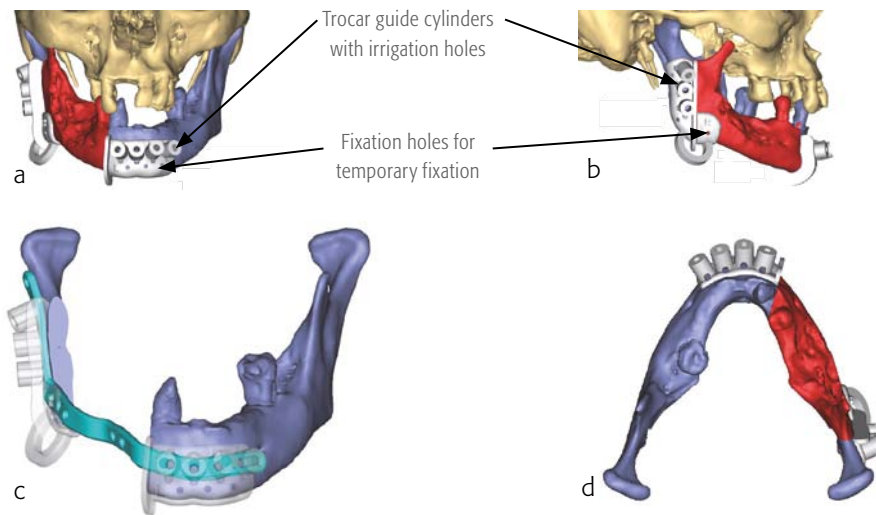


Fig 9a–d
Resection guides for the mandible with vertical flanges.

The flange for the posterior resection line conveys into a slot towards the inferior bony border. Just like the fibula cutting guides, the mandibular resection guides contain hollow cylinders for the mounting of the metal trocar drill guides, which exactly determine the patient specific plate screw hole position on the bony remnants. The transparent superimposition in Fig 9c reveals the interrelationship of the cylinders, the patient specific plate for mandibular reconstruction, and the underlying bony remnants.

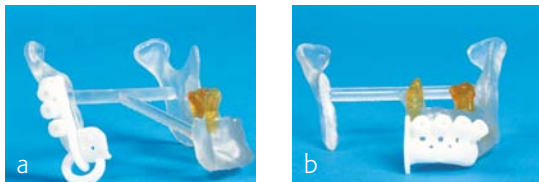


Fig 10a–d
SLS fabricated resection guides on the STL mandibular model with open defect.

Note: The images show the hollow cylindrical elements, the holes for irrigation/cooling, and the holes for screw fixation of the guides.



Fig 11
STL model of coupled fibular segments in "bayonet" assembly (left side being the posterior mandibular end obtained from foot end of fibula).



Fig 12
STL model of "bayonet" fibular segments inside the SLS fibula cutting guide for the anterior segment (right side of photograph corresponds to the anterior mandibular end as well as the knee end of fibula).



Fig 13
Patient specific plate for mandibular reconstruction with fibula graft. View from above. The plate was milled in a subtractive mode according to the given specifications.



Fig 14
Hemimandible patient specific plate applied to STL models of the mandible and coupled fibular segments.

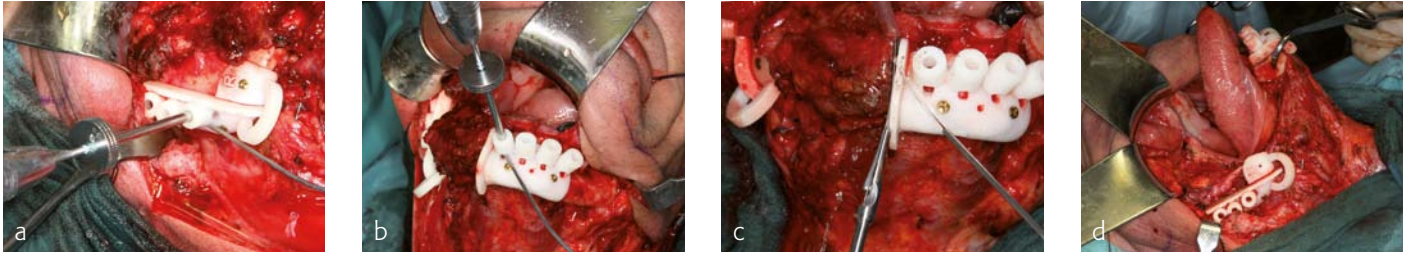


Fig 15a–d
Guided tumor resection intraoperatively.



Fig 16
Resulting continuity defect. The plate screw holes in the adjacent bony remnants can be recognized.

The bony surface of the mandible is covered with a tumor infiltrated soft envelope. The SLS resection guides are screw-fixed in place.

Prior to the resection with a reciprocating saw, the plate screw holes are predrilled using a metal drill guide, which is introduced into the cylinders of the SLS resection guides.

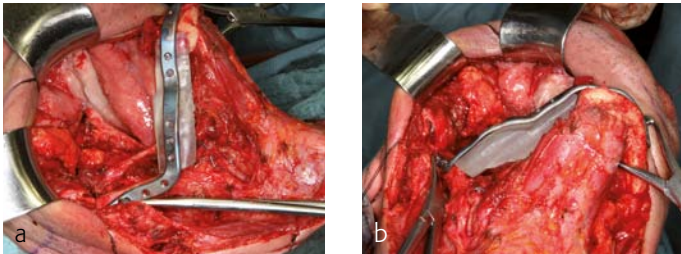


Fig 17a–b
Defect bridge with the patient specific plate for mandibular reconstruction, and filled with the STL model of the coupled fibular segments to control plate placement and defect extent/coverage.
a Lateral view.
b View from below.

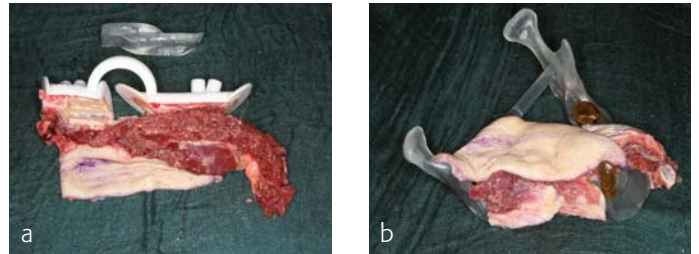


Fig 18a–b
Osteomyofasciocutaneous fibula flap on a side table.
a The bony rod is divided into 2 segments with the help of the SLS-cutting guide. The inner cortex of the posterior segment is removed for the “bayonet” style connection.
b The osteomyofasciocutaneous fibula flap fitted into the defect of the STL mandibular model for double-checking.

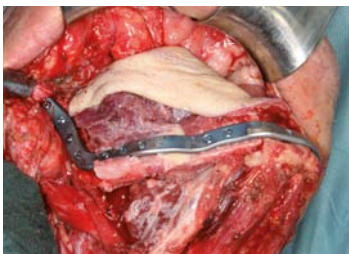


Fig 19
The osteomyofasciocutaneous fibula flap fitted into the real defect of the mandible, with screw fixation to the patient specific plate via the predrilled holes in the native mandible as well as the fibular neomandible.



Fig 20

Completed reconstruction. The peoral vessels are connected to superior thyroid artery and vein branches as recipient counterparts, while the skin island on top of the bone still waits for suturing.



Fig 21

Skin island after suture fixation from intraoral view.

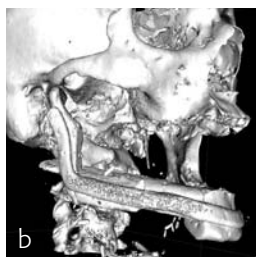
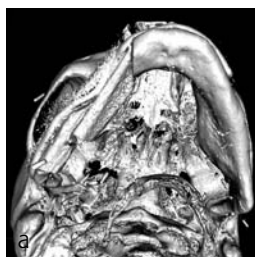


Fig 22a–e

Postoperative imaging: the 3-D reformatted CT scans and panoramic x-ray.

To conclude, it can be noted that the subtractive milling process for the manufacturing of patient specific plates for mandibular reconstruction eliminates the need for manual back and forth bending. This improves the fatigue strength and allows for a lower overall plate profile in comparison to standard reconstruction plates.

Patient specific plates for mandibular reconstruction present potential for time savings intraoperatively in exchange for time expenditure in the virtual planning and increased costs in production. Ideal plate fitting is dependent on preoperative planning accuracy, hence there is a need for time and thorough dedication at the initial planning stage.

A key advantage of patient specific plates for the mandible is the transfer of the bone work design into surgery without any compromise by insufficiently adapted plates that could lead to unwanted displacement, and in the extreme, to healing problems. A decisive requirement is to establish a complete digital workflow for the design and production of all necessary tools and models, to finally obtain an optimally fitting bony reconstruction stabilized by a patient specific plate.

Stephen Lewis, Christian Matula

NEURO



NEWG founding members Geoffrey Manley (left) and Christian Matula at their first AO meeting, still slightly suspicious of what is ahead of them.



Stephen Lewis (center) tries a prototype of the flap fixation application device – the first project of the group.



(From left to right): Edward Ellis III, Stephen Lewis, Christian Matula, and Aurelia Peraud assess the Anspach high speed drill in a lab session.

History of Neurosurgery in the AOTK System

This year, the AO will present a series of courses not only specifically designed for neurosurgeons, but, for the first time, run under the banner of AONEURO. This adds an exciting new leg to the existing clinical areas that have traditionally formed the AO Foundation. But what seems to be a surprisingly new strategic development to many is actually something based on a solid history of activities that were started some years ago.

As a matter of fact, the AOTK System had previously started to evaluate implants for the closure of cranial flaps following craniectomies in the 1990s. Furthermore, a number of leading neurosurgeons had been making substantial contributions to the activities of AOSpine from that clinical division's earliest beginnings.

The restructuring of the AOTK System into three pillars, of which CMF was one, then provided the ground for further exploration in this area. In 2006, the AOTK (CMF) decided to found a dedicated working group that consisted of neurosurgical specialists only. The Neuro Working Group's (NEWG) members (Christian Matula from Vienna, Austria; Geoffrey Manley from San Francisco, USA; and Stephen Lewis from Gainesville, USA) immediately committed to the AO Foundation and its philosophies regarding surgeon-guided technology development with industrial partners.

The NEWG's first projects focused on the improvement of existing flap tubes for cranial clamps, especially the development of an improved application device. Their specific clinical experiences helped to fully comprehend the required workflow for this technique and helped to come up with an instrument that merged the three application steps (precrimping, tensioning to a secure fit, and cutting off the tube) into one single motion.

