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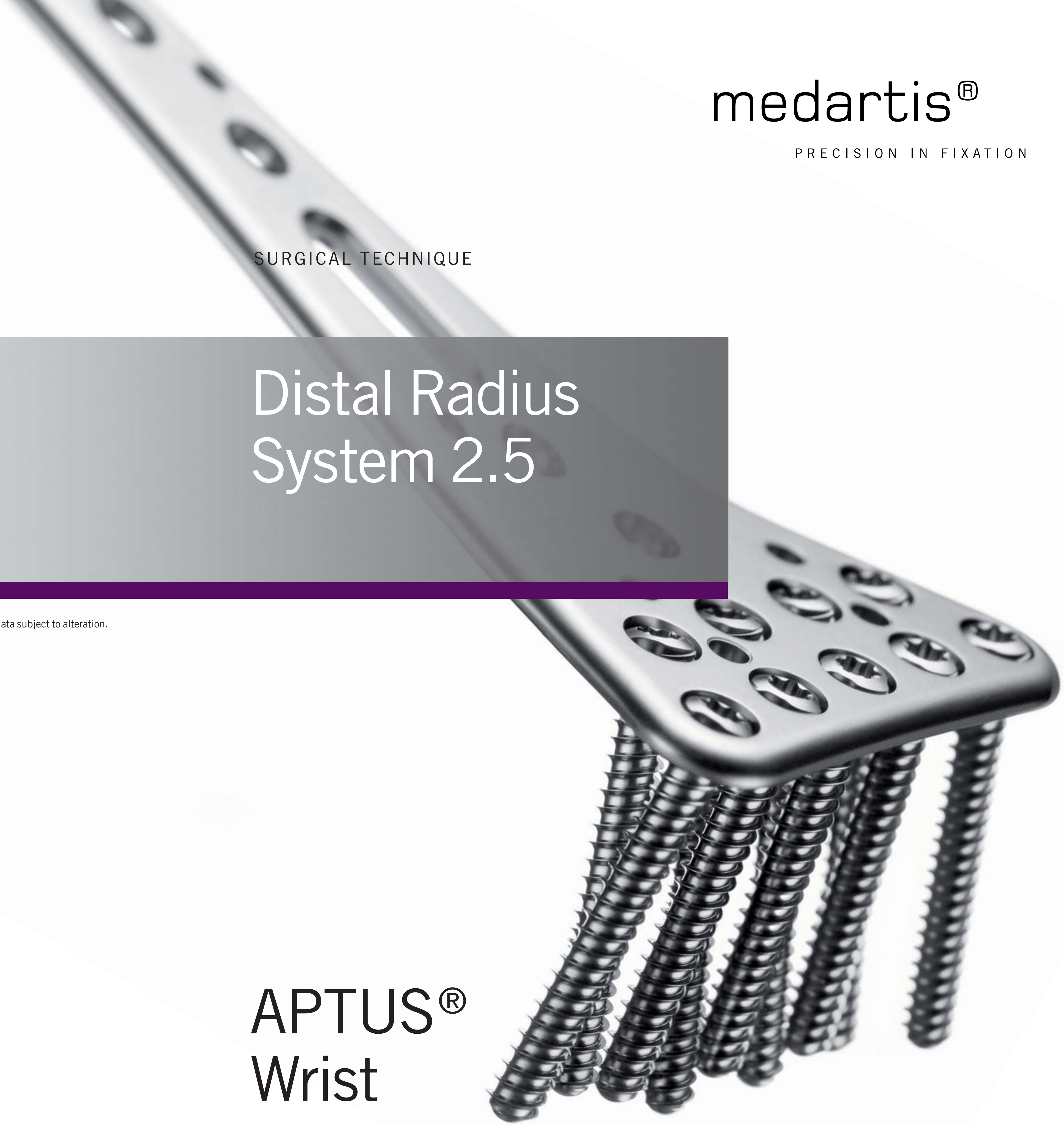
PRECISION IN FIXATION

SURGICAL TECHNIQUE

Distal Radius System 2.5



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Distal Radius System 2.5

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LITERATURE

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INTRODUCTION

In recent years, the distal radius fracture, first described by Colles in 1814, experienced great changes in the approach to its treatment. By using a conservative treatment in a cast or by stabilizing the fracture with minimally invasive Kirschner wires, the reduction result of the comminuted fracture is often compromised. Even external fixation, after reduction by ligamentotaxis, often does not lead to a permanent maintenance of the reduction.

The advantage of an O.R.I.F. volar approach lies in improved soft tissue coverage, less incidence of tendon irritation, early motion and improved reduction of the fracture.

