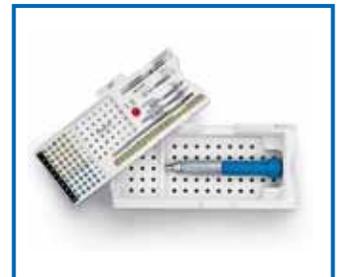


## New CMF Products from AO Development



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



Dear Reader,

Last year the TK-System of the AO Foundation underwent a huge change: under the guidance of the newly formed TK Executive Board (TKEB), three new Technical Commissions (AOTKs) were appointed, Trauma, Spine, and CMF. Each is tasked with approving products from the three major specialties within the organization

Along with this development, the concept of TK News has also been modified. TK News is intended to give an overview of recent innovative developments by presenting the latest approved products, as well as reporting from other institutes within the AO Foundation. Beginning in 2006, each of the specialties will have one issue to focus on their developments occurring that year.

This is the first issue of TK News focusing mainly on products for craniomaxillofacial surgery. Three Expert Groups dedicated only to craniomaxillofacial surgery have worked on new products of which several have recently been approved.

One of these new products is the Alveolar Distractor, an internal distraction device intended for vertical bone augmentation of the alveolar ridge in both mandible and maxilla. This should minimize the number of bone grafts necessary to permit the placement of dental implants. Alveolar distraction has been

shown to be more successful in vertical augmentation than standard bone grafts, and donor site morbidity is eliminated.

Optimal patient care is the major goal for all surgical treatments dealt with in our daily work. The surgeon's safety is equally important. Treatment of jaw fracture usually requires the application of arch-bars on the teeth to provide temporary intermaxillary fixation (IMF) while the fracture is being stabilized. This procedure takes time and requires wires to be wrapped around each tooth to hold the arch-bar in place. One of the hazards of placing arch-bars is that of impaling ones' finger on the many wires that are used. The Rapid IMF System addresses this potential problem by providing a temporary device for intermaxillary fixation without the risk of wire-stick injuries.

To meet the need for improved fixation of the medial and lateral canthal ligaments, a new Titanium Wire with swedged-on needle has been developed. This facilitates passing the wire through soft tissue. Additionally, another canthal fixation device that has a "barb" on the end of the wire to hold soft tissue in position, similar to a tendon fixation barb, has been developed.

As well as focusing on products from the specialties, TK News also provides information on product innovations for other anatomical regions, such as the new Sternal Cable System for thoracic surgery, or the helpful Air-Pen, originally developed for hand surgery but which could also be useful for craniomaxillofacial surgery.

It should be stated that the product descriptions on the following pages are for information only and are in no case to be used as a substitute for AO surgical techniques or teaching tools. More detailed information on these products can be obtained from AO or your local SYNTHES® representative.

The column Portrait features Alan Herford from California, USA. Despite his young age, he has been appointed medical member of the CMF AOTK in 2006 because of his innovative spirit and interest in development of new solutions for improved patient care. The TK-System always encourages innovative surgeons from all over the world to share their ideas with us. Please do not hesitate to contact me if you have any questions or comments.

Yours faithfully,

Edward Ellis III

Nils-Claudius Gellrich, Warren Schubert, Reid V Mueller

## NEW CRANIOMAXILLOFACIAL PRODUCTS



### Titanium Wire with Needle for Canthal Fixation

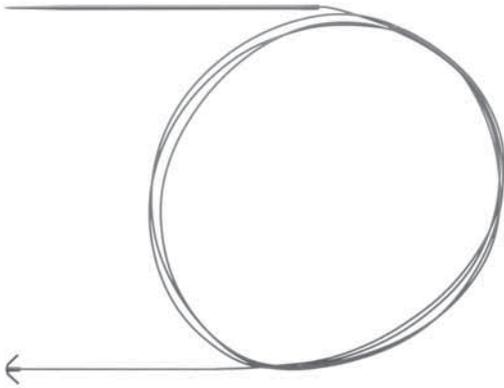
The Titanium Wire with Needle has been developed to meet the need for improved canthal fixation. The medial and lateral canthal ligaments attach to the medial and lateral orbital rims and provide palpebral fissure. Due to their position in the orbital region, these ligaments often get damaged in midfacial trauma, especially if the naso-orbital-ethmoid (NOE) area is affected, or in cases of damage to the lateral midface.

Furthermore, secondary injuries to these ligaments might appear when surgical exposure is required to gain access to these types of fractures, both in primary or secondary fracture repair. Lastly, restoration of the ligaments can be necessary in cases of congenital deformity such as Treacher Collins syndrome. Precise anatomic restoration of the ligaments is crucial for obtaining satisfactory esthetic results in the midfacial region.

When a ligament is damaged, current surgical practice typically uses stainless steel wire or nonresorbable suture to keep the reposition of the ligaments. However, the main clinical problem associated with stainless steel wire is scatter effects in postoperative imaging. A second clinical problem is the possibility of galvanic corrosion, as titanium plates and screws are often used for the fixation of fractures in close proximity to the damaged canthal ligament. Finally, stainless steel implants are known to elicit a reaction in patients with an allergy to nickel.

The new Titanium Wire with Needle directly addresses these clinical issues by causing minimal scatter, providing compatibility with titanium plates and screws, and eliminating the risk of an allergic reaction. The Titanium Wire with Needle is offered in four sizes, ranging from 26 gauge to 32 gauge. Each wire is mounted with a curved stainless steel needle which is removed after repositioning has been accomplished.





### Titanium Wire with Barb and Needle

In addition to the Titanium Wire with Needle, a version with an additional barb at its end has been developed which provides hold in the canthal area.

This device can be used for both conventional transnasal wiring or for the more sophisticated technique developed by Beat Hammer. With this technique, the titanium wire is diverted via the most posterior hole of a compact midface plate that serves as a cantilever in the ipsilateral medial orbital wall region.

The Titanium Wire with Barb and Needle is available in 28 gauge wire size and is mounted with a straight stainless steel needle.

