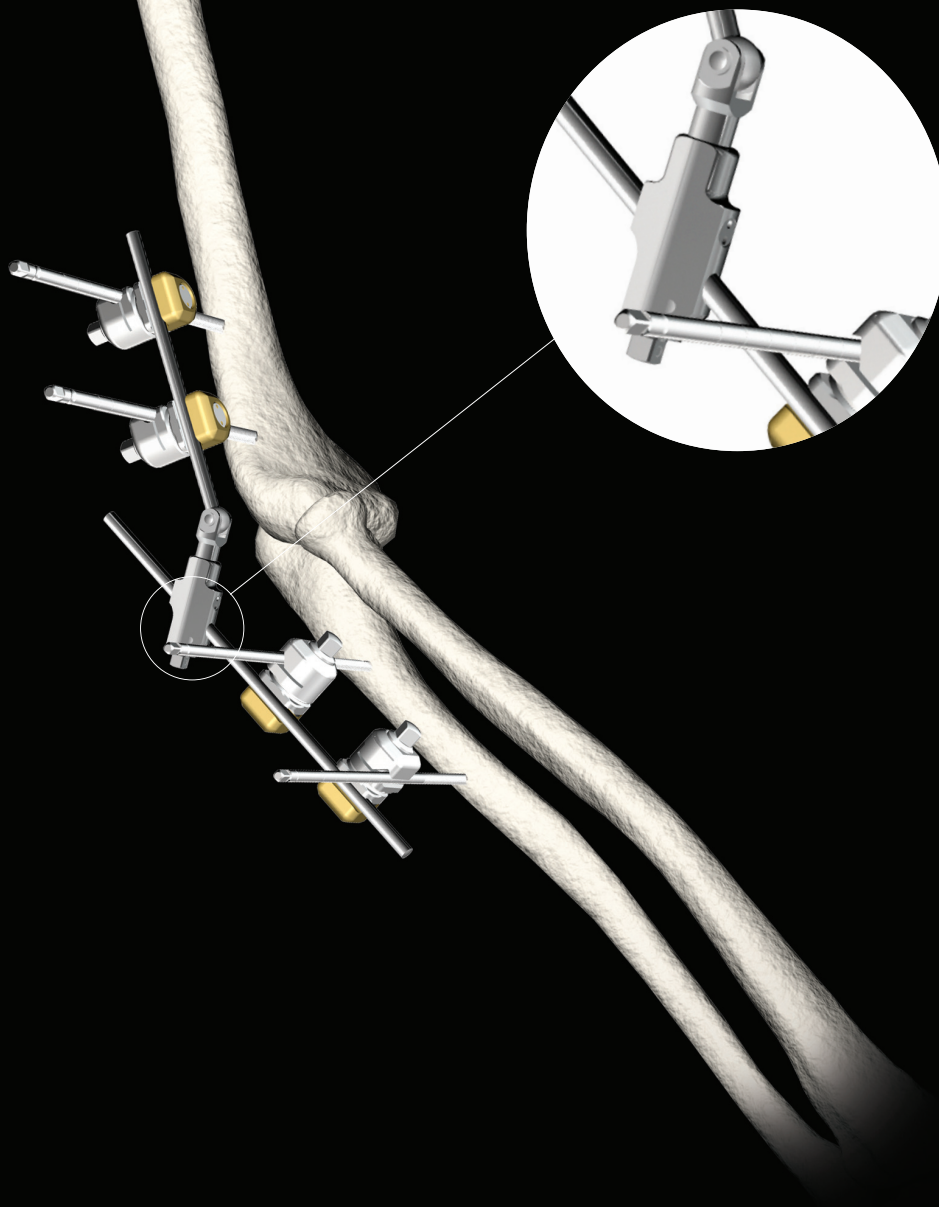


Dynamic Joint Distractor II

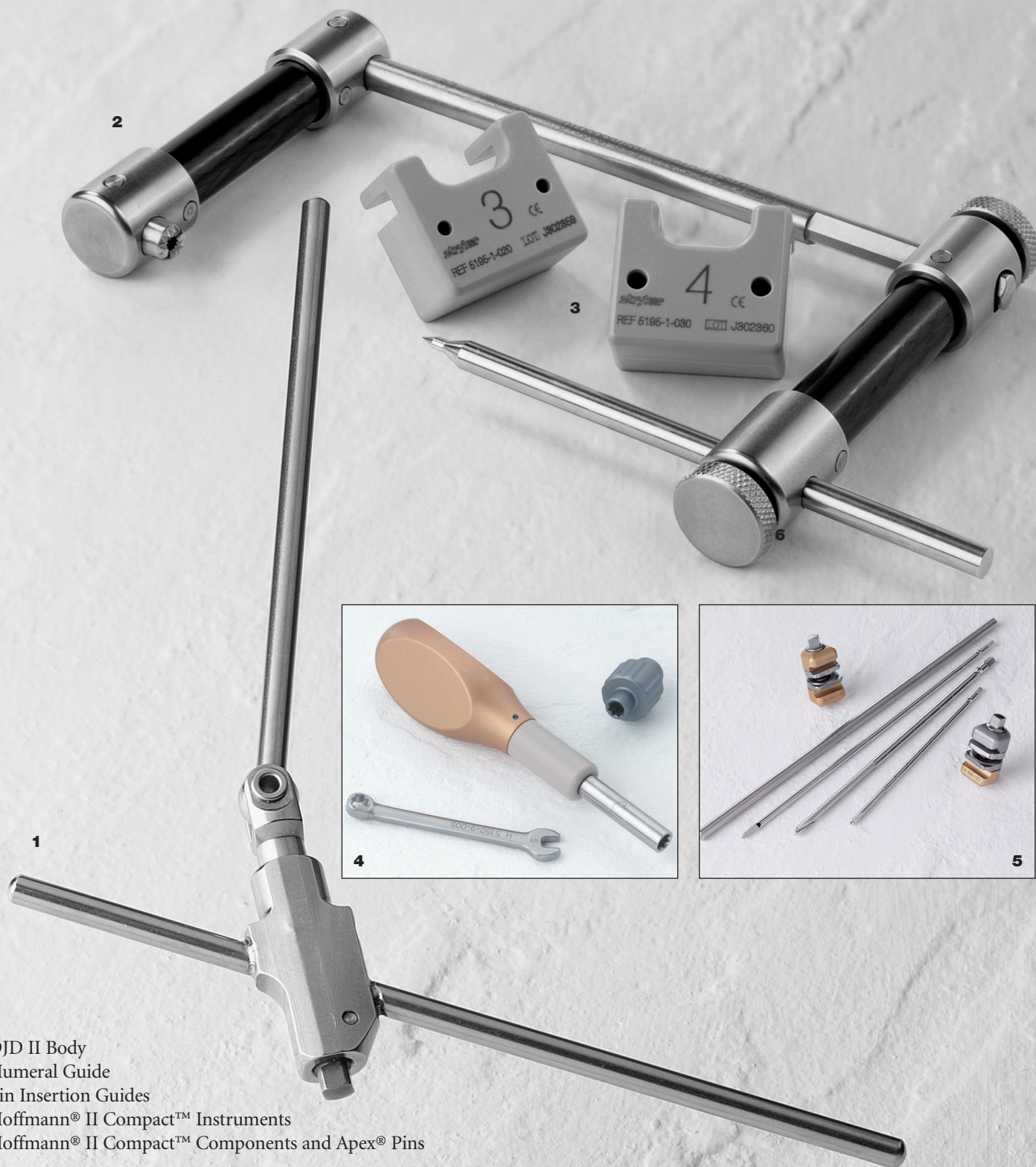
External Fixation System



Dynamic Joint Distractor II

B. F. Morrey, M.D.

Illustrations by Matthew Morrey, M.S.



1. DJD II Body
2. Humeral Guide
3. Pin Insertion Guides
4. Hoffmann® II Compact™ Instruments
5. Hoffmann® II Compact™ Components and Apex® Pins

Overview

There are two principal goals simultaneously achieved with the Dynamic Joint Distractor II (DJD II):

- 1) to allow active or passive motion
- 2) to protect the articular surfaces and the collateral ligaments

Design Concept