The development of the MatrixNeuro system marked a major step forward, as it comprised a complete set of plates and instrumentation where the development was guided by neurosurgeons only, and in which the bone management, in accordance with AO principles and philosophy, marked the integral characteristic. Embedded in the Matrix system platform for craniomaxillofacial surgery, the key feature of the system was that all plates could be used with just one screw diameter. Furthermore, the plate profile, a feature that is also of significant interest to the patient, was significantly reduced when compared with the systems that existed at the time.



Christian Matula (left) and Stephen Lewis demonstrate the new MatrixNeuro Rigid Mesh at a "Meet the Experts" hands on session during the Davos courses in 2012.



The NTREG's newest member Rocco Armonda during the Davos courses 2012.

Over time, the group was enhanced with additional expert surgeons, and consequently spread its activities and scope, especially with a new focus on powertools, such as the piezoelectric, electric, and pneumatic drill and cutting tools.

At the same time, the members of the group were engaged in the development of neuro course programs that transported the AO philosophy, and which were based on AO teaching principles.

Aurelia Peraud, who joined the NEWG as a member in early 2011, soon became the chair of the first European core group to develop a dedicated course curriculum on surgical treatment of cranial neuro-trauma under the umbrella of AOCMF. Building on the foundation of the first official AO neurotrauma course, which was held at the Davos courses in December 2010, this group established a broad teaching program for the treatment of traumatic brain injuries (TBI) with special focus on the management of the often complex challenges of bone fixation. With the support of AOCMF, they have since held numerous courses in Europe, North America, Asia, and Latin America.

Along with the broader scope of the AO's activities in neurosurgery came the need to integrate technologies that go beyond bone fixation, but could become every day tools in a neurosurgeon's practice, such as dural closure and repair materials, and other devices that measure and control the intracranial pressure (ICP) on site.

Reflecting its larger scope and importance in the AO, the NEWG was promoted to the status of an AOTK Expert Group, and Christian Matula was elected as the first Chair of the new AO Neuro Trauma and Reconstruction Expert Group (NTREG) in December 2012. The merger of the AO's longstanding industrial partner Synthes with the companies of the DePuy group presented the opportunity to establish a relationship with Codman, a company that offers a wide portfolio of neurosurgical technology, and who had already been on good terms with the individual members of the NTREG.

After a careful selection and review process conducted by NTREG, a number of Codman products received AOTK approval in the summer of 2013, making it only the fifth company in the history of the AO Foundation to get this coveted certification for its technology.

The AONEURO initiative is currently planned to continue until 2014. Given the dedication of the individuals that have been involved, and their commitment to the philosophy of the AO and its mission, it is an area already built on solid ground.



Fig 1
MatrixNeuro Rigid Mesh.

MatrixNeuro Rigid Mesh and Bender

Flat titanium mesh has long been a preferred method of choice for many surgeons for the reconstruction of large cranial defects in cases that required an appropriate balance between contourability and profile on one hand, and reliable rigidity on the other. The larger the defect area, the more important is rigidity.

The new MatrixNeuro Rigid Mesh (Fig 1) offers twice the rigidity of the established MatrixNeuro mesh system without increasing the thickness (0.6 mm). It can be used with the existing MatrixNeuro Self-drilling Screws, making the combination a rigid construct for a variety of cranial defects in procedures such as reconstruction, fracture repair, craniotomies, and osteotomies.

This extra rigidity was achieved by changing the design of the mesh to a new hourglass pattern with wider bar sections (Fig 2). Its low profile minimizes screw palpability and addresses patients' requirements regarding aesthetics. It is available in the following sizes:

- 100 x 100 mm
- 150 x 150 mm
- 200 x 200 mm
- ø70 mm
- ø100 mm

In addition to the mesh, two new corresponding instruments have been developed. The new reconstruction Mesh Bender allows for the creation of a smooth, gentle contour of the mesh with one hand, and there is also the corresponding new Mesh Cutter (Fig 3, Fig 4).

A contraindication exists in areas with active or latent infection or insufficient quantity or quality of bone.



Fig 2
Hourglass shaped pattern, with increased gaps
between the bars

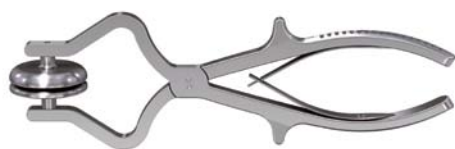


Fig 3a
Mesh Bender.



Fig 3b
Mesh Cutter.

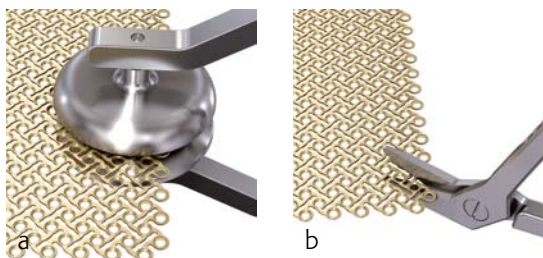


Fig 4a–b
Mesh Bender and Cutter for easy and precise
adaptation of flat mesh to the patient's anatomy.



Fig 1
MatrixNeuro ULP implants.

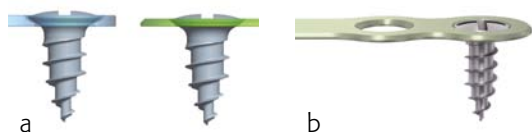


Fig 2a–b
Screw recess modified for more plate-screw contact (better seating) and lower profile.

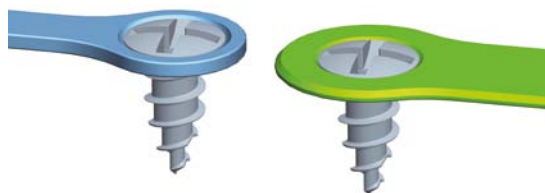


Fig 3
Chamfered edges on the ULP implants (green).

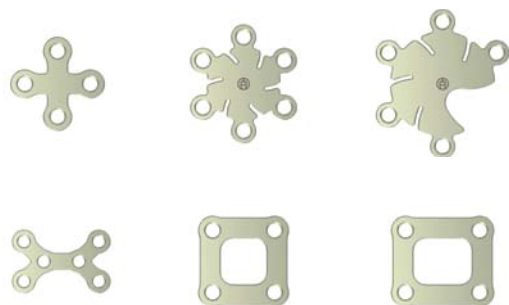


Fig 4
Selection of implant shapes.

MatrixNeuro Ultra Low Profile (ULP)

The MatrixNeuro system was developed in 2008 to offer a complete system for use in craniotomies, cranial trauma repair, and reconstruction of the craniofacial skeleton. Although it provided the lowest plate/screw profile in implants of its kind at that time, patients continued to require even less profile. Many patients find that plates can still be felt or visible as lumps under their skin. This is increasingly important, as there are a large number of procedures that include the frontal area, which, according to Prof Christian Matula, Chair of the Neuro Trauma Reconstruction Expert Group (NTREG) “is an area that the patient looks at every day in the mirror and can make them feel unhappy”. Additionally, the unconscious rubbing of plates can lead to other skin issues.

The new MatrixNeuro Ultra Low Profile (ULP) system (Fig 1) decreases the plate-screw profile even further while providing comparable construct stiffness and strength to the plates in the existing MatrixNeuro system. The plate thickness is only 0.28 mm (MatrixNeuro standard plates are 0.40 mm). Also, the screw recess was improved to achieve a better seating of the screw, which has led to a plate-screw profile of 0.44 mm, a reduction of another 10% compared with the existing system. And instead of having a rectangular edge, the plates are chamfered to achieve almost no palpability under the skin.

A wide range of plates is available based on the most frequently used MatrixNeuro standard plates, ie, Burr Hole Covers ranging from 12–24 mm with one additional version for shunt or drainage, as well as straight plates with center space in 2-hole and 4-hole versions. The system is completed with an X Plate, a square and a rectangular Frame Plate, a Double Y Plate, and a Strut Plate.

The new MatrixNeuro ULP system is fully compatible with the existing MatrixNeuro system so that no new or specific instruments are needed, and the same surgical techniques are used. Furthermore, all implants are fixated with the already existing self-drilling screws from the MatrixNeuro system, which have a unique thread design for rapid screw starting and significantly lower insertion torque. The screws start with bone contact almost instantaneously providing a fast closure of bone flaps and rapid fixation of cranial fractures.

Case provided by Richard Hopper, Seattle, USA.

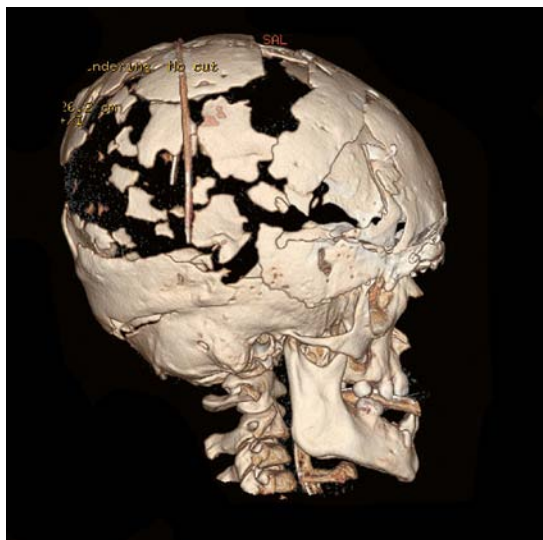


Fig 5

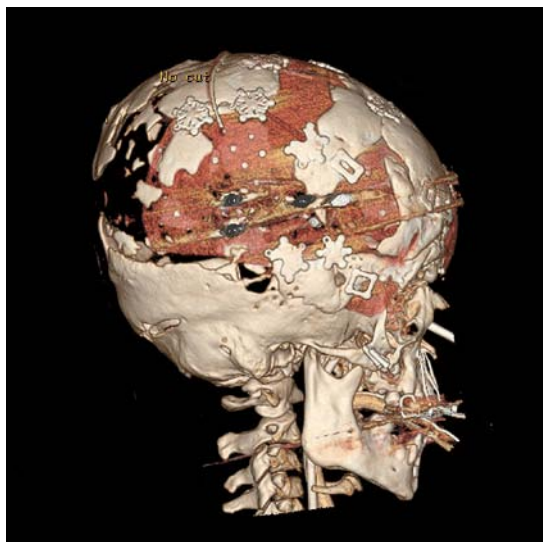


Fig 6



Fig 7

Case: Apert Syndrome

An 8-year-old girl with Apert Syndrome (Fig 5) was examined after being treated at another institution. The cause for loss of cranial bone was unknown. An anterior and posterior cranial expansion was given to treat the increased intracranial pressure.

