IBRA International Bone Research Association

FLASH

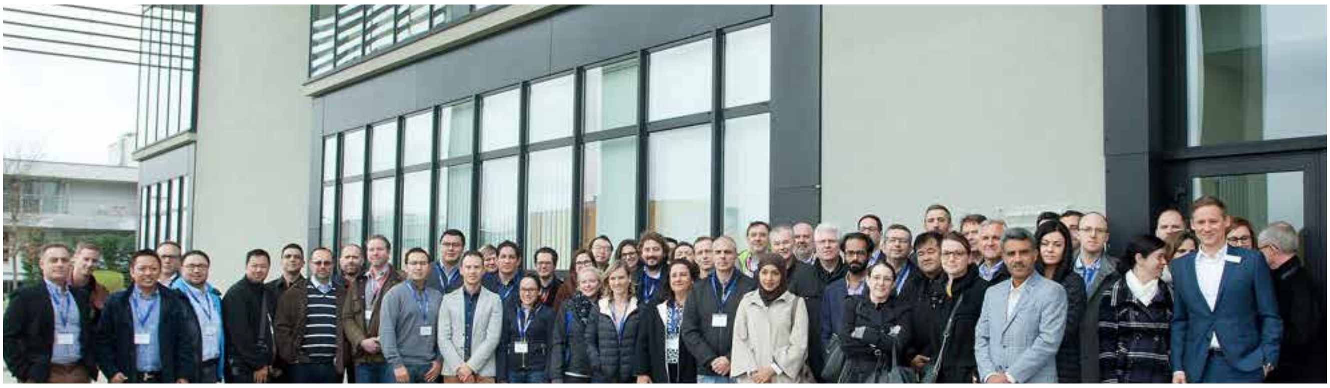
Edition 1, May 2017

Content

Review IBRA Seminar and Workshop

March 23 – 25, 2017 in Besançon, France

Located at the foot of the French Jura Mountains, Besançon is not only the capital city of the Franche-Comté, a traditional province of eastern France, but also one of the greenest cities in France offering an exceptionally high quality of life. Thanks to its rich historical and cultural heritage and unique architecture, Besançon has been awarded the „City of Art and History" since 1986. In the course of industrialization, Besançon became the center of the French watch and textile industry. To date, the city is a leader in micro- and nanotechnology.



Besançon is also the location of our biannual IBRA Seminar and Workshop „Orbital and Lateral Approaches – Internal Fixation" which has been held this year from March 23 – 25. The course focused on a selection of lateral facial approaches and orbital approaches and took place in the Anatomy Laboratory of the Besançon Faculty of Medicine led by Prof. Laurent Tatu.

Like in previous years, we could count on Prof. Dr. Christophe Meyer and Prof. Dr. Dr. Andreas Neff as Chairmen and Hosts of the course. Their devoted and well structured dedication for education combined with the most valuable scientific support and collaboration of the highly experienced international Faculty made this year's course a very demanded and eagerly awaited one.

If you would ask Prof. Meyer why to offer a facial approaches course, you would probably get to hear that it is of importance to look at two possible ways to teach surgical approaches:

One way is to focus on the procedure and have a look at the approach "straight-to-the-bone", but this one often leads to bad scars.

A second way – which represents also our claim – is to focus on the approach as it may be used for several procedures including the osteosynthetic techniques.

We have to bear in mind that the face is a very visible area and related to delicate structures that are to be preserved. With regard to the facial bones, approaches can sometimes have conflicting requirements: to expose the anatomical structures to be approached in the most satisfactory way while minimizing scarring as much as possible and taking care not to damage the delicate surrounding organs, which are particularly numerous in the face. The performance of approaches is often also the first activity entrusted to the young surgeons during their training and it is therefore vital to master this technique.

The highly positive feedback of the participants confirms that the Seminar and Workshop were very well structured and met the expectations throughout. Additionally, our courses are not only an opportunity for the exchange of experiences and enrichment of knowledge and skills, but they also offer the possibility of international encountering over geographical borders.

IBRA Medical further education in cooperation with Vienna

The link and collaboration with Vienna has meanwhile become an important pillar for IBRA's further education. How did this close collaboration between the Vienna Group and IBRA come about?

OA Dr. Martin Leixnering

We were asked by IBRA at an early stage to become involved as speakers in IBRA courses and to assist in designing the then young structure of the courses.
We soon appreciated how beneficial the international contacts between physicians from across the world and the IBRA speakers were, and particularly which common denominators linked us with IBRA: medical, targeted further education and the international exchange of experience in osteosynthesis. IBRA offers a suitable and well established platform for both segments.

Vienna is well known in the German-speaking countries for its „Vienna Hand Courses". Who conducts these courses?

OA Dr. Christoph Pezzei

These courses have been held since the opening of the new Lorenz Böhler Hospital (LBK) in 1972 under the management of Chief Physician Dr. Wolfgang Hintringer and Dr. Martin Leixnering. Our long-standing senior physicians at the LBK and renowned hand surgeons from the German-speaking region design and cooperate in these courses.
The basic and advanced courses are supported by the Accident Insurance and are held on the premises of the General Accident Insurance (AUVA) in Vienna. Wrist and rheumatic hand courses are held in our Lorenz Böhler Accident Hospital.

How long have the „Vienna Hand Courses" been in existence?

OA Dr. Martin Leixnering

The hand courses were started in 1958 by Professor Jörg Böhler, the son of Lorenz Böhler, founder of accident surgery and author of the book „Techniques for treating fractured bones".

Jörg Böhler retired in 1984. He was able to convey his knowledge during several hand courses every year. At this point, the advanced course was added to the basic course. Jörg Böhler passed away in December 2005. Acting on his will, the „Vienna Hand Courses" have since been continued by his scholars Wolfgang Hintringer and me – I have been working in the Lorenz Böhler Accident Hospital since 1980. All our courses have the objective of deepening knowledge in hand surgery.
Meanwhile we not only conduct basic courses, but also offer numerous special courses on the topics of hand and wrist surgery

For which target groups are the „Vienna Hand Courses" and the IBRA courses designed?

OA Dr. Martin Leixnering

Today, the „Vienna Hand Courses" offer basic and advanced courses for hands and wrists and thus primarily address trauma surgeons, hand surgeons, orthopedists and plastic surgeons. In contrast to the IBRA further education courses, which focus mainly on supportive osteosynthetic treatment, our courses are intended as holistic and comprehensive training in hand surgery. Until today, we have been able to welcome over 7,000 participants at our „Vienna Hand Courses".

The course structures in both Vienna and Basle are well thought out and didactically well adapted and designed for the addressed target group. Probably the most significant aspect of both course offers is a high level of presentation and discussion culture. The discussion option introduces innovations with direct feedback of the participants, followed up in depth by practical training on fresh preparations and evaluated in an exchange between colleagues and instructors.

Which format does IBRA follow in its practical training?

Primarius Dr. Wolfgang Hintringer, IBRA President

Over the years, the format of the IBRA courses has of course changed considerably. The first IBRA Workshops usually consisted of pre-operated preparations followed on screens by participants via camera-links, whereby discussion had to be limited, usually for time restrictions.

Today, our IBRA basic and advanced courses are run with well designed and high quality HD videos which focus on the essentials in didactic terms. This not only saves considerable time for the individual tutorials, but also allows free discussion and exchange of experience between all speakers and instructors during the workshops.

All instruction videos for the IBRA basic and advanced courses are produced here in Vienna in cooperation with Martin Leixnering and Christoph Pezzei in the own video studio. We focus on highest quality and attention to detail during production.