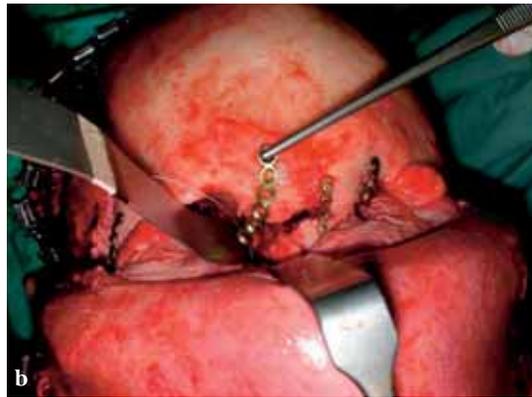
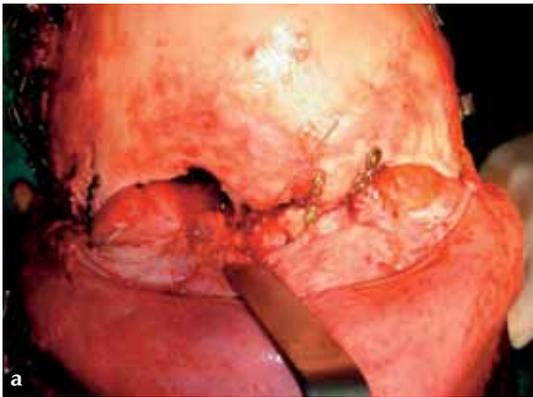


Fig a–d Canthal fixation with Titanium Wire with Needle and Barb.  
(Provided by A Schramm)



### SynPOR (porous polyethylene implant)

Over the past few years, porous polyethylene implants have gained popularity among many surgeons over metallic mesh implants in the treatment of orbital floor fractures. The reasons are multiple, and include ease of trimming and insertion of the implants into the orbit, as well as the ability to serve as a volume augmentation for the orbit in cases of enophthalmus and orbital dystopia. The implants are manufactured from an inert, nonabsorbable polymer (ultra high molecular weight polyethylene [UHMWPE]) formulated to contain a network of open and interconnected pores approximately 100–250  $\mu\text{m}$  in size. Interconnected pores of these sizes allow fibrovascular tissue ingrowth, which allows relative host incorporation, as opposed to host encapsulation observed with smooth surface implants. Tissue ingrowth into its pores, and the resulting tissue integration with surrounding tissues, provide stabilization of the implant.

They can easily be shaped and fixated to bone with metallic or resorbable screws, sutures, or wire. The fibrovascular tissue ingrowth into the pores provides stability in a relatively short time.

To date, SynPOR is available in a series of four 50 x 50 mm sheets, in thicknesses of 0.45 mm, 0.80 mm, 1.5 mm, and 3.0 mm. Other implants are also in development. The porous polyethylene implant is indicated for craniofacial reconstruction and augmentation. Orbital augmentation and reconstruction are among the primary applications.

### Burr-Free Cutter for Midface Plates

The Burr-Free Plate Cutter is an instrument for the cutting of plates in the already existing Compact Midface System. The instrument is therefore suitable for use on midface plates from 1.0 mm to 2.0 mm in size. Markings on the side of the instrument indicate the correct position of the plates as well as the direction of insertion. The contours on the cut implants are burr-free, even if the instrument has been used in long term. Its ergonomic design results in improved handling properties and reduced amount of needed instruments.





### Battery Powered Screwdriver (BPS)

Powered screwdrivers have long been the preferred alternative to manual insertion of multiple screws or taps. Multiple screw insertions in craniomaxillofacial and neurosurgical procedures can significantly reduce operating time when using an electrically powered screwdriver.

The new Battery Powered Screwdriver (BPS) has ergonomic improvements to the existing version with larger buttons to reduce hand fatigue. The BPS is lighter and easier to hold than the former BPS. The buttons are larger and easier to push, and the pen-style grip makes it more comfortable to insert multiple screws or taps.

The hand piece of the new BPS is designed to be reliable and durable and to withstand the demands of multiple exposures to high pH detergents, and sterilization cycles.

All circuits are sealed to protect the device against corrosion and wear caused by harsh cleaning solutions. The newly designed single-use battery provides the convenience of a sterile-packed product with the power and reliability of a fresh, new battery. It takes the guesswork out of whether the battery has been sterilized, is fully charged and has sufficient power.

Based on the specific clinical needs of the surgeon a new graphic case has also been developed. It includes an insert tray for two hand pieces as well as a separate tray for assorted screwdriver blades and taps. A small auxiliary finger mat is included to provide additional storage space.



Fig a–d Application of the Battery Powered Screwdriver (BPS) in clinical situations.

Lim K Cheung, Mario Gabrielli, Carl-Peter Cornelius, Daniel Buchbinder, Ralf Gutwald, Edward Ellis III

## NEW MANDIBLE PRODUCTS



### Alveolar Distractor

The new Alveolar Distractor is an internal distraction device intended for vertical bone augmentation of the alveolar ridge in the mandible and the maxilla with a deficit of in bony height and soft-tissue coverage. The alveolar ridge deficiency can be a result of:

- Traumatic tooth and bone loss
- Resorption after dental extraction
- Periodontal disease
- Tumor resection
- Congenital deformity



The distraction device consists of:

- The lower body with angulation mechanism which is welded to the base plate
- The upper body with distraction mechanism consisting of a threaded rod as well as a threaded transport plate.



One of the main features of the Alveolar Distractor is its vector adjustability: an angulation mechanism allows easy intraoperative selection of the distraction vector. Therefore, extensive adaptations to the foot plates can be avoided. The distractor can be angled up to 52° toward the buccal and 32° toward the lingual side. After adjusting the vector, the angulation mechanism must be relocked by tightening the fixation screw.

The rigid base plate, with optional screw holes next to the angulation mechanism, allows safe anchorage of the distraction device in the residual bone segment. This leads to high stability ensuring rigidity and preventing potential unfavorable distraction vector changes due to soft-tissue pull.

Three different implant sizes allow for 8 mm, 12 mm, and 16 mm of distraction. This choice offers the flexibility to fit the distractor to different anatomical conditions.



**Fig 1a–d** Distraction of a fibula flap in the mandibular body after tumor resection. The additional pin provides stabilization. (Provided by L Cheung)

To achieve the desired distraction result, the two bodies are connected with a pin to change the plane angle of the bone plates in one dimension. The angulation mechanism allows for fixation of this angle. This feature allows for a single, individual intraoperative adjustment of the distraction vector and addresses the importance of a correct distraction vector in a sagittal plane.