After that healed, a simultaneous PSI cranioplasty and Le fort II osteotomy with zygoma repositioning were performed. The PEEK implants were fixated using MatrixNeuro ULP implants (Fig 6). A midface distraction device was then mounted on the PSI implants and distracted the Lefort 2 segment to treat the patient's sleep apnea (Fig 7).

Lorin Benneker, Frank Kandziora

SPINE



Fig 1
Synflate system: main surgical procedure phases.

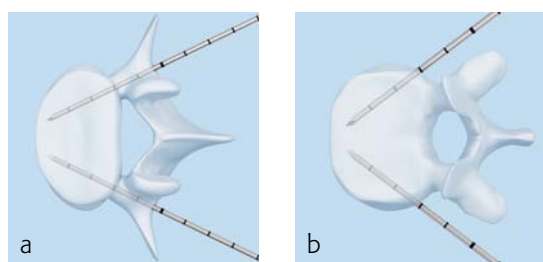


Fig 2a–b
a Transpedicular insertion.
b Extrapedicular insertion.



Fig 3
Synflate Vertebral Balloon Catheter.



Fig 4
Inflation system.

Synflate Vertebral Balloon System

Synflate is a vertebral augmentation system for the reduction of fractures and/or creation of voids in cancellous bone. It provides pain reduction in vertebral compression fractures originating from osteoporosis, trauma, and osteolytic lesions.

Some of the vertebral augmentation techniques currently available include:

- Vertebroplasty (eg, cement injection of Vertecem V+ or Confidence Spinal Cement System for pain treatment)
- Stentoplasty (Vertebral Body Stent (VBS) for pain treatment, cavity creation, and stent-supported height restoration)
- Kyphoplasty
- Lordoplasty

Synflate can be used stand-alone or in combination with posterior instrumentation (see the clinical cases within this article).

The Synflate system (Fig 1) allows accessing the vertebral body percutaneously with a 10 gauge needle and offers 3 standard sizes of balloons (small/medium/large = 10/15/20 mm). Access options include trocar (diamond and beveled) or wire guide access over cannulated trocar.

Both guide wire and trocar can be inserted through either a transpedicular (Fig 2a) or extrapedicular (Fig 2b) approach. The trocar allows access in a single step while the wire guide is first used to create a path for the access instruments.

The Synflate Vertebral Balloon Catheter is designed on a double lumen principle. This includes the inner lumen with the stiffening wire (Fig 3, ①) and the outer lumen (Fig 3, ②) which delivers the inflation medium to the balloon. Both lumens are independent, and therefore it is the surgeon's choice to remove the stiffening wire during inflation.

The inflation system has an angled manometer that shows the pressure ① in the balloon in pounds/inch² (psi) and bar. The volume scale ② on the fluid chamber displays milliliters (ml) (Fig 4). It is necessary to prepare one inflation system per balloon and to fill it with a mixture of saline solution and liquid contrast medium.



Fig 5
Balloon inflation.



Fig 6a
Bone Filler injection.



Fig 6b
Three stage bone segment injection.

The optimized balloon stiffness allows for well controlled inflation and optimized lifting efficacy, reducing the risk of the balloon following the path of least resistance. Moreover, 2 radiopaque markers help in the x-ray visualization of the balloon to facilitate accurate placement (Fig 5).

The controlled inflation of the balloons allows you to reduce the fracture and create a cavity in the cancellous bone. This containment can subsequently be filled using a legally-marketed bone filler adequately indicated for kyphoplasty and/or vertebroplasty procedures, to stabilize fractures in the vertebral body, prevent further collapse of the vertebra, and to reduce pain (Fig 6). The direction of the bone filler flow can be changed by orienteering the handle of the injection needle with the side opening.

The main contraindications for Synflate are:

- Stand-alone use with neurological deficits
- Stand-alone use with instability of posterior wall and/or pedicles
- Lesions requiring open anterior column reconstruction
- If vertebral dimensions or fracture pattern do not allow safe placement and inflation of the balloon
- Acute and chronic systemic or localized spinal infections
- Known allergies to contrast media.

Case provided by Lorin Benneker, Bern, Switzerland

Case 1: Steroid induced osteoporosis

A 78-year-old woman was affected by steroid induced osteoporosis. She had persisting pain (mechanic and muscular) due to static imbalance (hyperkyphosis) and nonunion 8 months after a minor trauma with a vertebral compression fracture and vertebra plana of L1, and development of symptomatic stenosis of the spinal canal with loss of mobility over time. Pre-existing degenerative lumbar scoliosis was increased by the fracture.

Preoperative



Fig 7
Standing preoperative lateral x-ray, kyphotic deformity of 34°.



Fig 8
Standing preoperative AP x-ray, scoliotic deformity of 25° (T12-L4).



Fig 9
The MRI shows severe spinal canal stenosis at conus level and non-union of the fracture (fluid within the cleft).



Fig 10
The CT shows partial realignment in supine position.

Intraoperative

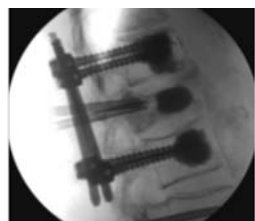


Fig 11
Intraoperative lateral fluoroscopy: reduction of the fracture by simultaneous application of balloon dilatation and the use of percutaneous, mono-axial dorsal instrumentation (after minimal invasive decompression at T12-L1).



Fig 12
Intraoperative AP fluoroscopy after filling of the defect with PMMA (Vertecem+).



Fig 13
Intraoperative lateral fluoroscopy after filling of the defect, with augmentation of the screws and prophylactic vertebroplasty of adjacent levels with PMMA (Vertecem+).



Fig 14
Postoperative standing lateral x-ray, correction of kyphotic deformity from 34° to 8°.



Fig 15
Postoperative standing AP x-ray, correction of scoliotic deformity from 25° to 19°.

Case provided by Lorin Benneker, Bern, Switzerland

Case 2: Advanced osteoporosis

A 76-year-old man was affected by advanced osteoporosis (SD -2.5) (alcohol, steroids).

Preoperative



Fig 16
Nontraumatic VCFx
of L1 with progressive
collapse and pain.

Intraoperative

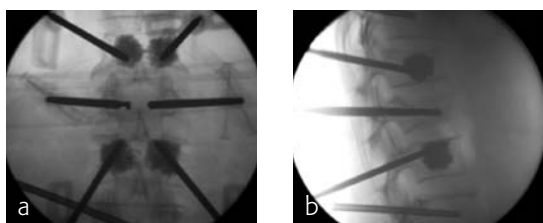


Fig 17a–b
Prophylactic augmentation of adjacent vertebrae
with PMMA. Preparation for balloon placement.

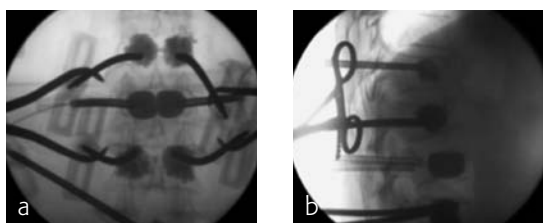


Fig 18a–b
Reduction by inflation of Synflate and lordoplasty.

Postoperative

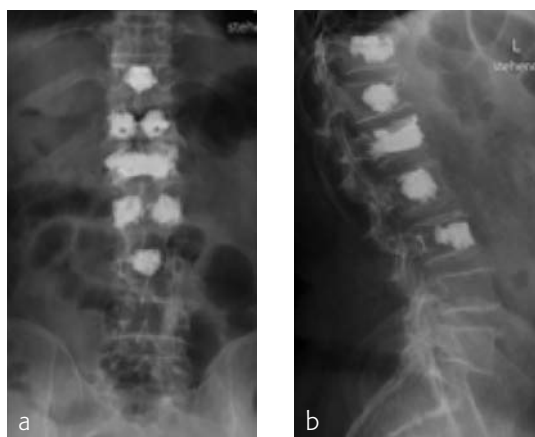


Fig 19a–b
Postoperative standing x-rays.

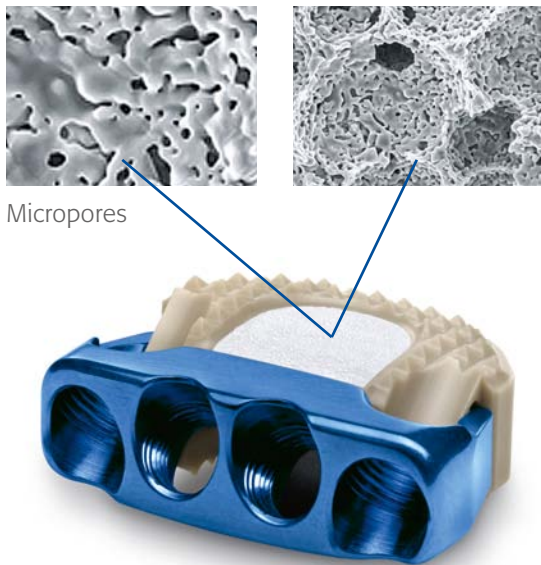


Fig 1
ZERO-P ChronOS provides strong osteoconductive and osteopromotive benefits.

ZERO-P ChronOS

Stability is a clear prerequisite for an implant to guarantee optimal healing results. Current state-of-the-art solutions for anterior cervical discectomy and fusion (ACDF) include existing nonfilled zero-profile devices, such as ZERO-P and ZERO-P VA, but also include cervical cages with anterior cervical plate fixation.

So far, biomechanical testing has already shown the stability of ZERO-P to be similar to that of traditional cage and plate constructs [1]. Further, clinical studies have demonstrated that ZERO-P implants filled with standard ChronOS cylinders for ACDF show excellent fusion results [2].

Now, the ZERO-P ChronOS is available. ZERO-P ChronOS (Fig 1) is prefilled with a bioresorbable synthetic beta-tricalcium phosphate cancellous bone substitute (ChronOS). ChronOS is osteoconductive and osteopromotive when perfused with bone marrow.

ZERO-P ChronOS is based on the ZERO-P surgical technique and no additional instruments are needed.

The indications for ZERO-P ChronOS are identical for those for the existing ZERO-P implant:

- Degenerative disc diseases
- Spinal stenosis
- Pseudoarthrosis.

In addition, ZERO-P ChronOS provides the following helpful features:

- Reduced OR time
- Less donor site morbidity
- Increased safety
- Enhanced fusion.