For over three years, we have now been offering Masters courses, but with a different format.

What is different for this format?

Primarius Dr. Wolfgang Hintringer, IBRA President

Let me first start by explaining what is common to both formats, the open discussion culture and the strong weighting in favor of a scientific exchange of experience. Great importance is also attached to both elements in the IBRA Master courses.

Further, and in contrast to the conventional courses with artificial bones or undamaged preparations, we work on specimens in the Master courses where realistic injuries to extremities are simulated.
In the last IBRA Flash issue 01/2016, our colleagues from Cologne University published an interesting report on Master courses conducted in Cologne which I would like to recommend here.

The continuously growing international demand for medical further education motivates us to permanently adapt our course structures and formats even if I believe that we will still focus on proven systems for some time.
The role of „Virtual Reality“ in surgical training will also become an integral part in the years to come.

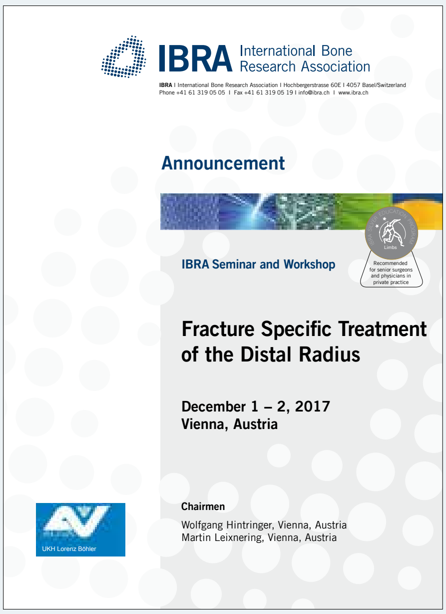
IBRA COURSES IN VIENNA

Since 2012, a Seminar & Workshop is conducted annually in cooperation with the Lorenz Böhler Hospital (AUVA) run by Senior Physician Dr. Martin Leixnering. The focus of the courses is on new treatment strategies, new technologies and in particular, on discussions and an exchange of experiences among colleagues from all over the world.

IBRA also supports scholarship applications (Program A) for participating in the „Vienna Hand Courses“

For details see „www.ibra.ch/Scholarship“

Next IBRA event in Vienna:



Fractures of the distal radius - current treatment

Hermann Krimmer, Roman Wolters

INTRODUCTION

Distal radius fracture is of special importance. First, it is the most common fracture in humans, and second, it can have a negative impact on the function of the wrist and hand in a special way. The frequency of distal radius fractures rises with increasing age because the incidence of osteoporosis is then higher.

In recent years the treatment of distal radius fracture has seen a significant change in trend, moving away from conservative treatment toward surgical treatment. Secondary dislocation after an initially good reduction outcome, inadequate restoration of the articular surface after closed reduction in the case of intra-articular fractures, and a long period of wrist immobilization often lead to unsatisfactory outcomes. Using the osteosynthesis methods of Kirschner wire fixation and the external fixator it was often impossible to achieve satisfactory anatomical reduction and long-term retention. The difficulty with plate osteosynthesis, especially in the case of a dorsal comminuted fracture zone and intra-articular fractures, was that in the distal comminuted fracture zone standard screws are insecure and it was often necessary to perform a cancellous bone graft as well. In addition, it was not always possible to make plate design meet the requirements for accurate reduction and retention so there are often scar problems and misaligned healing.

Only upon introduction of fixed-angle plates, and ultimately also multidirectional fixed-angle plates, was it possible to solve many of these problems. Palmar fixed-angle plate osteosynthesis now represents the preferred method of osteosynthesis and allows long-term anatomical retention of the articular surface, especially in cases of intra-articular involvement. In the case of fractures with a pronounced dorsal comminuted fracture zone or a dislocation that cannot be reduced from palmar the development of special dorsal osteosynthesis plates has brought about considerable progress, as has arthroscopically assisted fracture management with a direct view of the radius articular surface.

FRACTURE CLASSIFICATION

The simplest classification of a distal radius fracture according to the direction of articular surface tilt includes Colles' fracture (dorsal tilt) and Smith's fracture (palmar tilt). This original classification still applies but in recent years it has been extended to include numerous other, more differentiated classifications.
The AO classification is the most important and it is the one used most frequently. However, the disadvantage of all the classifications is that they do not dictate any specific treatment strategy. Meanwhile classifications based on CT scans seem to be more suitable to establish guidelines concerning approach and plate selection.

Fig. 1 Intra-articular distal radius multi-fragment fracture of the extension type (AO classification C3).
a Dorsopalmar x-ray.
b Lateral x-ray.
c Coronal CT.
d Sagittal CT
Treatment see Fig. 2.

DIAGNOSIS

Clinical Picture

In the case of swelling and pain in the wrist after a prior fall incident or any other wrist trauma there is always a clinical fracture suspicion. If there have been acute sensitivity disorders in the median nerve region, a post-traumatic carpal tunnel syndrome may be assumed. In such a case there is always an indication for decompression of the median nerve because otherwise the risk of a complex regional pain syndrome (CRPS, Sudeck's dystrophy) is substantially higher. Additionally important for the treatment concept is the existence of an open or closed soft tissue lesion. In particular, open fractures are common where the distal ulna is also involved.

Imaging Procedures

The standard radiological examination consists of making x-ray images of the wrist in dorsopalmar and lateral projection (projection radiography). In the case of intra-articular fractures or suspected concomitant fractures in the carpal region there is always an indication for thin-layer computed tomography (CT). For a differential diagnosis and with regard to frequent concomitant injuries it is always necessary to consider the existence of a scaphoid fracture, a scapholunate ligament injury, and instability of the distal radioulnar joint.

Magnetic resonance imaging (MRI) is only required if there is a suspected carpal ligament injury or damage to the triangular fibrocartilage complex (TFCC) with instability of the distal radioulnar joint (DRUJ).

TREATMENT

In many cases, good to anatomical reduction can be achieved by closed reduction with traction even if there is considerable malposition. Despite plaster treatment, however, many fractures result in repeated dislocation to the original malposition due to the metaphyseal comminuted fracture zone.

A decision in favor of conservative or surgical treatment should therefore be made dependent on accident images and not on images post reduction especially in case of extra-articular fractures (A3):

- If there is no malposition or if dislocation is only minimal, i.e. less than 10° dorsal tilt (Colles' fractures) and if radius shortening is less than 2 mm, conservative treatment can always be performed with immobilization in a lower-arm cast.
- If the articular surface is tilted to dorsal by more than 20°, if the fracture exhibits palmar tilt (Smith's fractures), or if an intra-articular fracture has developed an offset of more than 2 mm, there is always an indication for surgical management.

The criteria for determining an indication for surgical or conservative treatment therefore have to be initially derived from the morphological aspects of dislocation and instability, which have to be assessed radiologically on the basis of x-ray images and computed tomography.

Conservative Treatment

If the malposition is only minimal and if there is no metaphyseal comminuted fracture zone, closed reduction with traction takes place under adequate analgesia.

„Caution: It is absolutely imperative to refrain from painful reduction maneuvers, in order to avoid a CRPS."

Immobilization is accomplished by applying a radial gutter plaster or plastic splint with palmar and dorsal support, which may not project beyond the distal palmar crease in order to prevent obstruction to closing of the fist. A cast checkup the following day is mandatory. After 2 – 3 days the plaster splint can be wrapped. X-ray checkups should be performed after 1, 2, and 4 weeks in order to detect any secondary dislocation in good time. Immobilization for 4 – 6 weeks is usually sufficient.