The plate is extended vertically to improve the vertical stability of the system helping to withstand lingual and palatal soft-tissue tension and therefore also guarantees a stable distraction vector. This device has housing for the distraction body to prevent soft-tissue irritation as there is no exposure of the surrounding soft tissue to the threaded rod during distraction and latency.

Distraction should begin 3–5 days after implantation. To achieve lengthening the activation instrument is turned clockwise (in the direction of the arrow marked on the instrument). Each full rotation equals 0.35 mm of distraction. A rate of 1.05 mm of distraction per day (one turn, three times a day) is recommended to prevent premature consolidation. After a satisfactory gain in alveolar height, the new bone must be given a consolidation period of at least 10–12 weeks before the distractor can be removed through the same vestibular incisions used during implantation.

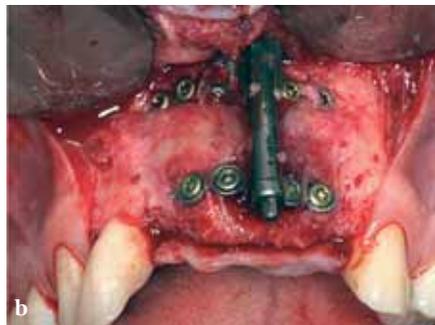
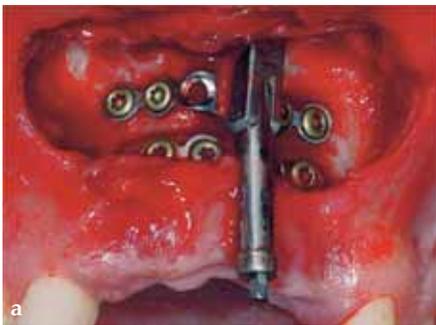


Fig 2a–b Maxillary distraction in a 34-year-old male after periodontal disease. (Provided by M Gabrielli)

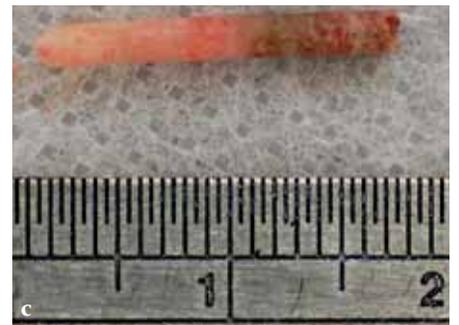


Fig 3a–c Mandibular distraction in a 20-year-old male after trauma. The bone biopsy shows a darker shading where the bone is newly formed. (Provided by M Gabrielli)



### Rapid IMF System—Temporary Mandibular Fixation Device

Most fracture treatments in the mandible or midface area will affect the dental occlusion and require temporary maxillo-mandibular or intermaxillary fixation (IMF). Although the well-established arch bar and circumdental wiring, and peralveolar screw systems provide good results for the benefit of the patient, frequent stick injuries due to the sharp stainless steel wires and the possibility of transmission of infectious diseases has led to the request by surgeons for a “safer” system.

The Rapid IMF System has been developed in response to this request. This device is an innovative, adjustable flexible band, which is wrapped around individual teeth, similar to an orthodontic band. A long elastic chain is then looped around the strategically placed brackets to achieve IMF.

Rapid IMF is indicated for fracture reduction to assist in the operative treatment of simple nondisplaced, comminuted fractures in the mandible, maxilla, or both, where there is a sufficient occlusion to guide reduction. Rapid IMF is not a replacement for arch bars and wire. It can however, be used instead of arch bars in some specific instances. Case selection is of utmost importance. If used correctly, the Rapid IMF will provide a fast and “safe” IMF method without the risk of needle-stick injuries for the surgeon.

To apply the Rapid IMF, at least six, preferably eight points are chosen for the placement of the nylon anchorage ties. After tightening and excess removal of all belts, a link of the elastic chain is passed over an anterior anchorage point and is looped over all anchorage ties in a zigzag manner and secured over an easily accessible upper anterior anchorage point.

It is very important to remember that Rapid IMF is designed only for routine trauma cases requiring temporary splintage. It would not be appropriate for comminuted fractures or orthognatic procedures, both of which might require a more prolonged maxillo-mandibular fixation period. The Rapid IMF ties are usually removed in the immediate perioperative period. If the surgeon chooses to leave them for a more prolonged period, close follow-up at regular intervals is mandatory to prevent damage to the teeth and supporting structures.

#### Indications

- Preoperative fixation
- Perioperative fixation
- Short-term (up to 3 weeks) fixation for minimally displaced fractures
- Splintage of post-jaw dislocation





### Basic Trocar System

The new Basic Trocar System was developed in response to a request for a more simplified set of trocars. Clinical feedback from many surgeons had shown that the already existing Universal Trocar System with its high number of components can be too overloaded for their needs in the OR.

The simplified Basic Trocar System was created by eliminating cannulae and drill guides from the existing system, and also by consolidating the functionality of three retractors (Malleable C-Retractor, Cheek Retractor Blade, and Cheek Retractor Ring) into one new instrument (Cheek Retractor Forceps). In addition to reducing the amount of instruments, a selection of new features has been included:

### Snap Lock Feature

The Basic Trocar System's drill guides and obturator fit into the cannula using a snap lock feature. This feature prevents unintentional decoupling of the instruments from the cannula, therefore preventing the instruments from dropping.

To remove a drill guide or obturator from the cannula, the instrument's head should be compressed with thumb and forefinger and then extracted.

### Rotating Trocar Handle

The Basic Trocar Handle can rotate around the cannula to allow for more space at the operating site. To maintain control over the instrument, the handle engages like a ratchet in discrete arcs instead of freely rotating.

### Cheek Retractor Forceps

The new Cheek Retractor Forceps allow the surgeon to retract buccal tissue quickly and easily. The forceps combine the functionality of the former Malleable C-, Blade- and Ring-Retractors. The recommendation of several surgeons, the forceps incorporate the same width and angles as the existing Cheek Retractor Blade. The forceps can be disassembled into two pieces, to allow for easy cleaning and sterilization. The forceps' interlock is asymmetrical, so it cannot be assembled incorrectly.

To prevent slippage, the threads on the inner surface of the forceps' jaw affix it to the cannula's shaft very tightly.