With no extra filling step required, there is reduced OR time as implants can be directly used after unpacking (to ensure rapid onset of fusion of the prefilled ZERO-P and subsequent remodeling of the ChronOS insert). The implant must be augmented with autologous blood or bone marrow aspirate. Soaking in blood should be done for at least 15 seconds to ensure sufficient perfusion of the ChronOS insert (Fig 2).



Fig 2
Presoaking in blood.

There is less donor site morbidity as there is no need for secondary surgery to remove autologous bone.

There is increased safety as the device is 100% synthetic, with no risk of cross infection. The synthetic bioresorbable material converts to vital bone within 6–18 months and is an alternative to allograft.

Finally, the device provides enhanced fusion for patients with expected or already experienced difficulties in fusion due to its osteoconductive features (macropores facilitate bone ingrowth, interconnected micropores allow an optimum supply of nutrients) and osteopromotive features (saturation with the patient's own blood or bone marrow during surgery supports bone integration and ensures rapid ongrowth to the implant) (Fig 1).

For optimal adoption to the patient anatomy, ZERO-P ChronOS is available in two sagittal spacer shapes (convex, lordotic), one standard footprint size, and multiple height options (5–12 mm in 1 mm increments).

References

- 1 **Scholz M, Reyes PM, Schleicher P, et al.** A new standalone cervical anterior interbody fusion device: biomechanical comparison with established anterior cervical fixation devices: *Spine* 34, 2009: 156–160.
- 2 **Scholz M, Schnake KJ, Pingel A, et al.** A New Zero-profile Implant for Stand-alone Anterior Cervical Interbody Fusion. *Clin Orthop Relat Res.* 2011 March; 469(3):666–673.

Case provided by Frank Kandziora, Frankfurt am Main, Germany

Case: Cervical radiculo-myelopathy

A 51-year-old woman was affected by cervical radiculo-myelopathy due to spinal and neuroforaminal stenosis. The preoperative CT scans are shown at Fig 4 and MRI at Fig 5.

The patient was treated by anterior cervical decompression and fusion (ACDF) with ZERO-P filled with ChronOS. No autologous bone graft was used. Post-operative images are shown (Fig 6–9).



Fig 4a–e

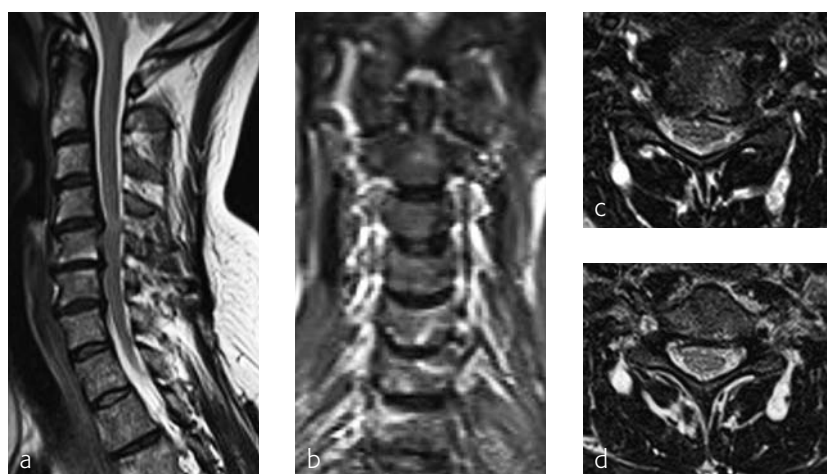


Fig 5a–d

Postoperative x-rays at 3 months.

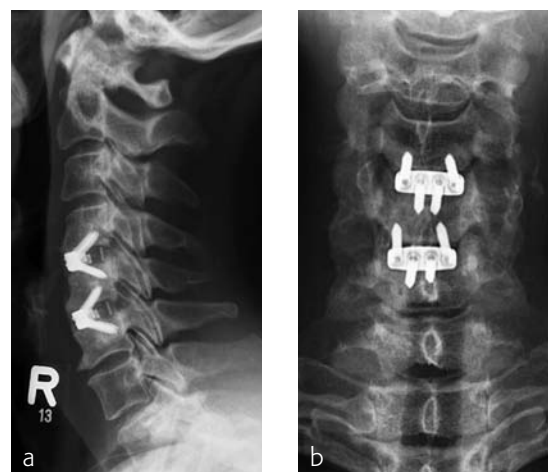


Fig 6a–b

Postoperative x-rays at 6 months.

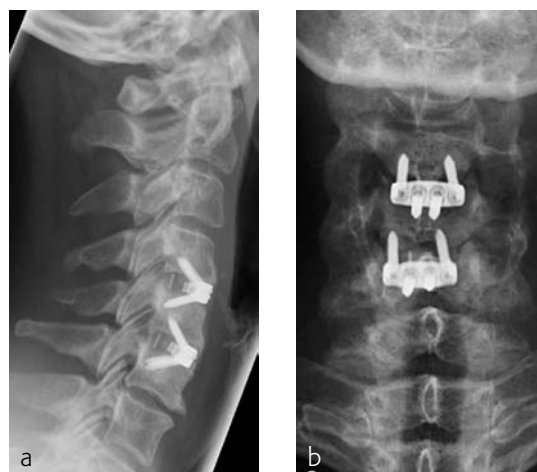


Fig 7a–b

Postoperative x-rays at 12 months.

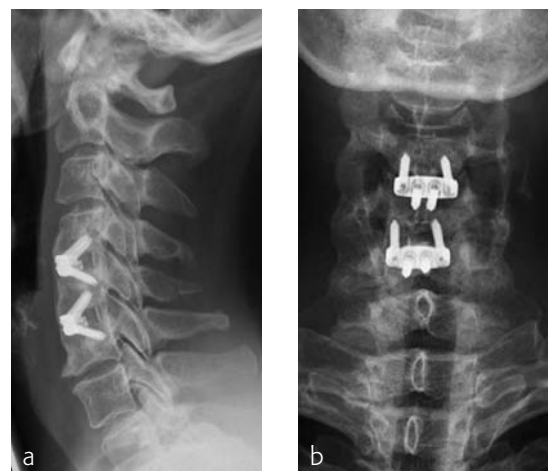


Fig 8a–b

Postoperative CT at 12 months.

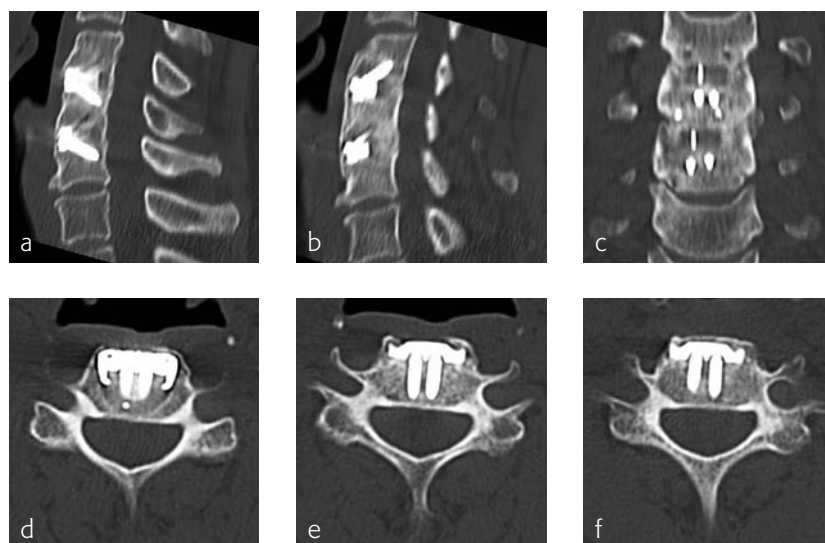


Fig 9a–f

NEWS FROM AOSPINE



From competitor to colleague: The evolution of partnership between neurosurgeons and orthopedic spine surgeons

Today, growing numbers of both neurosurgeons and orthopedic surgeons choose to specialize in spine surgery and are increasingly being referred to—and refer to each other as—“spine surgeons.” One day there may even be a well-defined medical specialty of “spine specialists” comprised of members of both specialties and defined by its own board certification, but this is not yet the reality.

Trained in spine

Neurosurgeons trained in the US gain experience in the diagnosis, nonsurgical and surgical treatment of spinal disorders in a six-or-seven year residency training program, during which time they will have assisted in hundreds of spinal procedures. To gain more advanced training, they may choose to do a post-graduate fellowship in spine surgery.

Orthopedic surgeons in training are also exposed to spine surgery during their four-or-five year residency program. If the resident attends an institution where there are orthopedic surgeons specializing in spine surgery, then he or she, may be exposed to a quantity of spine surgeries similar to that of a neurosurgery program. Orthopedic surgeons wanting to obtain further training may pursue a post-graduate fellowship in spine surgery.

Continued learning

A post-graduate fellowship will involve more specialized training in advanced spinal surgery techniques including spinal fusion, minimally invasive techniques, and complex spinal reconstruction. Both neurosurgeons and orthopedic surgeons that specialize in spine surgery are capable of dealing with many of the same procedures including disc herniations, disc degenerations, spinal stenosis, spine fractures, spondylolisthesis, bone tumors of the spine, and so on.

Only neurosurgeons, however, receive training during their residency to undertake procedures on the dura, meaning that certain conditions still fall under their exclusive domain, including: spinal cord tumors, arachnoid cysts, and spina bifida, to name but a few. Similarly, both pediatric and adult scoliosis and other spinal deformities are still treated primarily by orthopedic spine surgeons. Currently in the United States, neurosurgeons are certified by the American Board of Neurological Surgery, and orthopedic surgeons by the American Board of Orthopedic Surgery. There is currently no spine certification process that is recognized by the parent board, the American Board of Medical Specialties.

Common ground found

The Cleveland Clinic in Cleveland, Ohio, has one of the most respected spinal health programs in the United States due to its success in joining neurosurgeons and orthopedic spine surgeons with other spine specialists to work together on patient care and research.

Edward Benzel, MD, chairman of its Department of Neurosurgery and Medial Co-director of the Cleveland Clinic Spine Research Laboratory, remembers a time some thirty years ago when conflict between neuro- and orthopedic spine surgeons was “rampant and omnipresent” and attributes its start to the moment when neurosurgeons began performing spine instrumentation procedures, once the exclusive domain of orthopedic spine surgeons.

Over the years, the battles diminished as both sides realized they shared common ground. A fellowship developed, one that Benzel recalls existed for many years at the Cleveland Clinic and that eventually coalesced there in the late 1990s into a “formative structure” based on collegiality and cooperativeness.

In an article in Becker’s Spine Review, Benzel explains that the basis for the Clinic’s ongoing success was the establishment, over a five-year period, of one department to sit between the orthopedic surgery and neurosurgery departments.