Historically, in acute fractures, especially those with multiple fragments and dorsal comminution, screw loosening with secondary loss of reduction constituted a major problem. One issue was lack of stable bicortical screw fixation in the dorsal comminution. This was often augmented with cancellous bone graft or the use of a bone substitute inserted dorsally.

Currently, patient demands and socioeconomic factors have become increasingly relevant. Anatomic reduction coupled with short postoperative immobilization and early rehabilitation have become essential to successful outcomes.

Based on the principle of external fixation devices, new internal fixation methods have been developed. Functioning as an internal fixator, complications and the use of bone grafting have been reduced.

The volar approach allows for an anatomic reduction while the fixed angle device permits maintenance of reduction without the need for additional bone graft. The postoperative complications, particularly of malunion necessitating a revision, are markedly reduced.

SURGICAL PRINCIPLES AND OBJECTIVES

Anatomic reduction and fixation of unstable distal radius fractures using locked implants through a radio volar approach for restoration of radial length, volar angle and function.

ADVANTAGES

- Excellent soft tissue coverage
- Stable fixation
- Reduced need for bone graft
- Early functionality
- Limited secondary loss of reduction
- Improved outcomes

INDICATIONS

- Intra- and extra-articular fractures
- Correction osteotomies

CONTRAINDICATIONS

- Active or suspected infections at or near the implant site
- Foreign body reactions
- Known allergies
- Insufficient quantity or quality of bone for secure anchorage of the implant
- Conditions that tend to limit the patient’s ability and/or willingness to cooperate with surgeon instructions during the healing period
- Treatment of risk groups is inadvisable

PREOPERATIVE WORK-UP

- Standard radiographs posterior-anterior, lateral in neutral position
- Possibly computed tomography (CT) in instances of intra-articular fractures
- If a central compression of the radial articular surface is suspected, arthroscopy of the wrist may become necessary to evaluate reduction and diagnose concomitant injuries

SURGICAL INSTRUMENTS

- Set for radius surgery
- Image intensifier

ANESTHESIA AND POSITIONING

- Brachial plexus or endotracheal anesthesia
- Supine
- The arm in supination placed on an arm board, towel roll under the wrist to facilitate reduction
- Esmarch and tourniquet on upper arm
- Single intravenous injection of an antibiotic (such as a second-generation cephalosporin)

POSTOPERATIVE MANAGEMENT

Patients are advised to keep the arm elevated and to move the fingers as soon as feasible (extension of fingers – making a fist, 10 times every hour).

The wrist is immobilized for 2 weeks with a splint that does not include the thumb. Suture removal after 2 weeks.

After the first postoperative day, hand and fingers are actively moved daily with the goal to be able to make a complete fist and extend completely.

2 weeks postoperative, the splint may be temporarily removed and physiotherapy (active and passive), 5 times weekly, started. The patient is also encouraged to use the hand freely and to do exercises on his/her own. Sports activities and heavy work are not to be undertaken until bone consolidation, usually after 6-8 weeks.

Comminuted fractures are to be immobilized for 4 weeks. Passive mobilization after temporary removal of the splint begins after 2 weeks depending on the state of the fracture, at the latest after 4 weeks. Other treatment regimens constitute an exception.

REMOVAL OF IMPLANTS

Plate removal is usually not necessary. This is primarily due to the fact that the overall system height can be kept at a minimum utilizing Medartis unique TriLock technology. This feature allows for the requirement of a low profile implant system even in the fully angulated state of ±15°. Anodized surface, in combination with the atraumatic plate edges, minimizes soft tissue irritation.

However, hardware removal may become necessary if the plate was placed extremely close to the volar rim of the distal radius, i.e. when the flexor apparatus (mainly the tendon of the flexor pollicis longus) gets irritated. If synovitis is suspected, it is advisable to remove the implant.

PITFALLS & COMPLICATIONS

- Injury to the median nerve or its volar branch
- Injury to the radial artery
- Hemorrhage
- A scapholunate ligament injury or a triangular fibrocartilage complex (TFCC) lesion has been missed
- Intra-articular screw position
- Plate positioning too far distally may cause flexor tendon irritation
- Irritation of the extensor tendons by too long screws
- Threat of carpal tunnel syndrome
- Postoperative swelling and pain
- Infections. Although rarely seen, the risk of infections increases in open fractures or in patients with suppressed immune systems
- Reflex sympathetic dystrophy
- Deficit in motion
- Inadequate reduction of the fragments resulting in malunion