Surgical Treatment

- Kirschner Wire Osteosynthesis

The indication for closed reduction with Kirschner wire osteosynthesis exists particularly for fractures in pediatric and adolescent patients where the growth plates are still open. Here two Kirschner wires (1.4 or 1.6 mm) are introduced to the ulnar opposite cortical bone from the styloid process of radius via the fracture, preferably under fluoroscopic control. The two wires should be slightly divergent from each other in order to ensure rotational stability. If it proves impossible to achieve adequate stability, a third K-wire can be introduced at the edge of the 4th extensor tendon sheath in dorsopalmar direction. The wires should be buried subcutaneously in order to avoid infection. After immobilization for 4 – 6 weeks by means of a palmar, radial gutter plaster splint the wires are removed.

- Fixed-Angle Plate Osteosynthesis

Fixed-angle plates are always preferable for osteosynthesis of unstable distal radius fractures because with this method the risk of secondary dislocation of the fragments is much lower.

A distinction is made between unidirectional fixed-angle plates and multidirectional fixed-angle plates as well as between palmar and dorsal use thereof:

- In the case of unidirectional fixed angles the direction of the screw is preset. This is often adequate if plate position is optimal. However, if the plate has to be positioned far distal or far proximal on account of the fracture situation, there is a risk of an intra-articular screw position or suboptimal support of the articular surface because in the second case the screws can no longer be positioned subchondrally.

- With the multidirectional fixed-angle plate the screws can be introduced in various directions with a lateral deviation of up to approx. 15° from the perpendicular position. This permits screw positioning that is customized, fracture-oriented, and adapted to plate position.

Fig. 2 Osteosynthetic management using a palmar plate – fixed angle, multidirectional, watershed design (see Fig. 1).
a Dorsopalmar x-ray.
b Lateral x-ray.
c Coronal CT.
d Sagittal CT.

There are three fundamentally different methods of locking the screw head with the plate:

- Applying the principle of material deformation, a hard external thread in the region of the screw head cuts into the softer plate material. The drawback with this is that if the screw direction is adjusted, the screw head tends to take the path of least resistance and returns to the original direction. In addition, when the plate is removed, there is the problem of cold fusion between the screw head and the plate.

- Another method often used is to interlock the screwby engaging an external thread in the head section with an internal thread in the plate section. However, the disadvantage of this is that in the interlock the screw head seeks the path of least resistance and thus counteracts the variability of screw direction. To avoid problems with metal removal it is absolutely essential to use a torque screwdriver.

- A more recent method is spherical head space locking in which, during insertion of the screw head into the plate, friction grip occurs when resistance has been overcome, i.e. a kind of wedging takes place between the screw head and the plate. This creates the advantage of infinite locking without the risk of any cold fusion. In addition, with this method the plate design can be kept very flat and metal removal is possible without any problems.

Plate design and plate position

In the case of extra-articular fractures with a stable bone structur conventional T-plates with just one distal row of screws appear to be adequate. With intra-articular or multi-fragment fractures, however, multidirectional fixed-angled plates should be used with two rows of distal support because then both the central articular surface and the dorsal articular surface can be optimally supported (Fig. 2). In that case a subchondral screw position provides maximum stability.

Ulnar rim fragments can be optimally held by plates with a special watershed design (Fig. 3 c).
Secondary ruptures of the flexor tendons, especially the long thumb flexor tendon (flexor pollicis longus tendon, FPL tendon), are a feared complication. Prominent distal plate rims and projecting screw heads increase the risk of a rupture. For this reason, plates were developed with a low-profile design, as well as special plates that are recessed in the region of the FPL tendon, thus minimizing the secondary rupture risk (Fig. 3 d).

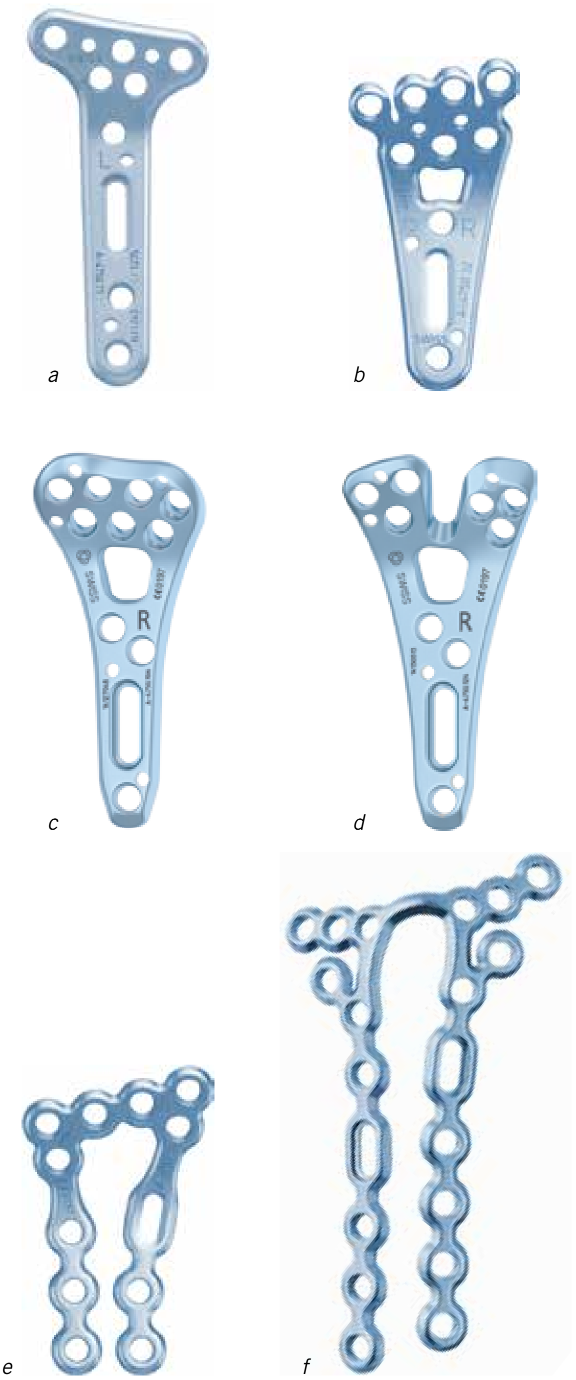


Fig. 3 Various plate types (courtesy of Medartis, Basel, CH).

a Fixed-angle palmar T-plate.
b Fixed-angle palmar plate with wide supporting surface.
c Fixed-angle palmar plate of „watershed design“ (see Fig. 2).
d Fixed-angle palmar plate of „FPL (flexor pollicis longus) design“ (see Fig. 6).
e Frame plate can be used for palmar as well as for dorsal approach depending on the indication (see Figs. 9 and 11).
f Dorsal plate for severely comminuted fractures of the dorsal rim (see Fig. 8).

However, the critical aspect of risk minimization is particularly optimal plate positioning. The watershed line (Fig. 4) must be regarded as the distal limit because otherwise the plate would exhibit distal prominence.
This line corresponds to the maximum prominence of the distal palmar radius surface. Here too, there are now special plates available, the design of which takes the watershed line into account (Figs. 3 c, d).

The distal and palmar prominence of the plates is defined by Soong's line (Fig. 5):

- Soong 0 describes an optimal plate position.
- In Soong 1 the distal plate end exhibits palmar prominence. Here there is an optional indication for metal removal.
- In Soong 2 there is palmar and distal plate prominence. Here metal removal is mandatory in due course.

Fig. 4 Watershed line.