This department, now called the Center for Spine Health, shared revenue between the two departments on a 50/50 basis and it established a separate research laboratory, employed a separate administrator, and kept a separate pocketbook. All of these steps, he says, “helped to unite as one.” “The key to our success gets back to...great partnerships. The administrative key is having the same pocketbook. We aren’t in competition with each other because of our fundamental training (orthopedic surgeon versus neurosurgeon). What matters is simply the provision of quality care. That’s the bottom line,” Benzel says.

Collaboration improves research

According to Adam Bartsch, PhD, director of the Cleveland Clinic’s Spine Research Laboratory, collaboration between the Clinic’s neurosurgeons and orthopedic spine surgeons makes a researcher’s life easy.

“Generally speaking, orthopedic spine surgeons have interaction with sports health providers and the neurosurgeons work more with neurologists and radiologists. We really want to do almost any project related to the head, neck or spine—and we have a team that is posed to ‘pull it off’ every time. “From the research side,” Bartsch continues, “the structure of the collaboration is great for fundraising and fund seeking because of the broader net we can cast.”

Edward Benzel believes having neurosurgeons and orthopedic surgeons work together brings unique skills sets and backgrounds to the middle. Although the creation of a separate residency training program for spine surgery has been suggested, he says that what is unique about the Clinic's training program is that both specialties have a chance to work hand-in-hand with surgeons from the other specialty. According to him, the close collegial and financial relationship allows the Clinic to provide better care and do better research.

Benzel believes the program in place at the Clinic will become more commonplace in US hospitals. "As physicians learn to deal with the political and economic barriers they face in individual practices or in their institutions, they will gravitate toward a more collaborative care model."

Best of both worlds

The 20-year partnership of Jack Stern, MD, PhD, and Seth Neubardt, MD, who together perform more than 200 spine surgeries a year at a private hospital in White Plains, New York, offers an example of how two specialists with distinct yet overlapping backgrounds can share a medical practice that works to optimize their patients' clinical experience.

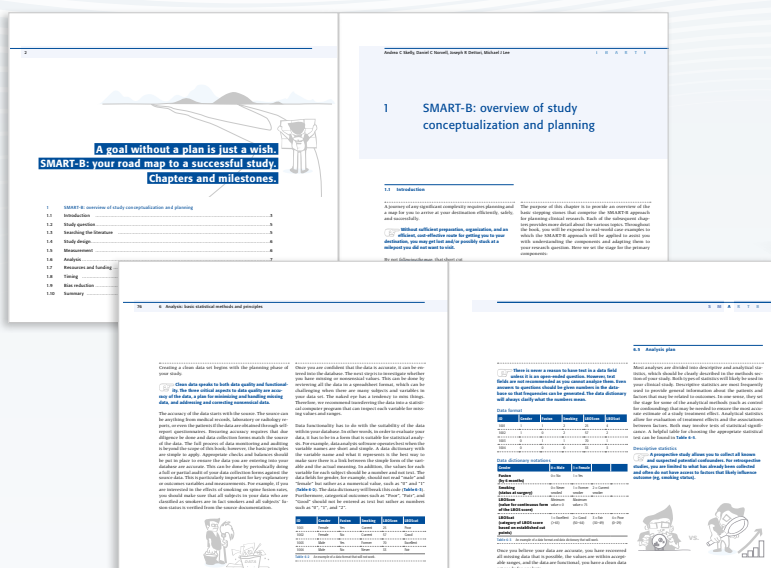
Seth Neubardt, an orthopedic spine surgeon with a combined orthopedic-neurological spine fellowship in spine surgery describes their partnership as follows: "Orthopedic surgeons typically specialize more with fusion surgery and implants...[whereas] neurosurgeons have been more involved with the nerves and tumors of the nerves, so we each come with a little bit of different experience." By having a neuro- and orthopedic spine surgeon work together, he believes patients "have the best of both worlds."

His colleague, Jack Stern, a neurosurgeon specializing in surgery of the spine, seconds that opinion. "We complement each other in a really interesting way. It's great assurance [for patients] when you've got two very well experienced surgeons working together, with four hands working as two.

"That equation means that our patients do better, there's greater safety, and much more experience in the operating room." Stern believes their partnership exhibits, "a paradigm that is now being emulated in many places in the United States."

It's representative of what some physicians are calling a "terrific, productive collegiality [that is] developing between orthopedic surgeons and neurosurgeons that wish to devote their careers to the advancement of spine care." Former competitors now "look at each other as colleagues with the same interests." The result of this friendship and professional association, they conclude, "will be of great benefit to patients."

SMART Approach to Spine Clinical Research



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The SMART Approach to Spine Clinical Research is a must-have guide for spine care professionals seeking to make a meaningful contribution to the scientific literature and advance their careers by publishing high-quality clinical research.

Planning, conducting, and publishing the results of your clinical research can be a long and arduous journey. This book presents and explains the many interrelated components essential to spine clinical research in an easily accessible way, guiding you step-by-step through the principles and methods of planning and evaluating clinical research. With a special focus on bias reduction and spine-related case examples,

this SMART approach represents these essential components:

- Study question
- Searching the literature
- Study design
- Measurements
- Analysis
- Resources and funding
- Timing

Also addressed in the book are special topics such as getting your manuscript published and conducting a meta-analysis. This SMART approach provides a clear and simple road map for the planning, execution, and critical appraisal of clinical research.

Brian Beale, Randy J Boudrieau, Michael Kowaleski, Rico Vannini

VETERINARY



Fig 1
Mini Plate 2.0, with cortex screw (gold) and
angle stable locking screw (blue).



Fig 2
Locking Reconstruction Plate 2.4, with a 2.4 mm
locking screw (purple) and a 3.0 mm locking
screw (aqua).

Locking Reconstruction Plate 2.4 and Mini Plate 2.0 System

This plating system offers a solution for mandible and maxilla fracture treatment in canines. The Mini Plate 2.0 is available in thicknesses of 1.0 mm/1.25 mm/1.5 mm/2.0 mm to address a variety of stability requirements. Furthermore, one screw size (2.0 mm) fits all Mini Plate 2.0 options (Fig 1) with the possibility of using a 2.4 mm cortex emergency screw when needed.

For larger dog breeds, the Locking Reconstruction Plate 2.4, with a thickness of 2.5 mm, should be the choice for fracture fixation in the mandible. This plate takes 2.4 mm and 3.0 mm locking screws, 2.4 mm cortex screws, and optional 2.7 mm locking cortex emergency screws (Fig 2). To fulfill the shape variation of the jawbones over the various dog breeds, the plates can be contoured in all three dimensions with appropriate instrumentation for perfect fitting. To prevent soft-tissue irritation, the plates have a low profile and highly polished surface.

Locking Design

The locking design increases the bone-plate construct stability by using angular stable screws. At the same time, it decreases the risk of screw back-out and subsequent loss of fracture reduction over time. The threaded Mini Plate holes accept both cortex and locking 2.0 mm PlusDrive screws. This configuration allows an angulation of the cortex screws of 13–18° from the central axis. The Reconstruction Locking Plate has a closely spaced hole-design pattern for optimized fracture fixation in minimal bone stock with locking screws or cortex screws.

Case provided by Randy Boudrieau,
Massachusetts, USA



Fig 3
CT image.



Fig 4
Intraoperative view of
the plates secured to
the mandible.

Case: Cocker Spaniel

A 4-year-old castrated male cocker spaniel was admitted with a complex odontoma (confirmed by biopsy and histopathology) of the left mandible of 1.5 years duration. The CT image (Fig 3) shows the complex odontoma, and indicates an inhomogeneous mineral density within the mandible causing thinning/disruption of the lateral cortex and tooth roots. The contiguous images demonstrated abnormal tissue spanning from PM3 to M1 of the left mandible.

Surgical reconstruction

A 12-hole Locking Reconstruction Plate 2.4 was contoured and secured to the ventrolateral mandibular border with three 3.0 mm locking screws inserted cranially and caudally. The most rostral 2 screws penetrated the canine tooth (a pulpectomy was first performed, since this is the only available point of screw purchase rostrally in the dog as the canine tooth fills the entire mandible at this location). The plate was then removed to facilitate resection of a 5 cm segment of the mandible from PM2 to M2 by transverse osteotomy between the teeth using an oscillating saw, obtaining 0.5–1 cm margins from the tumor. The plate was re-applied using the previous screw holes. The gingival margin was closed. An additional 16-hole, Mini Plate (intermediate size: 1.3 mm) was secured along the alveolar bone with four 2.0 mm locking screws cranially to the defect, and three 2.0 mm locking screws caudally. Two screws rostrally penetrated the canine tooth. The plate was anchored caudally to the coronoid crest of the ramus.

A block of compressive resistant matrix (CRM) was cut to fill this bone void, which was soaked with 2 mg of rhBMP-2. Fig 4 shows an intraoperative view of the 2 plates secured to the mandible and the CRM in place within the bone defect. The soft tissues were closed routinely. Immediate postoperative x-rays show the fixation (ventrodorsal view and lateral oblique view) (Fig 5). The radiopaque CRM can be observed spanning the 5 cm defect.

Follow-up x-rays at 7 months postoperatively (ventrodorsal view and lateral oblique view) (Fig 6) show healing of the defect (and resorption of the CRM), which was documented with a Jamshidi biopsy of the center of the original gap (Fig 7). The biopsy was performed at the same time as partial plate removal (Mini Plate) due to the intraoral plate exposure.

Long-term follow up of this dog was obtained in-hospital 26 months postoperatively (both plates were fully removed at 20 months postoperatively) (Fig 8), and via telephone follow-up 6 years postoperatively. At that time the dog was euthanized for an unrelated issue. However, the dog had done well with the mandibular reconstruction throughout this time frame.



Fig 5a–b
X-rays showing the fixation.



Fig 6a–b
At 7 months postoperatively.

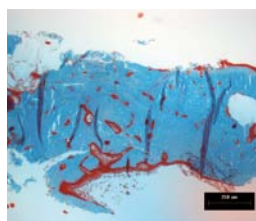
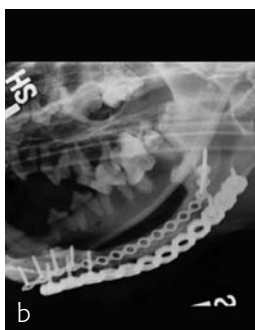


Fig 7
Jamshidi biopsy.



Fig 8
Postoperative image.



Fig 1
Notched head T plate with 1.5 mm locking screws inserted.



Fig 2
The new LCP 1.5 system portfolio in straight, T shaped, notched head T, and H shaped configurations.