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Surgical Technique

Locked Plate O.R.I.F. of an intra-articular extension fracture with dorsal comminution (classification type AO 23-C3) with the multidirectional, angular stable APUTS fracture plate

Example and technique by Prof. Dr. Hermann Krimmer, Ravensburg, Germany

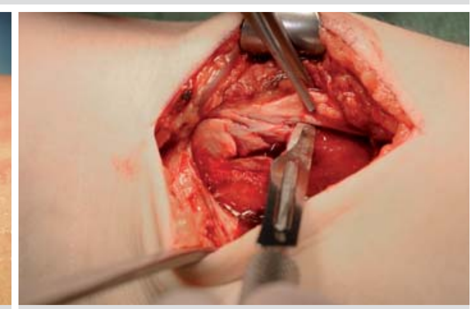
Clinical Case

STEP 1

Intra-articular extension fracture with dorsal comminution.

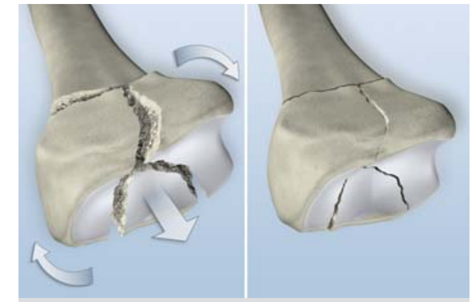
STEP 2

Through an incision approximately 10 cm (4 inches) long that ends 3 cm (1.2 inches) proximal to the wrist, the median nerve, the flexor pollicis longus (FPL) and the flexor carpi radialis (FCR) come into view. If necessary, the incision is continued distally up to the transverse skin fold of the wrist in radial direction in a right or acute angle. If posttraumatic sensory disturbances in the area of the median nerve are present or if the patient suffers from a latent carpal tunnel syndrome, the incision is lengthened distally and the carpal canal is opened.



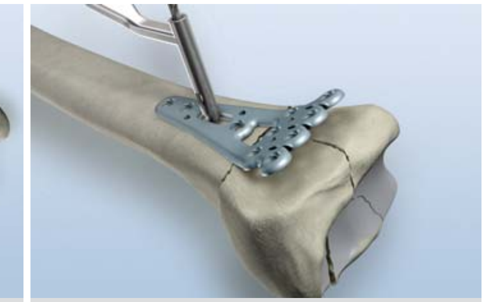
STEP 3

After splitting the fascia, approach through the FCR and the radial vessels. Exposure of the pronator quadratus muscle. Insertion of a Langenbeck retractor with ulnar retraction of the flexor muscles as well as of the median nerve. Sharp detachment of the pronator quadratus muscle with a scalpel leaving a 5 mm (0.2 inch) wide stump attached to the radius. Retraction of the muscle with a periosteal elevator. Opening of the first extensor sheath and subperiosteal detachment of the brachioradialis tendon facilitates reduction, especially in the case of a fractured radial styloid. Exposure of the fragments and the fracture gap.



STEP 4

Usually the reduction of the fragments is performed by longitudinal traction in combination with dorsal pressure.



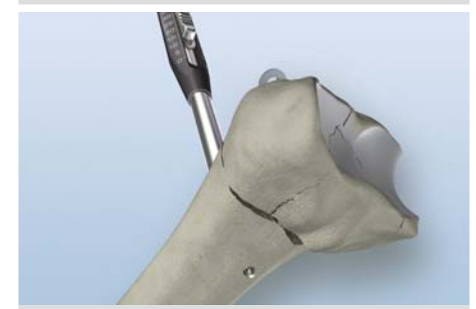
STEP 5

Ideally, place the plate centrally to the longitudinal axis distally towards the edge of the volar rim (watershed line).

Drilling of the longitudinal oriented slot in the shaft using the drill guide and APTUS twist drill for core diameter 2.0 mm (1 purple ring).

STEP 6A

Determine screw length using the depth gauge.



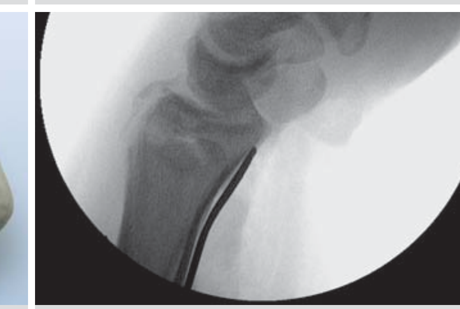
STEP 6B

Reference of the dorsal cortex for bicortical fixation.

STEP 7

Fixation of the plate with a non-locking screw (gold screw) inserted into the longitudinal oriented slot. Image intensifier control to verify the anatomic reduction and the correct plate position.
If necessary, position the plate longitudinally and/or laterally.