### Drill Bits

The Basic Trocar Set includes three drill bits. Each has a shaft diameter of 2.4 mm, a 30 mm fluted length, and markings indicating drill size and hole depth. The commonality of their diameters and lengths enables all three drill bits to be used with any of the basic drill guides.





### 500 mm Rod for Mandible External Fixator System

Feedback from surgeons using the already existing Mandible External Fixator revealed that some larger patients would benefit from a longer titanium rod than is currently available.

To accommodate this need, a kit has been developed, which includes a 500 mm long titanium rod as well as a respective 500 mm long bending template. This is available either as sterile or nonsterile. Both are offered as additionally available items to the Mandible External Fixator Set.



### Extra Long Screwdriver with Holding Sleeve

For treatments of angle fractures of the mandible, the patient's mouth must be open and instruments have to be brought in from the opposite side. Placing the most superior screw(s) of the plate can be difficult as the screwdriver gets close to the maxillary dentition. The length of the currently available screwdrivers often cause interference of their handles with the teeth.

Thus the need for long screwdriver blades, which can securely hold screws until they are placed, was expressed. The new Fixed Handle Screwdriver with Holding Sleeves has a 108 mm long blade, which is long enough for transoral insertion of 2.0 mm StarDrive and PlusDrive screws without contact to the teeth. It comes with an extra long holding sleeve for controlled grip on the screws.



Case provided by E Ellis III

Ralf Gutwald, Rainer Schmelzeisen, Joseph Huh

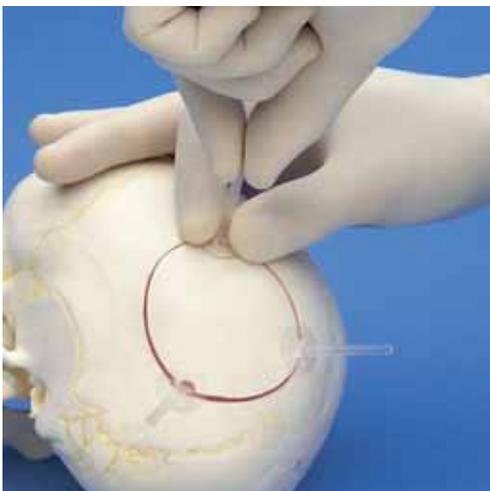
## NEW COMPREHENSIVE PRODUCTS



### Resorbable Cranial Clamp

In cranial flap closure procedures it is important to have a closure system which is fast and easy to use. The new Rapid Resorbable Cranial Clamp is intended to provide surgeons with a quick closure option and appropriate esthetic results. Its resorbability adds the benefit of not being a permanent fixture in the body. The design of the Rapid Resorbable Clamp eliminates the need to drill or tap, thereby speeding the closure procedure. Both the tensioning of the clamp and the cutting of the excess stem are performed with a special designed single instrument, which adds to the ease of use.

The Rapid Resorbable Cranial Clamp is made from a fast resorbing polymer [85:15 poly (L-lactide-co-glycolide)], the same material as used in the plates of the already existing Rapid Resorbable System. The implants degrade within approximately 12 months. The Rapid Resorbable Cranial Clamp is therefore indicated for use in pediatric and adult patients, with the majority of application being for pediatrics.





### **BoX Bone Fixation System**

The BoX Bone Fixation System is a small and modular osteosynthesis set for oral surgery.

It has been developed to address the need for a handy set that allows for basic surgical procedures, such as

- Lag screw osteosynthesis
- Bone augmentation prior to setting dental implants
- Basic fracture treatment

Having been reduced to only the necessities, it is more practical than the available standard modules and easy to transport. It can be sterilized in small autoclaves.

It is available in two versions: the BoX or the Twin BoX System.

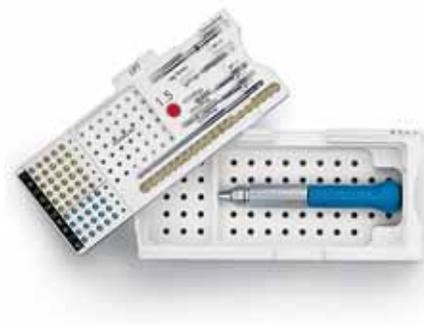
### **BoX 1.3, 1.5 or 2.0**

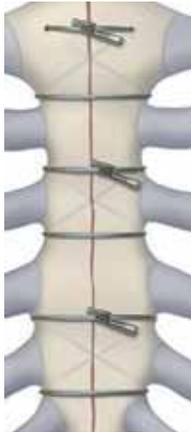
The BoX Bone Fixation System is available with inserts for screws with a diameter of 1.3, 1.5, or 2.0 mm.

### **Twin BoX 1.5/2.0**

The Twin BoX offers the option of diameter combinations as required. Three insert combinations of different screw diameters ( $\emptyset$  1.3/1.5,  $\emptyset$  1.3/2.0 or  $\emptyset$  1.5/2.0) are available. The combined plier allows for bending and cutting of plates with only one instrument. A large auxiliary tray offers additional room for storage.

All inserts are compatible for both in BoX and Twin BoX, and can be used interchangeable. Depending on the surgeon's preference all sizes are available with Cruciform Drive, Stardrive and PlusDrive screws.





### Modular Sternal System

With a minimum of 345,000, in the US alone, annually performed surgical procedures that involve splitting the sternum to enter the thoracic cavity and gain access to the heart and other key organs, the need for effective sternal closure poststernotomy is vital. For the last few decades, surgeons have relied on stainless steel wires as their preferred chosen method of sternal closure. Although the reported failure rate of this technique is low (2–5%), many patients still experience pain, clicking, and other problems associated with nonunions that go untreated.

The sternum is a unique bone located in an environment of constant motion. The thoracic cavity is highly vascularized, but a common practice of open-heart procedures is to remove one of the key blood supplies to the sternum for the heart. The bone is mostly cancellous with a very thin cortical shell, and its quality is often compromised, as many heart patients have other serious comorbidities such as:

- Chronic obstructive pulmonary disease (COPD)
- Obesity
- Diabetes
- Previous steroid therapy
- Osteoporosis

Problems with infection and failed closures have to be taken seriously, especially given the proximity to the heart. The need for an improved closure device has been recognized for many years and several products have attempted to solve this problem. For various reasons, none of these products have been able to obtain significant market share from the standard of care.