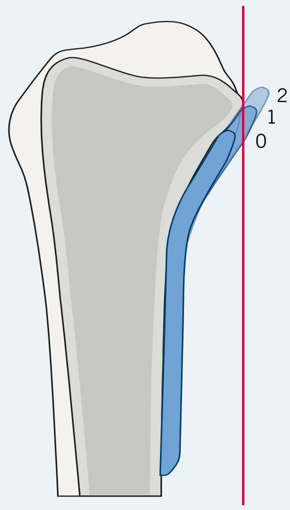


Fig. 5 Implant prominence with respect to the watershed line (Soong 0, 1 and 2).

In exceptional cases, far distal positioning of the plate may be necessary to support a rim fragment that is located far distal. In such a case, early plate removal should be envisaged after 6 months in order to avoid irritation and ruptures of the flexor tendons in due course.

To avoid secondary extensor tendon ruptures the selected distal screws should always be 2 mm shorter than measured. Biomechanically this does not bring about any reduction in stability. It is absolutely essential to avoid extensor-side prominence of screws. In case of doubt this can be examined by means of an x-ray checkup with a horizontal beam (skyline view, dorsal horizontal view). It is important to note that the distal radius toward dorsal has a triangular contour and on the lateral x-ray image the dorsal rim can falsely suggest that the screw ends are in a subcortical position.
In the case of a pronounced dorsal comminuted fracture zone or a dislocation that cannot be reduced from palmar, dorsal plate osteosynthesis may be indicated (Figs. 8 and 9) or even double plate osteosynthesis with a combination of a palmar plate and a dorsal plate.

Fig. 6 C3 fracture with ulnar rim fragment.
a Preoperative coronal CT.
b Postoperative x-ray image after treatment with palmar FPL plate.

In the case of extremely far distal intra-articular multi-fragment fractures, arthroscopically assisted fracture management has become increasingly important in recent years. Under vision of the articular surface the fragments can be reduced in a closed procedure and be subjected to osteosynthetic treatment with screws or wires in minimally invasive surgery. However, this calls not only for suitable instrumentation but also substantial surgical experience and it is only performed by appropriate centers at present.
If the lunate facet is involved release of the FCR tendon sheath allows to retract the flexor tendons far ulnarly for better overview .

As an alternative to temporary K-wire transfixation, after fixation of the plate in the shaft region the distal fragments can be reduced against the plate. Stabilization of fractures that are very far distal requires special analysis of the fracture morphology, especially if there is an ulnar rim fragment.
In this case, the plate must be mounted very far distal so plates with a watershed design and the FPL plate should be used chiefly (Fig. 6)

If the fragment is of sufficient size, stabilization or support can be provided by the plate, whereby certainly at least two screws should be placed in the fragment.

Fig. 7 Stabilization of a small shell fragment by a hooked mini-plate.

SURGICAL STEPS AND TECHNIQUES

Palmar Plate

- A longitudinal incision over the distal part of the flexor carpi radialis tendon (FCR tendon) is followed by deep exposure between that tendon and the radial artery.
- After exposure of the pronator quadratus muscle it is divided in the distal radial portion and detached from the radius.
- In the case of extension fractures, exposure of the fracture is followed by reduction with traction and countertraction, ulnar duction, and palmar flexion, if necessary with pressure from dorsal.
- In the case of intra-articular fractures of the styloid process of radius the distal insertion of the brachioradialis muscle should be detached from the process subperiosteally if the latter prevents anatomical reduction due to its traction to proximal.
- The reduction outcome can be subjected to temporary stabilization with a K-wire (1.4 or 1.6 mm) introduced percutaneously from the styloid process of radius, possibly supplemented by one introduced from ulnar.
- Inspection of the reduction by fluoroscopy is followed by placement and alignment of the plate. For the time being the latter is fixed in the gliding hole of the shaft region with a cortical screw.
- After another fluoroscopic check, and possibly correction of plate position, the other plate holes are filled step by step. In the fluoroscopic check the inclination of the distal articular surface of radius has to be monitored to be able to ensure an extra-articular screw position.

If the fragments are very small and have to be evaluated as osseous ligament avulsions due to a radiocarpal luxation, stabilization by a plate is no longer possible. In such cases the small fragments can be fixed in place either by fragment-specific techniques with small hooked mini-plates or by small screws from the hand system 1.2 – 1.5 mm (Fig. 7).

After that it is important to check the stability of the radiocarpal joint. If that is uncertain, for the time being temporary fixation of the proximal row of carpal bones against the radius should be performed using a Kirschner wire introduced from dorsal. This can prevent secondary radiocarpal dislocation until the ligamentous structures have healed completely (see Fig. 10).

Concomitant Injuries

Scapholunate ligament rupture is one of the most frequent overlooked concomitant injuries. Therefore, after stabilization of the distal radius fracture, it should be standard procedure to perform a cinematographic check on carpal stability under fluoroscopic control. Furthermore, with a lateral beam it is important to look out for an extension malposition of the lunate bone (dorsal intercalated segment instability, DISI) and palmar tilt of the scaphoid bone. If a dynamic examination suggests a scapholunate ligament injury, open reduction from dorsal with temporary carpal K-wire transfixation, and possibly ligament suture, is preferable to closed reduction.

A simultaneous scaphoid fracture also has to be ruled out. In case of doubt a preoperative CT scan should be performed. When a radius fracture undergoes surgical treatment, the scaphoid fracture can then be subjected to screw osteosynthesis at the same time. The stability of the distal radioulnar joint (DRUJ) should be tested clinically after treatment of the radius fracture. In the event of severe instability there is an indication for refixation of the ulnar styloid process (USP) or for refixation of the TFCC.

Follow-Up Treatment

When osteosynthesis has been performed, the wrist should be immobilized for 2 weeks in an anterior plaster splint in order to ensure wound healing devoid of complications. Any existing partial injuries to the ulnocarpal complex (TFCC) or the carpal ligaments worthy of surgery require a minimum immobilization period of 4 weeks for complete healing.

In the case of intra-articular multi-fragment fractures we extend immobilization to 4 weeks in order to ensure osseous healing without secondary dislocation. However, the wrist should be trained out of the splint with hand therapy from the 3rd week if possible.

If a palmar plaster splint is applied, care must be taken to ensure that the distal end of the splint does not project beyond the distal palmar crease, in order to ensure free finger mobility. If closing of the fist is incomplete, early hand therapy treatment is indicated in order to avoid functional impairments later.

Nor should appropriate postoperative pain therapy and physical measures to reduce swelling (limb raised, cooling, lymphatic drainage) be neglected, in order to minimize the risk of a CRPS developing in due course.

Indication for Metal Removal

If plate position is optimal, a palmar plate can be left in place permanently. If, however, there is palmar or distal plate prominence (Soong 1 and Soong 2, see Fig. 5) or if screws project dorsally, the plate should be removed at an early stage in order to prevent secondary tendon ruptures, which can still occur even if the osteosynthesis took place years previously.

Due to inferior soft-tissue coverage dorsal plates often cause persistent discomfort and soft-tissue irritation so in this case metal removal in due course is indicated.

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SURGICAL STEPS AND TECHNIQUES

Dorsal Plate

- In the case of dorsal plate osteosynthesis the approach is via a slightly curved skin incision in the region of the dorsal distal radius in projection over the 3rd extensor tendon sheath.
- First, the dorsal retinaculum is exposed. When the 3rd extensor tendon sheath has been opened, the EPL tendon is luxated out of joint and held away to radial.
- Now the adjacent extensor tendon sheaths are detached subperiosteally so that the floor of the extensor tendon sheaths remains intact.
- For reduction of the fragments the wrist can be opened from dorsal in order to obtain a direct view of the radial articular surface.
- After applying the dorsal osteosynthesis plate the screws in the shaft region are placed first and then the screws in the distal plate limb. Here again it is important to ensure subchondral screw positioning. If necessary, the distal plate section can also remain vacant if it is sufficient for the plate to have a purely supportive function.
- If for wound closure it is not possible to close the 3rd extensor tendon sheath due to high soft-tissue tension, it is no problem to move the EPL tendon subcutaneously.