Note:
If the plate extends beyond the volar rim (watershed line), flexor tendon irritation could occur.



STEP 8

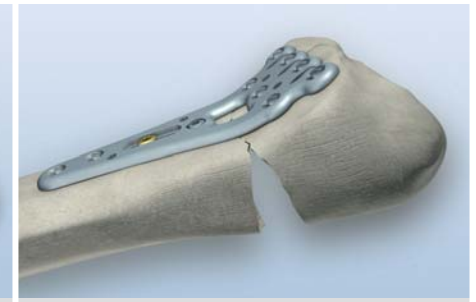
Reduction of the radius fragments and manual check of the distal radioulnar joint under image intensification.

STEP 9

Note:
It is recommended to place a second shaft screw, ideally a locking screw (blue screw)*, prior to performing the reduction once the correct plate position has been determined.

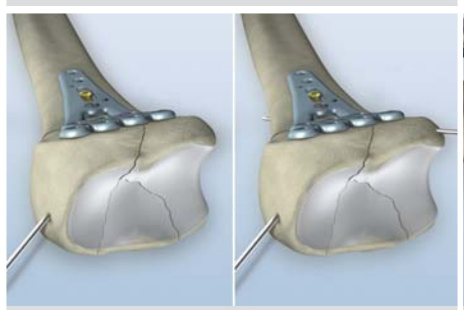
STEP 10A

Reduction by longitudinal traction flexing the injured hand; check with image intensifier.



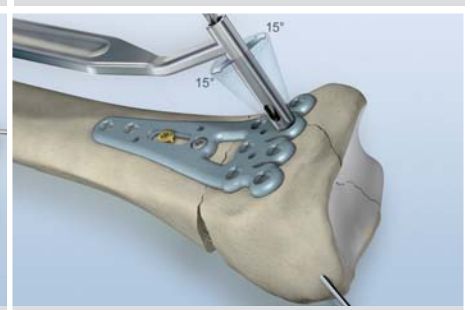
STEP 10B

Final reduction to the plate.



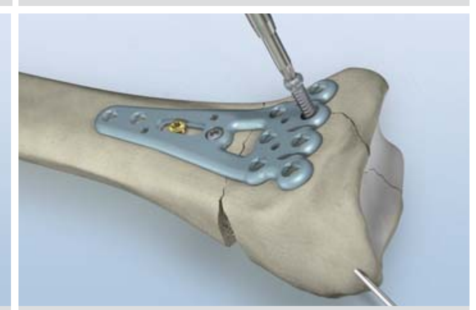
STEP 11

In the case of an unstable fracture, insertion of K-wires can be useful. This can be done either through holes in the plate in anterior-posterior direction or in an oblique angle through the radial styloid or at the ulnar border.



STEP 12

Drilling of the first distal hole using the drill guide and the APTUS twist drill for core diameter 2.0 mm (1 purple ring). The drill guide can be used multidirectionally in the range of ±15° to obtain angular stable fixation.
Determine the screw length with the depth gauge and insert the first screw in the distal row of holes.

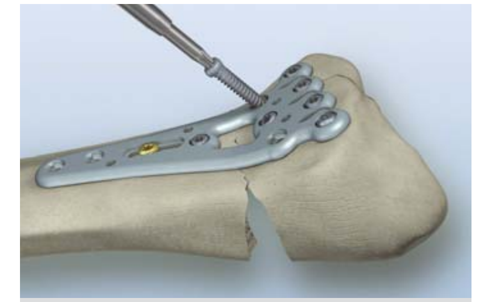


STEP 13

Completion of the insertion of screws in the first distal row of holes.

Note:
Choose the drill angle parallel to the volar inclination. Image intensifier control to check the subchondral position of the screws.

* For detailed information about the correct use of TriLock Locking Technology, see page 10.



STEP 14

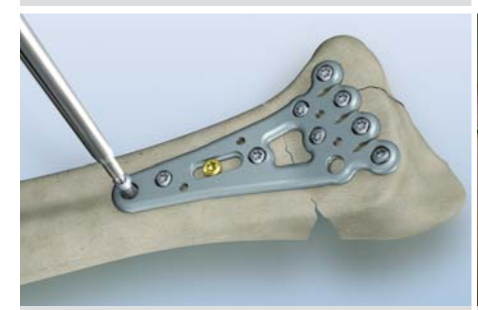
Drilling direction and insertion of the screws in the second row should angle toward the dorsal rim.