The new Modular Sternal Cable System has been developed to address these needs. It consists of three basic implant components, which can be used alone or in combination, based on the surgeon's preference and on patient condition.

### Stainless Steel Cable

The principal component is a flexible stainless steel cable with a diameter of 1 x 1 mm.

Contrary to standard wire, it has great strength, high flexibility, and a large surface area to allow for greater contact between bone and implant. Therefore the risk of pulling through bone is reduced.

Each cable is supplied with a crimp fitting, which slides over the end of the cable and is crimped to maintain the tension in the cable. It can be used as a stand-alone solution for parasternal closure.



### Cannulated Screw

For transsternal application of the cable, a blunt-tipped, self-tapping, stainless steel cannulated screw has been developed. The screw will be available in a variety of lengths at 1.0 mm increments for bicortical placement in the sternum with a minimum amount of protrusion through the posterior table. The screws serve as channels for the cable to pass through the sternum. This offers additional reinforcement instead of direct contact to the bone, therefore preventing it from damage.

### Reconstruction Plates

Another component of the system is a series of stainless steel reconstruction plates. These plates are indicated for primary as well as secondary closures, for patients with limited sternum quality, and for secondary reconstruction of sternums that have fallen apart after initial surgery. The plates are fixed to the sternum with cannulated screws to reunite the hemi-sternums, which also serve as stress distributors. Depending on the surgeon's preferred technique the cable is then applied through the cannulated screws and/or around the sternum and/or through the transverse holes in the plates to join and secure the two sternal halves.

### Instruments

In addition to the implants in the set, a selection of instruments is offered, such as an instrument to tension, crimp, and cut the stainless steel cable.

It is recommended to suture the cable directly through the sternum using the attached needle. Instrumentation to perforate the bone and facilitate cable passage when using cannulated screws is also available. Plate benders, plate cutters, depth gauges, screwdrivers and forceps are included in the system to facilitate installation of the implants. The screwdrivers have adjustable spade-bit tips that provide self-drilling functionality to the blunt-tip screws.

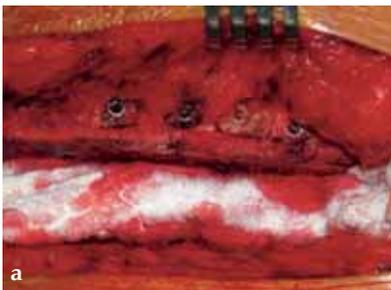


Fig a–c Closure of the sternum with cable. (Provided by J Huh)



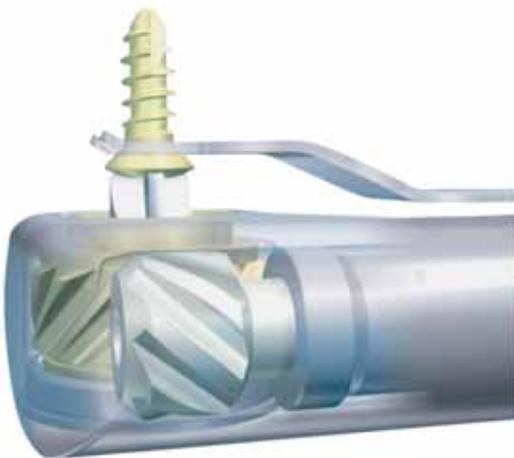
### Rectangular Drill/Screwdriver

The Rectangular Drill/Screwdriver has been developed for predrilling and screw insertion on mandible and midfacial fractures with minimal invasive approaches. Its flat head (6.5 mm) and low overall height allows for intraoral fracture treatments especially when endoscopically supported. Among various possible applications are plate fixation on subcondylar fractures and bilateral sagittal split osteotomies (BSSO).

The Rectangular Drill/Screwdriver is offered with a Minimodule including screwdriver shafts (StarDrive, Cruciform) and drill bits. It has inserts for screw sizes of 1.5 mm/2.0 mm and 2.4 mm. All parts can be picked up and exchanged quickly, which makes the device easy to clean. For better visibility and less irritation of soft tissue the screwholder can be turned at an angle behind the head.

By removing the screwholder insert or the complete screwholder and connection of a conventional drive unit at the handle the device can also be used for rectangular predrilling.

The device is equipped with an intracoupling according to ISO 3964/EN 23 964 (maximal output: 5.000rpm). The gear ratio is 1:2.



Martin Langer

## PRODUCT DEVELOPMENT IN TRAUMA RELEVANT TO CMF



### Air Pen Drive

The Air Pen Drive (APD) is a pen-shaped high speed, air-driven surgical power tool for small and micro bone surgery.

The set contains a machine washable hand piece, an air hose, 27 attachments (similar to those of the Electric Pen Drive (EPD), already available), as well as similar accessories, such as cutting tools, irrigation nozzles, irrigation tubing etc. The range of application covers trauma (hand, foot, and shoulder), spine, neuro-, as well as craniomaxillofacial surgery.

The APD is the first air-powered high-speed system with integrated irrigation for the prevention of heat necrosis during cutting. Unlike the EPD it does not require a console, and is therefore easier for the OR staff to assemble and handle. In case of enhanced bone resistance the APD's torque decreases, providing the surgeon with an authentic sense of drilling.

It is a both robust and light-weight device. It can be used either with the detachable hand switch, with telescopic extension for better control, or with a foot switch with a large pedal and an extra button for irrigation. The air hose is 3 m in length.

Other important features are:

- Quick and easy fixation and loosening of tools (click-in wherever possible)
- Quick and stable coupling of attachments on hand piece through cone coupling
- Torque-limited screw insertion



Piet de Boer

## NEWS FROM AO EDUCATION



### My view

As the first Director of Education for AO I feel, excited at the prospect at working with the AOTK.

A key element of future development will be to implement new courses and new course formats, fostering a closer integration of Faculty and participants. Naturally, such courses will rely more on interactivity and interactive technology than has been the case so far.

Introducing new technologies approved by the TK is an educational challenge. If new implants are presented in isolation, then education can be regarded as promotion of the particular implant. New technologies therefore need to be taught in the context of a broader educational strategy. For example, the development of the circular frame fixator can most effectively be taught in the context of a course specialising in the treatment of infected nonunion and the correction of complex malformations.