Fig. 8 Fracture management using specific dorsal plate.
a pa severely comminuted fracture.
b Destroyed dorsal rim.
c postop.

Fig. 9 Fracture management using a dorsal plate in the case of preserved palmar cortical bone and impression of the articular surface.
a Fracture with central impression of the articular surface.
b Fracture with central impression of the articular surface.
c Postoperative dorsopalmar x-ray.
d Postoperative lateral x-ray.

COMPLICATIONS AND SECONDARY INTERVENTIONS

Attention has already been drawn to the risk of rupturing the long thumb flexor tendon if the palmar plate is positioned too far distal. In such a case, revision is indicated with plate removal and tendon reconstruction, e.g. by transferring the superficial flexor tendon of the ring finger (FDS IV transfer). If other flexor tendons are ruptured, they should always be reconstructed, whereby the present functional impairment has to be taken into account when determining the indication. Apart from tendon transfers, tendon transplantations are also feasible.

If the long thumb extensor tendon (extensor pollicis longus, EPL) is ruptured due to screws projecting dorsally, the standard reconstruction procedure is transfer of the extensor indicis proprius tendon (EIP transfer). Tendon transplantation is an alternative.
Naturally the screws projecting dorsally have to be removed simultaneously, usually within the scope of complete metal removal after securing the complete osseous consolidation.

If an intra-articular screw position is suspected a CT scan should be performed. If the evidence is positive, metal removal should take place at an early stage in order to avoid radiocarpal cartilage damage and arthrosis.

A secondary dislocation (Fig. 10) can occur as a result of a multi-fragment, highly unstable fracture, but also in the case of inferior bone quality due to osteoporosis. In the second case there is so-called through-sintering of the distal fragments, whereby the position of the fixed-angle plate/ screw construction is unchanged. For elderly patients affected by this, simply removing the metal may be adequate if there is little discomfort. In younger patients and if functional requirements are demanding, a secondary dislocation makes it necessary to perform an early correction, possibly with a cancellous bone graft. However, before surgery takes place severe radiocarpal arthrosis must be ruled out.

In the event of manifest radiocarpal arthrosis, acceptable pain-free function can be achieved by radioscapholunate arthrodesis (RSL fusion). Since for fracture management a palmar approach has normally been used already, this intervention should also be performed from palmar in order to allow reduction of the carpus and to avoid additional scarring.

Fig. 10 Secondary dislocation.
a Secondary dislocation with subluxation of carpus to palmar with an unstable palmar rim fragment.
b Correction using FPL Plate and screws with temporary fixation of the carpus.

Fig. 11 Radiolunate arthrosis.
a Radiolunate arthrosis with intra-articular screw position.
b Dorsopalmar x-ray following RSL fusion.
c Lateral x-ray following RSL fusion.

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Talonavicular Joint Arthrodesis

Tim Schneider

INTRODUCTION

Talonavicular joint (TNJ) arthrodesis is the treatment of choice for degenerative conditions of that joint. It is also a helpful adjunct in hindfoot malalignment problems. It was first described by Ogston (10) in 1884 for pronated feet in the paediatric population. It has been used in the adult population more commonly since the 1970's and since then numerous reports of the procedure have been published. The indications can be largely grouped as inflammatory or degenerative arthritis, acquired planovalgus deformity and (less commonly) avascular collapse of the navicular (Müller-Weiss syndrome).

BIOMECHANICS

Biomechanical studies show that isolated TNJ arthrodesis more effectively controls hindfoot position than either subtalar or calcaneocuboid arthrodesis alone (1, 11,13). Double arthrodesis (TNJ and CCJ) does not confer significantly greater control than isolated TNJ arthrodesis (11).
Studies show that TNJ arthrodesis has the effect of increased force transmitted through the axially loaded STJ, but significantly less than if a double arthrodesis is performed. (16) While some evidence suggests that a triple fusion will increase force across an axially loaded ankle there is no clinical evidence demonstrating increased ankle degeneration after that procedure.

SURGICAL TECHNIQUE

Isolated TNJ arthrodesis has general been described via a dorsal approach between Tibialis Anterior and EHL , or a medial approach just above the Tibialis Posterior Tendon. My preferred method is via dorsal approach.

Once the dorsal margin of the joint is displayed , the dorsal osteophytes are removed from both sides of the joint. Care needs to be taken to avoid removing too much from the navicular as this forms part of the dorsal buttress holding the retrograde screw fixation. Both the medial and lateral ends of the joint are exposed to allow adequate mobilization for preparation and positioning of the joint for final fixation.

An elevator placed under one side of the talar head levers the navicular down for talar preparation with either osteotomes, a ronguer, or a small saggital saw. The aim is to sculpt a convex surface with minimal joint resection and shortening. The retractor is repositioned to access the other side of the talar head. This should create a curved cancellous bone surface.

The navicular surface is accessed by reversing the retractors to raise the navicular. A laminar spreader in either side of the joint is helpful, but care needs to be taken to not fracture the dorsal margin of the navicular . The joint surface is rather difficult to prepare as it is concave and usually very sclerotic. Curved osteotomes are best to remove all articular debris. This generally leaves dense sclerotic subchondral bone which needs to be penetrated with multiple passes of a 2mm K wire or a fine drill, or a small sharp osteotome. The aim is to create a curved surface to match the head of the talus.

Positioning of the arthrodesis is critical. There is potential to malposition the navicular with: abduction- adduction, pronation – supernation, and dorsiflexion – plantarflexion.

With the surfaces coapted, a guide wire (1.6mm) for a 5mm cannulated screw is placed centrally from the distal navicular in a retrograde fashion. It needs to exit the articular surface of the navicular around the junction of the middle and upper 1/3 of the joint. This provides a sufficient buttress to stop the screw breaking out dorsally while being flat enough to avoid penetrating the STJ. Observe from above for abduction position and from laterally for flexion position. The position can still be rotated to correct pronation while looking along the axis of the second metatarsal and observing the plane of the plantar surface of the foot.

A second guide wire is placed percutaneously from the distal medial tubercle of the navicular and aimed slightly more dorsally as its staring point is lower than the first. Try and make it as parallel as possible to the first wire. A third wire is place in the lateral third of the navicular, also in a retrograde fashion and roughly parallel to the first wire. Do not advance the second and third wires until the surfaces are compressed together and you are satisfied with the rotation. Once these wires are advanced into the talus, the position is fixed in all dimensions.

If the surfaces are not coapted as these wires advance into the talus, they can act to splint the joint space open and contribute to a non union.

Fixation is with 3,5mm cannulated compression screws of around 25 to 35mm. Pre drill all holes to avoid fracturing the dorsal margin of the navicular. Check with image intensifier to be sure the screws are not violating the navicular to cuneiform joints or the STJ. Be sure to bury the screw heads. Close the wound in layers and apply a fiberglass back slab caste with foot in a neutral position.

Fixation can be supplemented with a dorsal locking plate and screws, however the majority of evidence report only marginal superiority of plate and screws over a screw only construct (7). I supplement the screw fixation with a plate if there are concerns such as a broken dorsal navicular margin, poor bone stock, or concerns about patient compliance.