Locking Compression Plate 1.5 System

When it comes to fracture treatment in felines and small breed canines, a variety of plating solutions are needed. For example, fractures of the radius and ulna are very common in small breed dogs, yet besides the small size of the bones, it is also known that there can be a decrease in vascular density to the distal radius in these dogs compared with normal sized dogs.

To address these issues, the veterinary plating portfolio has been expanded to include the Locking Compression Plate (LCP) 1.5 system (Fig 1). This system, which includes straight, T shaped, notched head T, and H shaped plates, has been available for human hand surgery for several years (Fig 2). Because the long-bone geometry of cats as well as toy and miniature breed dogs is similar to the long-bones of the human hand, the contours of the plates fit these animals well. The thickness of the plate is also well-suited for these patients to reduce the chance of stress protection and bone resorption, which is a common problem in toy breed dogs.

The LCP 1.5 system is low profile with rounded edges to minimize soft tissue irritation. To apply this system at different implantation sites, the plates can easily be bent or cut with the respective instrumentation. Combination holes in the straight plates allow the use of cortex or locking screws. Thus, the fracture site can be compressed by placing the screw in the dynamic compression unit portion of the hole to achieve increased fracture stability. Two possible indications for the LCP 1.5 system are hyperextension from rheumatoid arthritis, and distal radius fractures in toy or miniature breed dogs and cats.

The adaptation of the LCP system from the human hand to cats and miniature and toy breed dogs addresses a clinical need and provides a perfect solution for many long-bone fracture fixations in small dogs and cats as well for the stabilization of flat-bone fractures such as pelvic or scapular fractures in these animals.

Case provided by Antonio Pozzi, Florida, USA



Fig 3
5-year-old Dachshund.

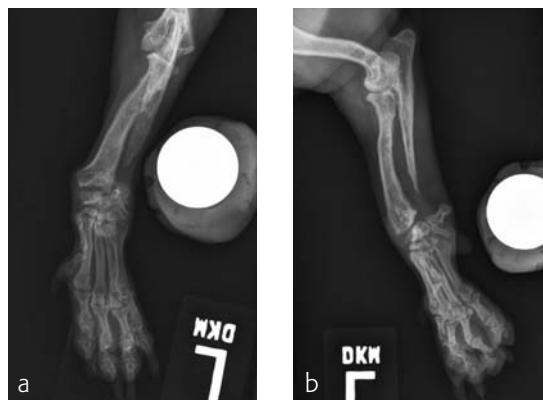


Fig 4a–b
Preoperative craniocaudal and lateral x-rays of the left antebrachium showing periarticular subchondral erosions and valgus deformity.

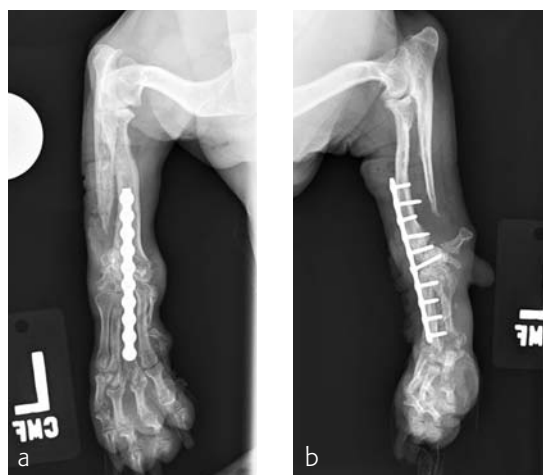


Fig 5a–b
Postoperative craniocaudal and mediolateral x-rays following left pancarpal arthrodesis with a straight LCP.

Case 1: Pancarpal arthrodesis

A 5-year-old female 3.5 kg dachshund with bilateral carpal hyperextension secondary to erosive polyarthropathy (rheumatoid arthritis) (Fig 3, Fig 4) was treated bilaterally with a staged pancarpal arthrodesis with straight LCPs. The right carpus was operated first and healed in 10 weeks. The left carpus was operated 5 months after the initial surgery (Fig 5). Complete healing was noted 3 months postoperatively (Fig 6).

At the most recent follow-up 20 months postoperatively (first arthrodesis), the dog was comfortable and very active. The plates were selected based on the small bone size and the risk of secondary osteopenia. Locking screws are important to prevent screw loosening in patients with poor bone quality, especially in the case of pancarpal arthrodesis where high bending forces must be neutralized.

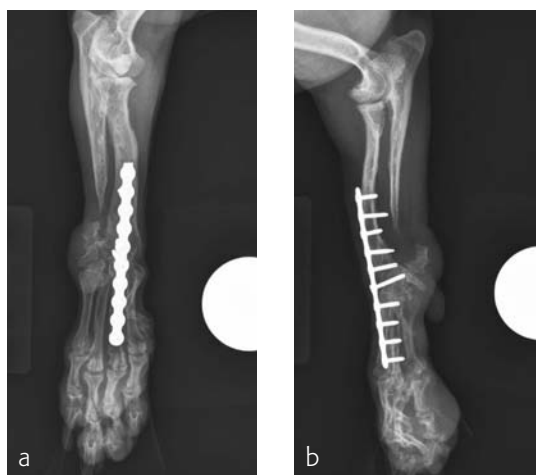


Fig 6a–b
Three-month postoperative craniocaudal and mediolateral x-rays. Bone healing at the arthrodesis site was progressing nicely. The patient was doing very well and had regained mobility.

Case provided by Amy S Kapatkin, California, USA



Fig 7a–b
Preoperative craniocaudal and lateral x-rays. Complete transverse fractures of the distal diaphysis of the left radius/ulna with a mild latero-proximal displacement of the radial fracture and mild caudal displacement of the ulnar fracture. There is soft-tissue swelling along the length of the left antebrachium.

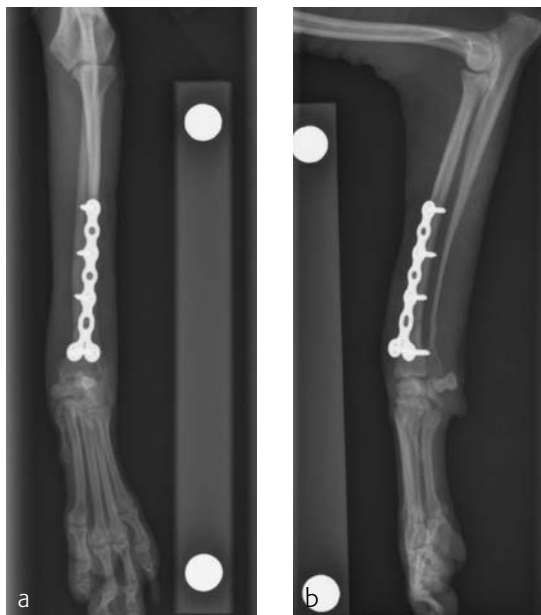


Fig 8a–b
Postoperative craniocaudal and lateral x-rays. Good apposition and alignment of the radius and ulnar fractures were achieved.

Case 2: Open reduction and internal fixation of distal radius and ulna fractures

The patient was an approximately 2-year-old 1.5 kg miniature poodle with a radius and ulna fracture of the left thoracic limb. Although there are (1.5 mm screw) cuttable plates available for these small breeds, they require disruption of the periosteum and sometimes the distal fragment has room for only one screw if a straight plate is used. The tiny T plates, using cortex screws, are often too short; ideally at least 35–50% of the limb length has to be spanned. In traditional plates, every hole must be filled and contributes to stress protection of the bone. These plate options also do not permit the use of locking screws. Therefore, the condylar LCP 1.5 was a perfect plate for these fractures (Fig 7).

An open but do not touch approach was performed with 3 proximal screws and 2 distal locking screws inserted in the LCP (Fig 8).

After 3 months, the previous fracture of the radius was no longer visible and there was smooth callus in the region of the previous fracture (Fig 9). There was bone loss at the distal ulna, most likely due to stress shielding. Plate removal can be considered at 6 months if bone resorption is a concern.



Fig 9a–b
Three-month postoperative craniocaudal and mediolateral x-rays.

Jörg A Auer | Ortrun Pohler | Martina Schlünder | Ferenc Kása | Gerhilde Kása
Marvin Olmstead | Björn von Salis | Gustave E Fackelman

History of AOVET

The First 40 Years



To obtain a free print copy contact

patricia.codyre@aofoundation.org

or visit

www.aofoundation.org/Structure/education/publications/news/Pages/aovet_40.aspx

The AO Foundation, Publishing and Faculty Support Media is proud to announce the launch in Lima, Peru on June 13, 2013 of "History of AOVET—The First 40 Years", written and edited by exceptional AO veterinary, surgical professionals and founding members. The book traces the milestones, history, and key personalities responsible for the formation of AOVET and celebrates its 40 years of achievement. Despite being worshipped, domesticated, and loved, animals were for a long time mistreated and largely neglected medically.

However, as scientific understanding of bone healing in humans grew, led by many of AO's own founding fathers, the determination of a small group of veterinarians and others to transfer this knowledge to the animal world resulted in the formation of AOVET.

With inspiration from childhood experiences of seeing a tragic horse racing accident, to a founding AO surgeon with a passion for dogs and a penchant for telling the local vet how to improve his fracture care technique, the History of AOVET is a fascinating story about the dedication and commitment shown by a small group of veterinary and human surgeons and scientists.

It details their quest to find the right techniques, create the correct implants and instruments, and identify the best education and training methodologies, to ensure pain-free and successful surgical outcomes in small and large animals—including a polar bear. Under the editorship of Jörg A Auer and Ortrun Pohler we follow the journey of AOVET, from its origins in a small workshop of enthusiastic surgeons to today's world-class international organization. We guarantee that this book will be of interest to all AO surgeons, regardless of their specialty.

Matthias Forte, Ladina Hofmann-Fliri, Claudia Münch, Norbert Südkamp, Daniel Widmer, Markus Windolf

NEWS FROM ARI



Fig 1
PHILOS repair constructs with various cement augmentation patterns.

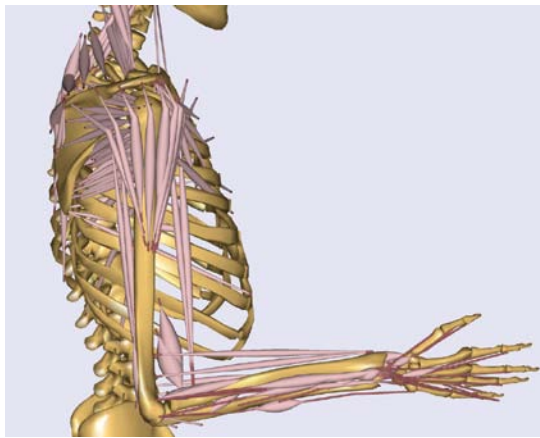


Fig 2
AnyBody™ model to calculate muscle forces and joint reactions.