### Projects 2007

Projects for 2007 include a course on the use of osteotomy in the correction of deformity and the prevention of arthritis, as well as a course on the use of circular frames for the treatment of nonunion, infection, deformity, and leg lengthening.

### eLearning

Our eLearning modules need to be reviewed and brought much more closely in line with precourse assessment, distance learning, and perhaps most importantly, postcourse follow-up and directed learning. A needs assessment program, designed by Bob Fox and Karen Costie, will move from its current pilot phase into more worldwide use. In addition the final version of the course assessment protocol, designed by Joe Green, will be piloted in Davos this year, with a view to rolling it out globally in 2007.

### Video

Video production will gradually move to high definition television (HDTV). All new videos and most of our existing videos will be prechunked to aid our table demonstrators and practicals directors. Furthermore, all videos used for the Principles and Advances Course will have stated learning objectives.

### Publishing

The second edition of the "AO Principles Fracture Management" will be available at the end of this year, together with the book on spine. Projects for next year include a book on the use of osteotomies, a handbook for junior doctors and senior medical students, and a book on the pelvis and acetabulum. Finally, all of us have to accept that AO Education and its Faculty are now operating within a new CME environment. The implications for teaching new technologies are significant and we must ensure that the AO Foundation continues to be regarded as an independent scientifically based community.

Piet de Boer, FRCS  
Director of AO Education

Nicola Rusca

## CMF TEACHING VIDEO COLLECTION AVAILABLE ON DVD



The complete collection consists of eighteen CMF Teaching Videos covering a wide spectrum of CMF surgery; from the fixation of the symphysis of the mandible using lag screws and various implants to complex midface fracture surgery such as, orthognathic surgery. Additionally mandibulo-maxillary fixation with arch bars, Ernst ligatures, IMF screws, and the transbuccal system are presented. The teaching set and these videos have been designed for use within AO teaching worldwide.

All CMF Teaching Videos contain the following features:

- Clear structure with chapter and navigation interface (Fig 1)
- Objectives (Fig 2)
- Clinical footage (Fig 3)
- Animations and illustrations (Fig 4)

For more information please visit the site: [www.aofoundation.org/video](http://www.aofoundation.org/video)

If you have any comments or questions regarding AO Teaching Videos, please contact: [nicola.rusca@aofoundation.org](mailto:nicola.rusca@aofoundation.org)

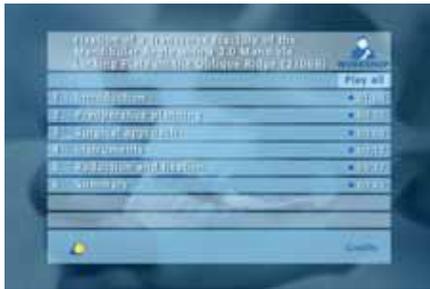


Fig 1

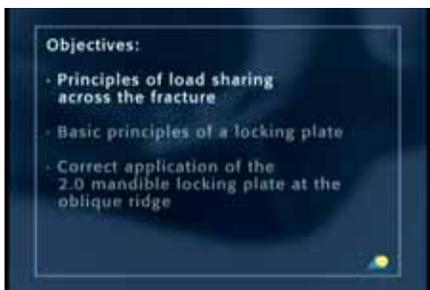


Fig 2



Fig 3



Fig 4

- 21060** Mandibulo-maxillary Fixation with Arch Bars, Ernst Ligatures, IMF Screws, and Plates and Screws
- 21061** Mandibulo-maxillary Fixation with Arch Bars, Ernst Ligatures, IMF Screws, and Plates and Screws (US)
- 21062** Fixation of a Transverse Fracture of the Symphysis of the Mandible with 2.4 mm Lag Screws
- 21063** Fixation of a Transverse Fracture of the Symphysis of the Mandible with two 2.0 Mandible Mini Plates
- 21064** Fixation of a Transverse Fracture of the Symphysis of the Mandible with a 2.4 LC-DCP The removal.
- 21065** Fixation of a Transverse Fracture of the Mandibular Angle with a 2.0 Mandible Mini Plate and an Angled 2.4 Universal Fracture Plate
- 21066** Fixation of a Transverse Fracture of the Mandibular Angle with a 2.0 Mandible Mini Plate and an Angled 2.4 Universal Fracture Plate (with skin)
- 21067** Fixation of a Transverse Fracture of the Mandibular Angle with a 2.0 Mandible Mini Plate on the Oblique Ridge
- 21068** Fixation of a Transverse Fracture of the Mandibular Angle with a 2.0 Mandible Locking Plate on the Oblique Ridge
- 21069** Fixation of a Transverse Fracture of the Mandibular Angle with a 2.0 Mandible Mini Plate on the Oblique Ridge (with skin)
- 21070** Fixation of a Transverse Fracture of the Mandibular Angle with a 2.0 Mandible Locking Plate on the Oblique Ridge (with skin)
- 21071** Fixation of a Comminuted Fracture of the Lateral Body of the Mandible with a 2.4 Locking Reconstruction Plate following Simplification with 2.0 Adaption Plates
- 21072** Bridging of a Segmental Defect of the Lateral Body of the Mandible with a 2.4 Locking Reconstruction Plate
- 21073** Fixation of a Zygomatico-maxillary Fracture using a 1.3 Adaption and a 1.5 L-plate and an Orbital Floor Fracture with an Orbital Floor Mesh Plate
- 21074** Fixation of a Complex Midface Fracture with 1.3 and 1.5 Adaption Plates
- 21075** Advancement and Fixation of the Maxilla and Mandible in Orthognathic Surgery
- 21076** The Transbuccal System
- 21077** The Transbuccal System (US)

Lukas Kamer, Hansrudi Noser, Hans Lamecker, Stefan Zachow, Antonia Wittmers, Thomas Kaup, Alexander Schramm, Beat Hammer

## NEWS FROM THE AO DEVELOPMENT INSTITUTE (ADI)

### Three-dimensional statistical shape analysis—a useful tool for developing a new type of orbital implant?

**What is the average three-dimensional (3-D) shape of the orbit? Is size related to shape? Is there a relevant difference between the left and the right orbit or between different individuals? If so, can it be categorized? In replying to these questions we aim to improve the quality in the repair of complex orbital fractures (COF).**

#### Clinical background

The repair of COF is still a clinical challenge as limited access and visibility make exposure difficult and correct implant-shaping and -positioning is not easy to achieve. Within this fracture pattern the posterior medial wall and orbital floor is an area of special importance where inadequate reconstruction leads to serious functional and cosmetic defects. Typically globe position is affected, resulting in visual impairment and posttraumatic enophthalmos. In order to improve and facilitate the repair of COF, an anatomically preshaped implant which could be perfectly positioned using active intraoperative navigation would be desirable.