Postoperative remain strictly non weight bearing in a caste until union at 6 to 8 weeks. If there is any uncertainty as to the union, check CT scan at 8 weeks before full weight bearing.

COMPLICATIONS

1. Non Union: This procedure has a reputation for non union, because of historical experience. However more recent series report a greater than 95% union rate with contemporary fixation methods , better preparation and use of intra operative XR (3,4,12,2,9)

2. Malunion: Excessive pronation or supernation can lead to excessive loading of the lateral foot or hallux. Abduction can contribute to painful lateral weight bearing.

3. Adjacent Joint Arthritis: Several studies have investigated the problem of adjacent joint arthritis. There is definite evidence of overload on surrounding joints in laboratory simulations. This has not proven to be a significant problem in spite of reports of up to 30% incidence on some longer term follow up series (5).

4. Metalware Problems: Care needs to be taken to avoid violating the surrounding joints. Flat head compression screws make it easier to bury the screws and spare the distal joints. Dorsal plates can be easily recessed and are rarely prominent. Care needs to be taken to avoid extending a dorsal plate to far proximally and impinging on the anterior ankle joint.

BIOMECHANICAL OUTCOME

An isolated TNJ arthrodesis results in a 70% reduction in hindfoot inversion and 40% prolongation in the heel-off during the stance phase of gait. This resulted in decreased step length and reduced velocity (10). In comparing an isolated TNJ arthrodesis and triple arthrodesis, Suckel (15) demonstrated that the TNJ arthrodesis gave lower peak pressure loads in the ankle joint.

CLINICAL OUTCOME

Several series report a high level of satisfaction in patients with primary degenerative, inflammatory and planovalgus deformity (5, 6, 7, 8, 15, 16). The procedure affords good pain relief, although most patients report at least some difficulty on uneven surfaces. In spite of that most patients are very happy with the level of pain relief regardless of the stiffness.

SUMMARY

Isolated TNJ arthrodesis is procedure which effectively alleviates degenerative pain in that joint. It effectively controls and stabilizes hindfoot motion with relatively less impact on the surrounding joints when compared to a double or triple arthrodesis. With careful preparation, joint positioning, and modern compression screw fixation very high union rates and patient satisfaction can be achieved.

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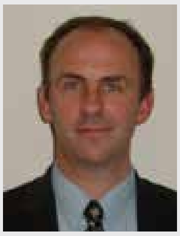

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Condylar head fracture osteosynthesis

Andreas Neff

INTRODUCTION

Until the beginning of this century, mandibular condylar head fractures (CHF, also called diacapitular or "intracapsular" fractures) were considered not to be amenable to safe and effective osteosynthesis [2]. Besides lack of suited osteosynthesis materials, the vicinity of the CHF to the facial nerve was considered to be a major risk factor. Thus, according to general consensus, ORIF was considered still to be experimental [4] and CHF remained a domain of non-surgical treatment. Thus, a malposition of the fragments and loss of physiological functionality of the TMJ had to be compulsorily accepted. In 1992, RASSE [22] was the first to describe a resorbable PDS pin osteosynthesis following the K-wire technique, which, however, failed to withstand to high functional loadings presenting in the temporomandibular joint (TMJ). With the advent of modern titanium small fragment screws exhibiting high retentive values in the spongious bone of the mandibular condyle and refined techniques to approach these fractures affecting the TMJ, both an efficient and stable ORIF of the condylar head could be realised [18, 20,26] and can be considered as golden standard of CHF osteosyntehsis by now [9, 16]. By now, a broad range of different methods have been proposed [1, 5-8, 10-11, 13, 21-26]. Nevertheless, any method of ORIF of the condylar head should aspire to stand measurement not only against closed treatment methods, but against the efficient function of a pretraumatic TM-joint. Therefore, ORIF in condylar head traumatology must aim not only at an anatomically precise reduction, but equally importantly, the physiological restoration of the disco-ligamental structures.

BIOMECHANICAL CONSIDERATIONS

Major requirements for a functional and physiological restoration of condylar head fractures are an exact anatomical reduction of hard and soft tissues and an efficient early functional mobilisation [14-15, 12-20]. Preservation of both disc and condylar mobility are prerequisites to allow for free functional movements in order to prevent degenerative long term sequelae, such as disc perforation or osteoarthrosis after ORIF [5, 9, 16].

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Therefore, an efficient ORIF of condylar heads must meet the following criteria:

- sufficient primary stability to prevent secondary displacement, e.g. due to manipulations during osteosynthesis of complex trauma cases.
- sufficient secondary stability to allow an efficient early functional mobilisation, if possible even under forced training conditions.
- atraumatic design and position of the osteosynthesis material to prevent functional limitations due to intra- and/or periarticular scars.

Biomechanical stability of ORIF performed with screws depends on number, material, core diameter and retentive values of the screws applied for condylar head osteosynthesis [14-15, 18-20, 25-26]. According to biomechanical tests a combination of three positional screws gives optimum stability and significantly increases torsional stability by a factor more than twofold compared to a combination of e.g. two lag-screws [18]. According to the experiences with ORIF in a collective of more than 300 condylar head fractures since 1993 [9, 18-20], titanium small fragment screws (e.g. diameter 1.7 or 1.8mm) have successfully proven their clinical applicability [16] and thus can be recommended as a material of choice (cf. case series fig. 1). Titanium small fragment positional screws (SFPS) allow a reduction of core diameter in combination with a significantly better retention in the cancellous bone of the condylar head compared to conventional cortical or resorbable screws [18-20]. Thus, they represent an ideal compromise between necessary load resistance, superior retentive values and least traumatic effect to the condyle, and allow the placement of a sufficient number of screws. Another important clinical factor is the flat shape of the small fragment screw heads, which are the only parts that may interfere with the periarticular soft tissues and thus will induce less scarring [14-15, 18-20]. In the author‘s experience, titanium osteosynthesis materials need to be removed after healing of condylar head fractures in order to preclude potential adverse long-term sequelae. After ORIF some remodeling process takes place which is not precisely predictable and may lead to interference of the osteosynthesis material with the periarticular soft or hard tissues (cf. fig 2). Using for example miniplates [6, 19] or headless titanium screws [11], later management e.g. in case of posttraumatic osteoarthrosis might occur.

Figure 1: Clinical case series of a condylar head fracture type C [12, 17] presenting after an unavailing conservative therapy with persisting occlusal disorders; top: preoperative 3D-CTs showing the loss of the condyle to fossa relation; bottom: preoperative OPT and postoperative OPT and Clementschitsch (viz. Townes view).

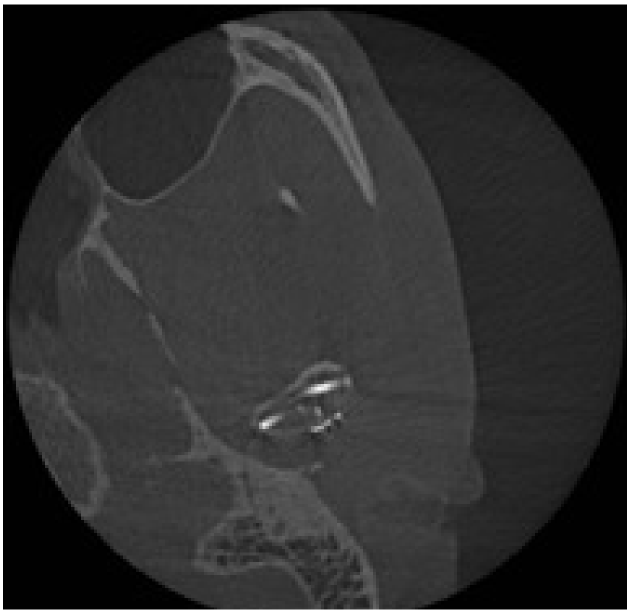

Figure 2: Left: Head of a small fragment positional screw (SFPS) protruding over the lateral aspect of the right condyle due to a remodelling process, with no signs of OSM loosening or instability of the fragments at removal of OSM 3 months postoperatively via retroauricular approach.
Right: postoperative cone beam showing the screw still at bone level (control postoperatively).