STEP 15

The screws of the first row should be angled slightly in a proximal direction while the screws of the second row should be inserted in a distal direction. This subchondral positioning offers an ideal support of the central part of the radius as well as the dorsal rim.

STEP 16

Intraoperative image intensifier control to verify the correct placement of the plate and the screws.



STEP 17

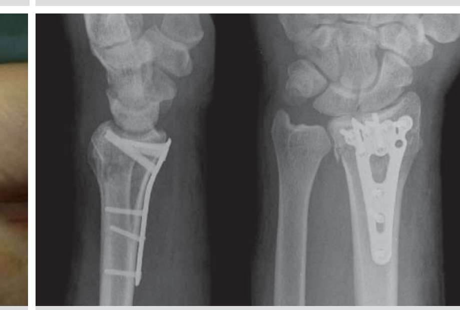
Placement of the final screws in the plate shaft.

Note:
It is recommended to use at least 1 locking screw (blue screw) in the radius shaft to obtain a proper bridging effect.

For ideal results, place at least 3 locking screws (blue screws) in the most distal row and 2 locking screws (blue screws) in the second distal row.

STEP 18

Reattachment of pronator quadratus muscle. Insertion of a suction drain. Would closure to be performed in layers. Application of sterile dressing and posterior forearm splint up to the metacarpal heads in approximately 20° extension of the hand at the wrist.



STEP 19

X-ray control 8 weeks postoperatively.

Correct Use of TriLock Locking Technology

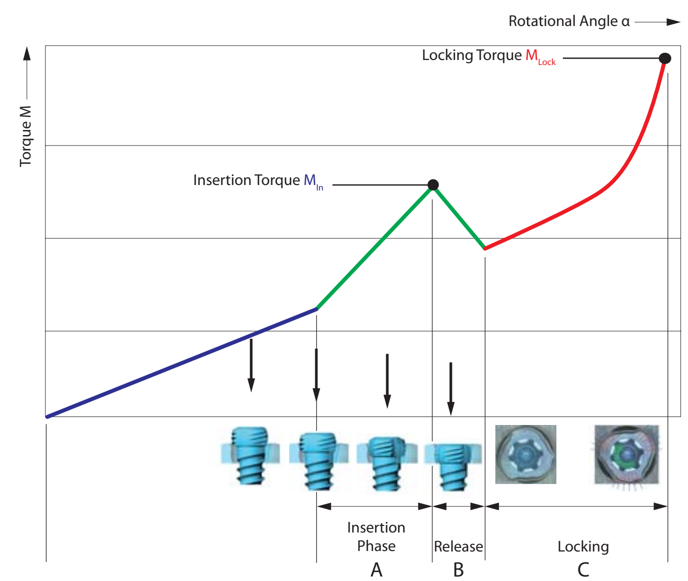
APPLICATION

The screw is inserted through the plate hole into a pre-drilled canal in the bone. An increased resistance will be felt as the screw head engages the plate surface.

This identifies the start of the "Insertion Phase" as the screw head enters the locking zone of the plate (section "A" in the diagram). Next, a decrease of the tightening torque (resistance) occurs (section "B" in the diagram). The final lock is initiated (section "C" in the diagram) as a friction connection is established between screw head and plate when tightened firmly.

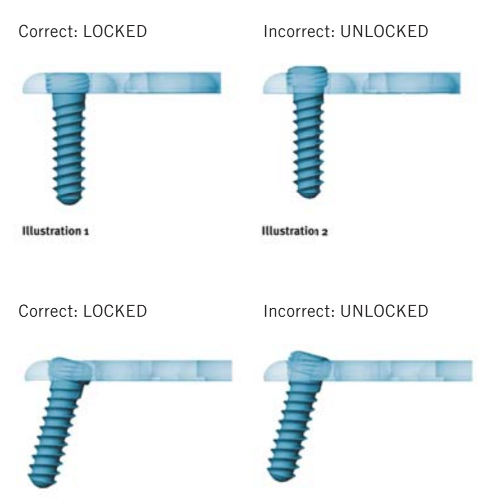
The torque applied during fastening of the screw is decisive for the quality of the locking as described in section "C" of the diagram.

Do not overtighten the screw, otherwise the locking system can become compromised.



CORRECT LOCKING OF TRILOCK LOCKING SCREWS IN THE PLATE

Visual inspection of the screw head projection provides an additional indicator of correct locking. Correct locking has occurred only when the screw head has locked flush with the plate surface (illustrations 1 + 3).
However, if the screw head can still be seen or felt (illustrations 2 + 4), the screw head has not completely entered the plate and reached the locking position. In this case the screw has to be retightened to obtain full penetration and proper locking of the system.



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