In order to achieve this, a more detailed 3-D specification of the anatomy of the bony orbit is necessary. Our objective is to introduce a method for the 3-D statistical assessment of normal orbital shape and its variability. Therefore, with the support of the AO Research Fund, a collaboration between the AO Development Institute (ADI) in Davos, the Konrad Zuse Zentrum für Informationstechnik Berlin (ZIB), and clinicians has been established.

#### 3-D statistical shape analysis

To build statistical orbital models (Fig 1) 3-D triangulated shapes have first to be extracted from the CT data by an expert, using manual, semi-automated segmentation tools. In a second step the expert determines anatomically meaningful patches or regions on the orbits. Patch boundaries are constructed by specifying characteristic anatomical landmarks. Finally the computer determines the corresponding points and produces a statistical model, based on principal component analysis. Such a model contains all shapes of the sample set and enables users to visualize in 3-D the mean shape and its most important variations (Fig 2 and Fig 3).

#### Conclusions

We describe a method to capture patterns of shape variability, providing a useful and powerful tool to assess the variations of the bony orbit. In order to render the variability of a statistical model, it can be visualized, animated or quantified in different ways (Fig 3). Our experience is that among different pathways the methodology may vary, firstly according to the definition of the number and distribution of suitable anatomical landmarks and secondly, depending whether only shape, or shape and size play an important role.

The method is applicable to many medical problems and disciplines. In technical terms it may be adopted to automate the task of image segmentation or to generate virtual templates. As illustrated in Fig 4, several orbital shapes can be produced by rapid prototyping. It may help the clinician to better describe and understand the difference between pathological and normal shape conditions as observed in trauma surgery or craniomaxillofacial deformities. Further it may help to improve analysis, planning, and simulation of surgical procedures.

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Fig 1 Statistical shape model of a left orbit with patches.

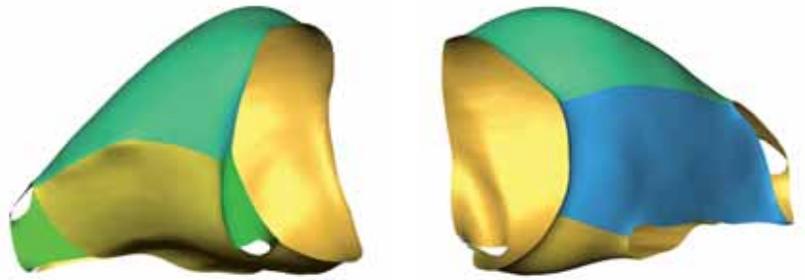


Fig 2 Three shape variations of the orbit, generated from the statistical model.



Fig 3 Visualization of shape variation by colormaps or distance vector fields.

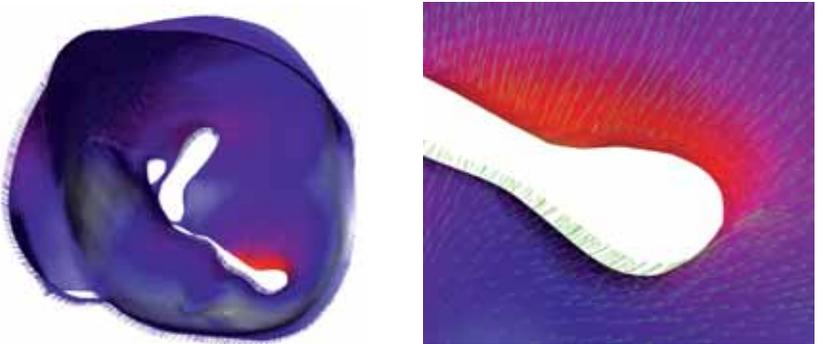


Fig 4 Illustration of shape variability using rapid prototyping.



R Geoff Richards

## NEWS FROM THE AO RESEARCH INSTITUTE (ARI)

### Important developments in implant surfaces



**Fig 1** Example of excessive bone bonding. The entire plate is hidden within the bone. Taken from a critical size defect, sheep model from early work on internal fixation with locking head screws.



**Fig 2** Polished titanium cortex screw after 12 weeks within a sheep tibia showing good bony growth between the threads, but with less direct bone contact compared to the standard microrough titanium screws. It was shown that polishing also reduced the removal torque.

Today a variety of metals are selected for plates used in internal fracture fixation: stainless steel (ISO 5832-1), “commercially pure” titanium (cpTi) (ISO 5832-2), Ti-6%Al-7%Nb (TAN) (ISO 5832-11), and titanium molybdenum (Ti15Mo) (ASTM F2066). Ceramics, polymers, carbon composites, and biodegradable materials are also used in combination with metals for special applications where high load is expected. In general in CMF surgery, the number one choice for plates and meshes is cpTi, using TAN screws. Titanium and cpTi alloys have extreme chemical inertness and are considered highly biocompatible. An oxide passivation film forms on titanium which alloys very quickly and is much more corrosion resistant and thermodynamically stable than the chromium oxide film that forms on stainless steel. This passivation film also forms on titanium wear particles which may be produced, retaining their chemical inertness. For flexible internal fracture fixation where motion and, as a result, fretting is likely, titanium or titanium alloys are therefore the materials of choice. Currently no allergic reactions have been clinically observed to cpTi used exclusively in internal fixation, whereas allergic reactions to nickel in stainless steel implants after internal fixation are estimated to occur in 1–2% of cases.