TECHNIQUE

The procedure presented in this report was basically adjusted to the retroauricular approach [3, 14-15, 19-20] and small fragment positional screw osteosynthesis (SFPSO) [9, 16, 18-20] based on elaborate biomechanical testing [20]. The technique is presented in detail as a step by step procedure in the manual of the modus 1.8 CFS system, which is readily available for download . As a principle, ORIF has also been performed and described by a PDS-Pin or Kirschner's wire fixation, followed by cortical screws [6, 20], cannulated lagscrew [7, 11, 21], resorbable screws [13, 18-20, 25] or resorbabable pins [1, 23]. So far, however, no functional and biomechanical testing results are available for these latter procedures in contrast to SFPSO [20].

Step 1

Reduction of the small fragment

As a rule the small fragment is displaced by the lateral pterygoid muscle in an anterior and medioinferior direction [22]. After entering the inferior joint space a distraction of the fracture site must be performed for reduction. A special retractor fixed by an ancillary screw (cf. fig. 3) reduces trauma to the periarticular soft tissues (including auriculotemporal nerve and frontal branch of the facial nerve) as the forceps traction is directed towards the bone via the ancillary screw and allows a refined three-dimensional guide vis-a-vis the fracture gap. Next, the small fragment is reduced together with the disc after securing complete muscular relaxation.

Figure 3: Ancillary screw in the upper condylar process, length about 9mm (top) and special tissue retractor (bottom) for an improved three-dimensional guidance (cf. manual MODUS™ CFS 1.8 [14]).

As the lateral pterygoid muscle must never be detached from the small fragment, it is crucial to perform this step as atraumatically as possible, e.g. using a pair of special atraumatic reduction forceps (cf. fig. 4). As sharp clamps might induce additional fragmentation of the delicate proximal fragment, special care should be taken to avoid any trauma to the condylar head during reposition. In order to secure an optimum three-dimensional position of the condylar head, it is mandatory to control the anatomically correct transition both to the condylar neck in the lateral condylar pole area and at the lower border of the fracture gap, i.e. the medial and caudal transition to the dorsal condylar neck. Here, due to rotational forces acting upon the small fragment, it may be necessary to correct the position using a fine hook (cf. fig. 4 right). Next, the correct three-dimensional position can be maintained e.g. using a rectangular ancillary microplate (cf. figs 4 & 5).

Figure 4: Reduction forceps (top) for an atraumatic reduction of the small fragment. If necessary the position is corrected by a fine hook (bottom) and then can be secured by an ancillary microplate (cf. manual MODUS™ CFS 1.8 [14]).

Step 2

Screw osteosynthesis of the small fragment

Internal fixation of the condylar head is performed with at least two, respectively three screws whenever possible. The self-cutting positional screws are predrilled over the lateral condylar pole strictly below the lateral attachment of the capsule, respectively via the upper condylar neck (cf. fig. 5). This will secure that the screwheads will stay extraarticular afterwards, minimizing trauma to the periarticular soft tissues. During the whole drilling procedure the correct anatomical position of the condylar head is secured by the ancillary microplate. As the position and direction of the screws should be oriented according to the transversal axis of the condylar head, the reduction forceps with its length markings can be used both for the orientation and adjustment of the drilling guide and tissue protection of the medial joint area.

If drilling from an anterolateral direction is necessary, the drilling guide can also be introduced via the external auditory canal (retroauricular approach) or transcutaneously (preauricular approach). After insertion of the screw the reduction forceps serves also as a control to exclude any overprojection of the screw (cf. fig. 6). If necessary, the screw may be replaced by a shorter one. Minor overprojections in medial or anterior direction (lateral pterygoid muscle) may be tolerated as long as the screw stays out of the joint space itself. In most cases, screws 13 to 16mm will fit best (cf. fig. 6).

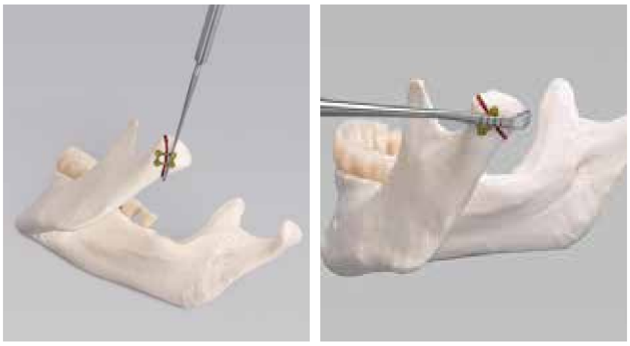

Figure 5: Screw length and direction are given by the reduction forceps with length markings (top). Drilling guide for tissue protection and length adjustment for drilling in the direction of the transversal condylar axis (bottom), the reposition is secured by the ancillary microplate (cf. manual MODUS™ CFS 1.8 [14]).

Figure 6: Top: Functionally stable ostesynthesis with three positional screws via the lateral condylar pole; bottom: The reduction forceps serves also as a control to exclude any overprojection of the screws (cf. manual MODUS™ CFS 1.8 [14]).

As the lateral pterygoid muscle (pull up to 400N) outweighs any interfragmentary interdigitation, the buttress effect in condylar head fractures is negligible [12, 14-15, 18-20]. ORIF therefore must stand both high retentive and torsional forces and is more or less fully loadbearing. Especially in case of multifragmented fractures, which make up as much as 1/3 of all head fractures and which are significantly most frequent in case of type B fractures [12, 17] (cf. figs 7 & 8), it is often necessary not to remove the ancillary rectangular plate, which can provide an efficient torsional protection. However, as a principle, the osteosynthesis material must never interfere with the condylar surface and the gliding path of the articular eminence, respectively.

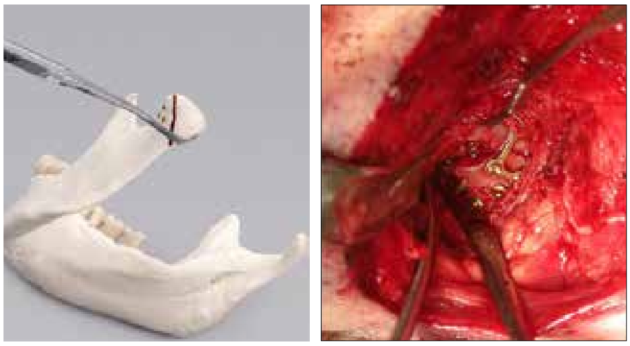

Figure 7: Clinical aspect in case of a type B fracture with butterfly fragment of the lateral condylar pole [14, 17]. The microplate is required to warrant full functional stability.