PHILOS Augmented – which screws to augment and how?

A numerical analysis of a complex problem

The treatment of fragility fractures remains a major challenge in trauma surgery, particularly at the proximal humerus. Factors such as highly compromised bone mass, complex loading conditions, multi-fragmental fractures, absent bony support, and limited surgical access to the region make the proximal humeral fixation problem a complex one. Currently, the implant design process is driven by individual opinions and philosophies of medical and technical experts. We hypothesize that this approach will reach its limitations, particularly in the face of complex fracture situations. Rethinking of the design process in terms of employing new tools and procedures for evidence based development will gain importance in the near future.

Computer model to analyze cement augmentation patterns

A first generation computer model has been developed at the AO Research Institute (ARI) in collaboration with AOTK, AOTrauma, and DepuySynthes, to systematically investigate the influence of specific cement augmentation patterns when using the PHILOS plate in combination with bone cement (Fig 1) on the biomechanical competence of the repair construct. The finite elements model employs high resolution quantitative CT image-data of a representative osteoporotic proximal humerus. Each element of the model was assigned with the specific mechanical properties of the corresponding CT gray-values. An unstable 3-part fracture (11-B3) was created by virtually cutting the bone. The fracture was stabilized with a PHILOS plate and screws (6 proximal, 3 distal). Additionally, 0.5 ml bone cement clouds were virtually placed around the tips of the proximal screws. Overall construct stiffness was validated by mechanical testing, and physiological loading was mimicked by simulated rotator-cuff tendon forces and joint reactions from inverse dynamic calculations (using the AnyBody technology) (Fig 2).

The activity of lifting and placing a cup on the table was simulated, and the corresponding forces were applied to the model. Custom-made software algorithms were used to interlink several software packages from pre to postprocessing to enable efficient simulation of the, in total, 64 combinations of augmented and nonaugmented screws from fully augmented (all 6 proximal screws) to the cementless configuration. Stress/strain progressions within the bone structure along the screw axes were evaluated. As a general measure for construct performance, strain data around all proximal screws were averaged for each simulation.

Confirming common sense, a general tendency was observed that bone deformation (strain) decreased with an increased number of augmented

screws. Here, with all six proximal screws augmented, a maximum strain reduction of 33% was achieved compared with the nonaugmented case. However, there were augmentation patterns with fewer augmented screws that yielded a comparable strain reduction. For example, with the most favorable 3-screw pattern (total cement volume 1.5 ml), 29% reduced strain was found (pattern 12p, Fig 3).

On the other hand, the least favorable 3-screw pattern offers a strain reduction of only 8% (pattern 5ap, Fig 3). According to the model, the 4-screw patterns offer strain reductions between 31% and 15% and the 5-screw patterns between 32% and 25%. The fewer screws augmented, the more the actual location of the screws appeared to matter.

It cannot be answered here if these results reflect the performance of an individual case, with specific loading, specific fracture, and individual bone mass distribution, or if they already apply to a population of patients. Enhancement of the model is ongoing by integrating statistical bone models and clinically more relevant fracture patterns. It has to be evaluated in a next step as to what extent these models can support clinical practice by reducing mechanical complications. A future potential is, however, undisputable.

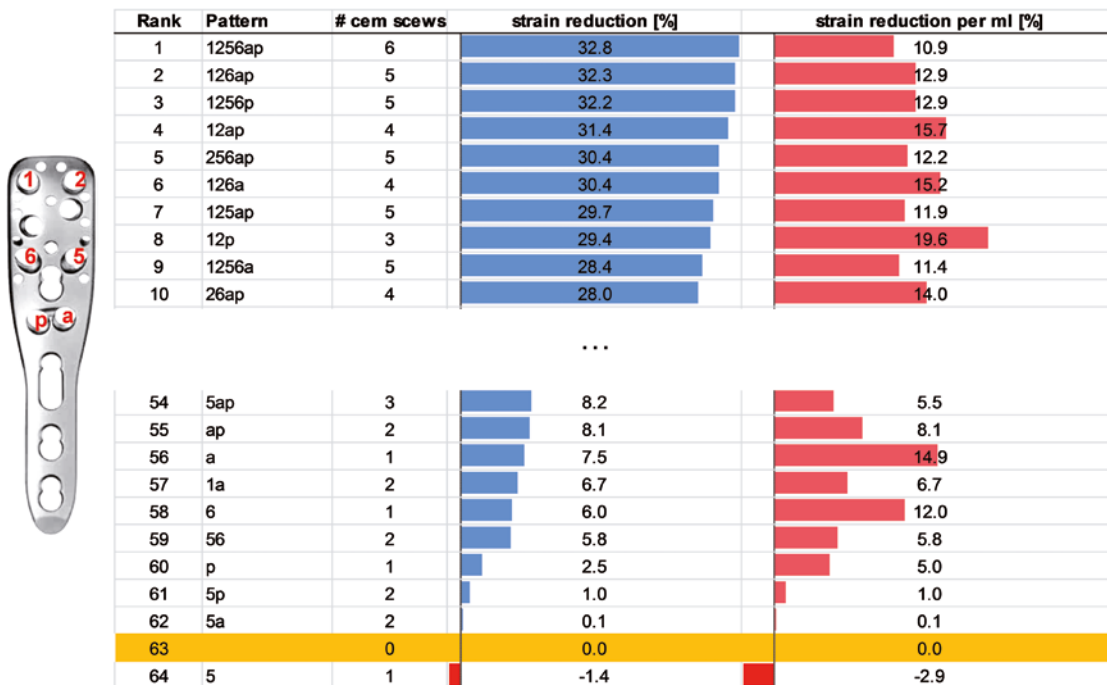


Fig 3

Ranking of augmentation patterns in terms of total strain reduction in the bone (blue bars) related to the nonaugmented control (yellow row). Best ten and worst ten are displayed. Pattern coding corresponds to the labeled screw positions at the left (eg, 1a: only screws 1 and a are augmented with bone cement). Red bars indicate the effectiveness of a specific procedure with regard to the amount of injected cement (strain reduction per injected ml).

Charlotte Newton, Diarmuid De Faoite, Markus Zeppetzauer

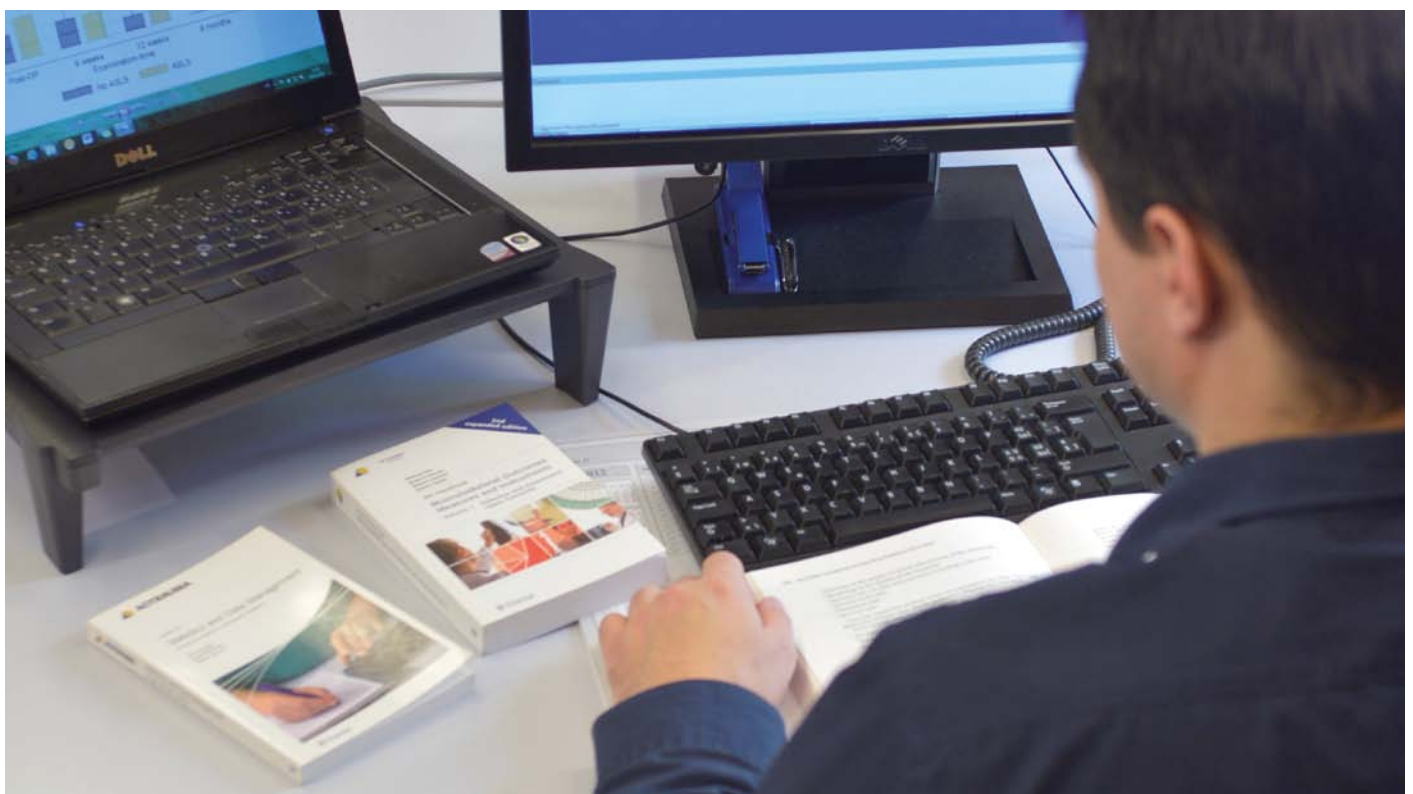
NEWS FROM AOCID

Focused Registries: collecting feedback to answer clinical needs

It is self-evident that evidence based medicine (EBM) cannot function without evidence. While the AO collects evidence in various forms, there is a pressing need to receive faster clinical feedback on certain, mainly new, techniques. In this, we are still akin to the founding fathers of the AO who needed evidence quickly in order to recalibrate their techniques, instrumentation, and so on.