When an implant is inserted into the body, protein adsorption occurs within seconds and cell adhesion usually within minutes, followed by either soft-tissue adhesion or matrix adhesion and mineralization. Early soft-tissue integration with vascularization at the tissue-implant interface, but without liquid-filled capsule formation, is desirable. While traditionally, soft-tissue attachment to implants is a design goal, certain osteosynthesis applications require that neighbouring tissues freely glide over the implant. Such instances include orbital fractures where connective tissues should glide freely and not adhere to the implant surface. The intrusion of a plate can produce friction for the gliding tissue and is liable to become a site for tissue adhesion and inflammation. These osteosynthesis applications require the development of surfaces that prevent soft-tissue attachment and irritation, allowing tissue gliding, but maintaining their biocompatible properties. One way to reduce the tissue adhesion would be to reduce surface roughness of the plate in contact with the tissue. With long term or permanent CMF implants, osseointegration is vital to their success. In other cases such as plating in pediatric tissue, or areas where esthetics are important, minimal bone bonding to implants is desirable for the least traumatic explantation (Fig 1).

Internal fixation screws require a stable bone–implant interface for transmission of forces, and their success is related to both design and



**Fig 3a** In vivo evaluation of screw removal of polished versus nonpolished titanium. LCP plates with polished versus nonpolished TAN locking head screws. 6, 12 and 18 months are being used to determine whether polishing helps LCP plate and screw removal. We will keep you informed.



**Fig 3b** Standard microrough 4-hole LCP and TAN locking head screw.



**Fig 3c** Polished smooth 4-hole LCP and polished smooth TAN locking head screw.

surface structure. Bony integration is increased on implant surfaces with higher amounts of microroughness. Strong bony integration between the bone and screw is a disadvantage when considering removal of screws (especially in pediatric patients with fast-growing bone); the surface microstructure is the major determinant of this. Bony integration is minimized by using surfaces with minimal microstructure reducing the forces required to remove screws. Recent work with polished titanium and titanium alloys has shown the surfaces to be favourable for such applications (Fig 2). Current studies examine the effect of polishing of multicomponent screw and plate systems (Fig 3) over various clinically relevant time periods. They observe the tissue–implant interactions and their effect on ease of hardware removal. The microstructure of the implant surface of these metals has been shown to be more important than the implant surface chemistry, which is usually similar in the final anodization process (which both protects the implant with a thicker oxide layer and gives the implant its final colour).

In hard-tissue or soft-tissue interactions with biocompatible bulk materials, the “implant biocompatibility” is determined more by design and surface characteristics. Without surface modification an implant may be biocompatible in one anatomical situation, yet not in another. There is no “one surface” for all applications and surfaces even on one implant interacting with different tissues need to be considered as separate entities.

#### Development of implant surfaces in fracture fixation

When developing an implant surface one must always consider that the surfaces must be able to withstand numerous influences. These include sterilization technique; storage time within the sterile packing material; abrasion from handling within the sterile packing material during transport; surgical manipulations such as adapting the implant to the patient’s anatomy; the highly corrosive milieu within the patient’s body; abrasive muscle, tendon or ligament movements upon the implant surface; and time within the body to achieve the desired regeneration or repair. Also, fretting particles produced during implantation should not cause inflammation and should preferably remain at the local site (not entering the lymphatic system). If the surface is a coating, it should not delaminate from the bulk material or cause corrosion to the bulk material if it is to resorb.

In summary, in internal fracture fixation, our in vitro and in vivo findings indicate that surface chemistry is not as paramount to cyto- or biocompatibility as much as surface microtopography. Fortunately microtopography can be adjusted with minimal production costs and can override chemical and other cues, and so has a bright future in solving several current trauma problems.

Edward Ellis III

## PORTRAIT OF ALAN S HERFORD



Alan Herford is Chairman and Program Director of the Department of Oral and Maxillofacial Surgery at the Loma Linda University School of Dentistry as well as Associate Professor of Oral and Maxillofacial Surgery of the Department of Surgery. Born in Michigan, USA, he lived there until he moved to California to pursue additional training at the Loma Linda School of Dentistry in Loma Linda, California, where he became Doctor of Dental Surgery. He then moved to Dallas to attend the Southwestern Medical School to get his Medical Doctor degree. After a one year internship in general surgery at the Parkland Memorial Hospital in Dallas, he completed a residency in oral and maxillofacial surgery under the direction of Edward Ellis III. During his residency, he was awarded the 1st Place Resident Research of the Year Award by the American College of Oral and Maxillofacial Surgeons, one of his many honors and awards.

They say "If you haven't been to Texas, you haven't been home!", but after 6 years in the Lone Star State, Alan Herford decided that it was time to return to California and he went back to Loma Linda University. He chose to return for the opportunity to be involved in an academic center and because of the large patient population there, allowing him to treat hundreds of trauma patients each year. He also

wanted the opportunity to build a program and to train oral and maxillofacial surgery residents. During his tenure at Loma Linda the residency program has tripled in size and has integrated with the Loma Linda University School of Medicine.

Alan's main interests in the field of CMF include trauma and reconstruction of traumatic defects. He also enjoys applying distraction osteogenesis to the facial skeleton as one option for reconstruction. He developed a transport distraction device available clinically to regenerate large mandibular defects.

Alan Herford is an active member in a large number of associations. Having trained with Edward Ellis III in Dallas, Texas, significantly influenced his decision to become a part of AO. Being introduced to the AO philosophy early in his career, he attended his first AO Course while still in residency. He became an AO Faculty member in 2002. Since that time he has served as Faculty at many courses including taking the Chairmanship of two courses over the past year. Chairing the AO Courses has been a gratifying experience to him as he enjoys assembling a great Faculty and seeing the attendees gain from their knowledge and experience.

Alan Herford is happily married and the couple had their first son born this year. When he was young he participated in amateur boxing for many years. Sticking to this old love, he now volunteers at a local amateur boxing gym and serves as a ringside doctor for many of their contests.



**Department of Oral and Maxillofacial Surgery at the School of Dentistry, Loma Linda University, USA**

Renate Huter

## NEWS FROM AO PUBLISHING (AOPUB)



We are happy to announce our latest publication

### AO Manual of Fracture Management Minimally Invasive Plate Osteosynthesis (MIPO)

This publication offers case-based recommendations on the latest development in minimally invasive plate osteosynthesis as taught in the AO MIPO courses organized by the AO East Asia MIPO Group.

The book is divided into a principles and manual part. The principles part introduces the basics in MIPO technique. The manual part deals with recommended indications for MIPO, in well-illustrated cases with detailed step-by-step description.

The book is targeted to an experienced audience.

Number of pages: 370

Number of illustrations: 440

Number of photos: 400

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