POSTOPERATIVE CARE

According to the author's protocol a correct screw position will be controlled best using a cone beam CT. Basically, ORIF with 2-3 positional screws will allow for an immediate postoperative loading under soft to normal diet conditions. Patients should perform early mobilization of their joints with a special focus on rehabilitation of protrusive and laterotrusive movements of the mandible in order to restore first of all normal translatory movements, i.e restoration of normal mobility both in the upper and lower joint compartment. Physiotherapy, therefore, is considered rather as a support treatment adding to the patient's functional loading and physiological movements of the jaw. In contrast, conventional forced mobilisation measurers e.g. by jaw opening devices will lead to a primarily rotatory mobilisation and may induce potentially excessive joint loading. As forced mobilization is associated with high lever action [18], this may lead to secondary displacement especially in case of multifragmented fractures (Caveat). As the TMJ disc and periarticular tissues require motion, any kind of immobilisation should be avoided whenever possible.

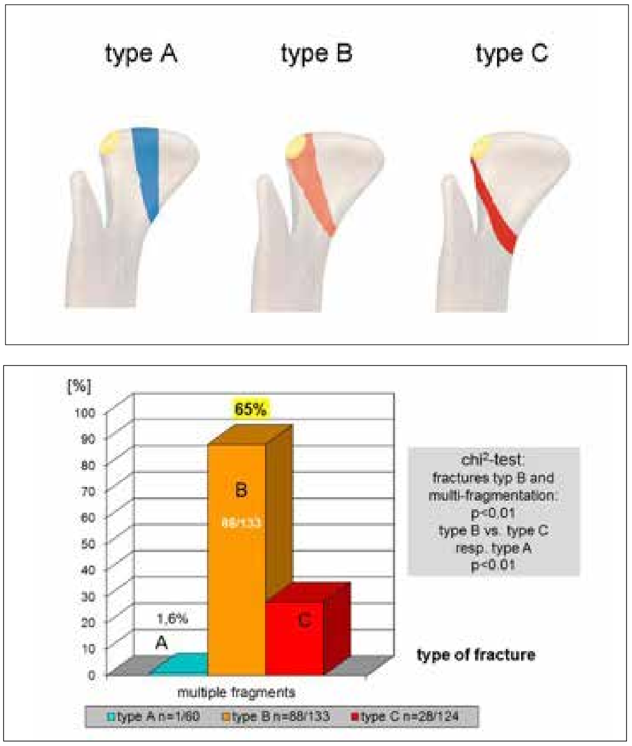

Figure 8: Above: Areas of typical fracture lines with regard to the lateral attachment of the capsule (yellow area), with fracture types A, B and C (cf. manual MODUS™ CFS 1.8 [14]). Below: Incidence and distribution of multifragmented condylar head fractures. The overall incidence of multifragmented fractures is over 30% (119 out of 317 fractures per 12/2016) with type B (over 60%) as the most prevalent type by far (chi-square test, p<0.01).

CONCLUSIONS

In contrast to conventional resorbable materials [1, 13, 18-20, 23-25] and solely micro- or miniplating [6, 10, 18-20], titanium positional screw osteosynthesis allows a functionally stable ORIF in condylar head traumatology without interfering with the highly sensitive disco-ligamental structures. However, an anatomically correct ORIF alone (i.e regarding the alignment of the bony structures as seen on the x-ray) will not automatically lead to a good postoperative function. An atraumatic soft tissue management, an efficient functional training and a stable (or at least stabilized) occlusion may be considered as equally important factors [16]. Finally, ORIF of the condylar head should stand measurement not only against closed treatment methods, but should restore full physiological function.

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IBRA SCHOLARSHIP 2017

Dr. med Tomasz Zacharias-Nalichowski from Kraków, Poland (Ministry of Interior Hospital), was the first IBRA Scholar in 2017. As per our requirements, he sent us his Scholarship Report describing his experiences.

From the left: Dr. Tomasz Zacharias-Nalichowski, Prim. Dr. Wolfgang Hintringer, Dr. Lillivett Jean Louis (Panama), Dr. Christoph Pezzei and OA Dr. Martin Leixnering

Dr. med. Zacharias-Nalichowski has been granted an IBRA Scholarship „B“ at the Lorenz Böhler Trauma Hospital in Vienna, Austria, from 20.02. – 10.03.2017.
During his stay at the Lorenz Böhler Trauma Hospital he was able to enhance his knowledge of hand surgery, especially in the areas of fractures, instability and posttraumatic changes of the wrist. Also he was given the opportunity to participate at the Basic Wrist Course, organized by the Wiener Handkurse.

„I can really recommend the Lorenz Böhler Trauma Hospital for young doctors interested in hand and wrist surgery“. (Tomasz Zacharias-Nalichowski)

Scholarship Reports are an important requirement and an integral part of our scholarship programs.
All Reports are published on our website www.ibra.ch.

SCIENTIFIC COLLABORATION

An important aim of the IBRA - International Bone Research Association - is to build up an international platform allowing scientific and medical discussions as well as the exchange of relevant information and experiences in the musculoskeletal system.

Scientific Collaboration with devoted national and international Medical Societies in the relevant segments is therefore crucial. If we want to reach this important objective, we continuously have to build up a trustful and long lasting cooperation with the Societies on one hand and most important for our society, we have to be able to count on dedicated and active IBRA Members with a vast interest in education on the other hand.

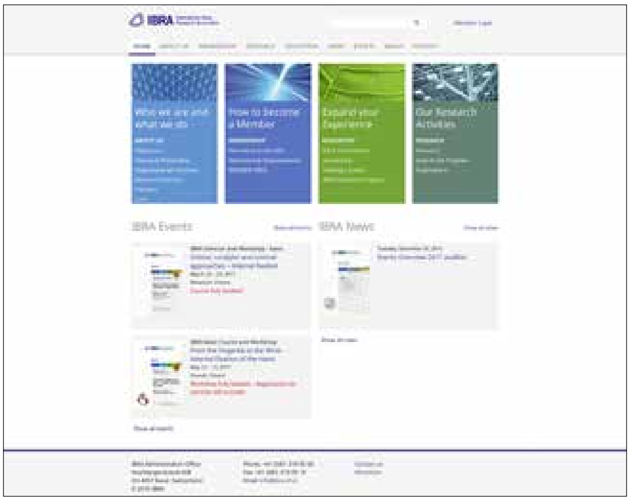
A recent example of this collaboration are the two IBRA Scientific Satellite Sessions on „Distal Radius - Fracture Specific Treatment“ and „Salvage Procedures Around the Wrist“ that we could organize as invited Society during the annual congress of the Brazilian Society of Surgery of the Hand „Mão 2017“ in Belo Horizonte/Brazil. This scientific collaboration with the Brazilian Society is going back to 2010 when we could organize our first Satellite Symposium. Thank you for this most valuable opportunity.

NEXT IBRA Satellite Symposium:

4th International Advanced Orthopeadic Congress (IAOC)
18 - 20 May 2017, Dubai, UAE

THE IBRA WEBSITE HAS BEEN UPDATED

At the beginning of this year the IBRA website has been slightly redesigned and enhanced with new functions:



All IBRA events 2017 are now clearly displayed in a calendar and a list view. They can be selected according to the divisions „Head“, „Limbs“ and „Foot & Ankle“. A new function is the subscription possibility for announced IBRA events, enabling you to receive information and registration details for the related events as soon as available.

In the section MEMBERSHIP you will find not only information about the benefits of being an IBRA member, but also details about the application process.

In the section EDUCATION detailed information about the Research & Education Committee, the different scholarship programs as well as guidelines for the application process are displayed. All IBRA Training Centers, including contact details are listed, too.

The section RESEARCH shows IBRA’s research activities, the goal of the program and publications.

Looking at ABOUT US, all interesting facts about IBRA, its structure and vision can be found. Information about our partners as well as a selection of related links are provided in this menu item/section.

To stay up-to-date about IBRA and its activities, please consult our website regularly or use the messaging function of it (www.ibra.ch).

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