While Müller and his colleagues were collecting information that would lead to a paradigm shift, the contemporary AO still requires this kind of feedback to improve, albeit incrementally. Data collected can help us to find out optimal indications, to learn about clinical experience, so we can optimize instrumentation and operating room techniques. This kind of data also feeds into AO education in the form of 'tips & tricks', which are presented at AO courses and in AO books.

While a properly conducted Randomized Controlled Trial (RCT) provides the best evidence, an RCT may take 5 to 10 years to complete making it unsuitable for fast feedback purposes. However, an RCT or an elaborate study design is not always necessary. The AOTK looked for a trade-off between speed and evidence level to arrive at an option to collect standardized data quickly, and adopted Focused Registries.



Inputting clinical data.

What is a Focused Registry?

Focused Registries, as designed by AO Clinical Investigation and Documentation (AOCID) for use by the AO Technical Commission (AOTK), are patient related datasets collected by healthcare professionals in their clinics. They are created using simple, widely available electronic data capture (EDC) systems, allowing data to be gathered both efficiently, cost-effectively, and safely (complying with data protection regulations).

Focused questions are presented to gain patient-related data, medical information, product performance data, and to establish simple clinician and patient-reported outcome parameters. This thereby facilitates a stream of clinical feedback to the AOTK System. In particular, this information informs the AOTK “Milestone D”, where discussions on the first clinical experience are conducted as part of the AO ethos of continuous improvement over the whole product lifecycle.

Because the AO is ever mindful of patients’ rights, advice from an Institutional Review Board / Ethics Committee will always be sought and a full submission may be required in some instances.

Benefits of Focused Registries

Due to the ease of use and ability for widespread implementation, Focused Registries complement existing AOTK processes by enhancing surgeon participation and increasing the number of clinical cases reviewed surrounding a single product.

Registries make it easier to recruit patients and enhance the collection of all relevant patient information. Multicenter input speeds information collection, using a wider range of patients and generating additional comparable results.

Focused Registries are designed to deliver focused medical information that contributes to decision making within a short timeframe. This is achieved through having a maximum of five investigation sites, which have the aim of collecting approximately 20 cases in total in the first six months after approval for the Focused Registry has been received. Furthermore, Focused Registries may also ignite enthusiasm among surgeons to participate in more clinical research in the future.

Improved data

The use of Focused Registries also allows for the periodic control of collected data by AOCID and site personnel, thereby enhancing the reliability of the data evaluated by the AOTK. There is an improved information exchange between the cooperating partners of the AOTK and AOCID, facilitating the decision-making process.

Background and future use

The first AO Focus Registry was initiated by the Pelvic Expert Group and began in 2012 as a clinical assessment of quadrilateral surface comminution associated with acetabular fractures using the respective 3.5 mm plates from the Low Profile Pelvic System. Currently, there are 14 active Focus Registries in various stages of development, with even more planned for the near future. Although Focus Registries are a new tool for the AOTK, discussions on the collected cases already form a very important part of the Expert Groups' work today. They will also feed into the AOTK's strategic approach of applying success control to its projects. Consequently, the TK Experts' Symposia, which are held in Europe, Asia, North America, and Latin America, will also benefit from the data produced by them.

Focused Registries within the AOTK could potentially be used for hypothesis generation for future clinical trials if gaps in knowledge, practice, or trends are identified. Focused Registries provide the TK with a data repository, meaning they could be leveraged to provide a valuable tool to target and preselect sites for future studies and projects. The collection of valuable socio-economic data aids future management plans and Focused Registries may have a role in training and teaching better clinical standards.

Who can get involved in Focused Registries?

All clinical centers that have the appropriate infrastructure and training in the data-collection system are able to participate in a Focused Registry. If you would like to know more, please contact aocid@aofoundation.org.

Conclusions

To sum up, Focused Registries offer a very time and cost-effective way of collecting data on first clinical experiences without having to launch a full scale clinical study. Their versatility and ease of use means that Focused Registries have a wide application to AO activities, particularly those undertaken by the AOTK. The first results to arise from these AOCID administered registries are already beginning to feed into the work of the TK Expert Groups. We fully expect Focused Registries to become a staple element in clinical research across the AO.

Tim Pohlemann

AOTK AWARDS



TK Innovation Prize – awarded to Michael Mayer.

TK Innovation Prize 2013

Prof Dr med Michael Mayer is the winner of the AO Foundation TK Innovation Prize for 2013.

Prof Mayer is Chairman and Medical Director of the Spine Center at Schön Klinik München Harlaching, a major spine center in Europe, and is a neurosurgeon specializing in spinal surgery. Following his initial medical studies, with experience as a research fellow, and training in neurosurgery and orthopedic surgery under Prof Mario Brock and Prof Ulrich Weber at the Free University in Berlin, he went on to complete a PhD in Neurosurgery in 1991 with an experiential and clinical study on endoscopic disc surgery.

With a specialization in spine surgery, his talents were soon recognized, and he became Chief Staff Surgeon and Deputy Chairman of the Dept of Orthopedic Surgery of the Free University of Berlin in 1992.

He is a former President of the European Spine Society and the German Spine Society, and has published/edited more than 150 scientific papers and 7 books, with current or previous editorial/advisory roles on the European Spine Journal, Operative Orthopedics and Traumatology, the Asian Spine Journal, the Open Spine Journal, the Open Bone Journal, and as Deputy Editor of the Global Spine Journal.

He has organized more than 40 international congresses and workshops, such as Eurospine 1999 and the German Spine Congress 2006.

He is indeed a man highly respected and admired by peers and patients alike.

Recognition for his contribution towards the Prodisc-C Vivo

The AOTK System awards the 2013 TK Innovation Prize to Prof Mayer “for his outstanding contribution to the development of the Prodisc-C Vivo System”.

Prodisc-C Vivo was designed to replace a diseased and/or degenerated intervertebral disc of the cervical spine in patients with symptomatic cervical disc disease (SCDD). The implant significantly reduces pain by allowing for the removal of the diseased disc while restoring biomechanical stability, disc height, and providing the potential for motion at the affected vertebral segment.

Awards ceremony in Lima

Prof Mayer was presented the award in absentia at the 2013 Trustees Meeting in Lima, Peru. In a prerecorded video message, Prof Mayer said that he greatly thanked the AO Trustees, the AO TK System, and AO members for awarding him the TK Innovation Prize. He said that the award had come as a great surprise to him but thanked everyone again for recognizing his work.



Prof Mayer (left) has been recognized for his outstanding contribution towards the development of the Prodisc-C Vivo system, shown here demonstrating the system (with Chair of Expert Groups Robert McGuire) during a “Meet the Experts” presentation at Davos Courses 2012.

TK Innovation Prize—Foot and Ankle Expert Group (FAEG)

The Foot and Ankle Expert Group (FAEG) has also received a TK Innovation Prize.

The FAEG members Dr Andrew Sands from New York, USA (Chair), Dr Per-Henrik Agren from Stockholm, Sweden, Dr Michael Castro from Scottsdale, USA, Dr Juan Gerstner Garcés from Cali, Colombia, Dr Leslie Grujic from Sydney, Australia, and Dr Ian Winson from Bristol, England were awarded the TK Innovation Prize for their contribution to the development of the Variable Angle Locking Forefoot/Midfoot Set.

The Variable Angle Locking Forefoot/Midfoot Set became a highly successful product shortly after it was presented to the market.

Members of the Foot and Ankle Expert Group (FAEG) receiving their award from AO Foundation President Jaime Quintero (far left) and Chairman of the AOTK System Tim Pohlemann (far right).

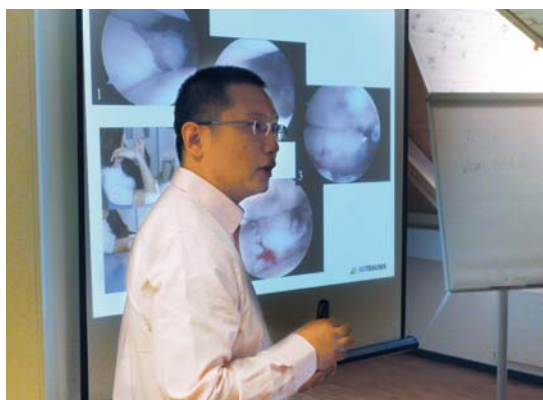


Merng Koon Wong

PORTRAIT: YI LU



Since its inauguration in 2006, the Asian Trauma Working Group (ASWG) has played a significant role in developing and customizing special surgical solutions for the Asian population, providing specific expertise from this region to the workflows of the AOTK System. Specific solutions for small stature patients are also of increasing interest to US and European markets due to the significant population of small stature people in those developed markets. Even more so, the group is pivotal in identifying expert surgeons as well as new talent and linking them with the AO world. With the AO Foundation's increased activities in China, this will become even more important in the future.



Yi Lu is Associated Professor at the Sports Medicine Department at the Jishuitan Hospital in Beijing, China. He specializes in the treatment of shoulder and elbow fractures, and has a strong focus on arthroscopy procedures in this region as well. He holds an MD and a PhD from the Peking University Health Science Center as well as a Master Degree from the Beijing Orthopedic Research Institute.

His relationship with the Jishuitan Hospital in Beijing goes back to the year 1997 in which he started as a resident surgeon in the Orthopedic Trauma Department, later moving his way up to consultant and finally Associated Professor. He also took part in visiting clinician programs at the Washington University in St Louis, USA, the Mayo Clinic in Rochester, USA, as well as the Madi Shoulder Center in Seoul, Korea.



On top of his various committee positions within a number of Chinese Medical Associations, and in addition to being the Executive Secretary of the Chinese Shoulder and Elbow Association, Li Yu greatly enjoys his involvement in the AO. Having been a faculty member for AO courses in China for quite a while, his first actual encounter with the AO was in fact way back in 2004 - he was an AO fellow at the Charité-Universitätsmedizin Centre for Musculoskeletal Surgery (CMSC) in Berlin at a time when its Director Norbert Haas was also the Chairman of the AOTK System.

Yi Lu presenting at a meeting of the ASWG at the AO Center in Davos, September 2012.

Yi Lu served as table instructor at the Davos AO Courses in 2010 and as a faculty member at the AOTrauma Advances Course two years later. This year, he returned to Davos to share his thoughts on the use of variable angle screws in elbow fractures with the ASWG.

In his rare private time Yi Lu describes himself as a quiet man that enjoys reading and music but does biking and running every week just for the fun of it. However, most importantly for him is his family life shared with his wife and their 7 year old daughter.

We can expect that with his broad expertise and his enthusiasm for the AO Foundation, Yi Lu will continue to make a strong contribution towards the organization's future activities in China.



ASWG Chair MK Wong (left) with Yi Lu.

Hazards

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