Reliable identification of the axis of rotation and rigid skeletal fixation can be obtained by an articular device which replicates the axis of rotation.

Skeletal fixation on the ulna with the DJD II allows protection or neutralization of the articular surface for a variety of clinical circumstances.

Motion in flexion/extension is allowed without encumbrance particularly in both the articular surface and the collateral ligaments.

OPTIONS: The DJD II may be used in either a unilateral or bilateral configuration. This allows a great deal of flexibility of use and a wider range of indications (Fig. 1).

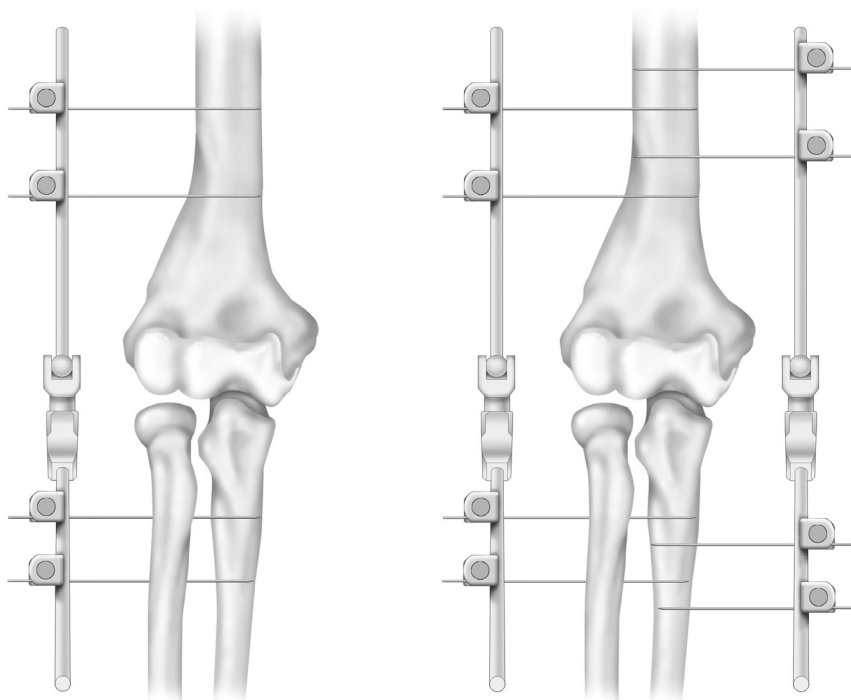


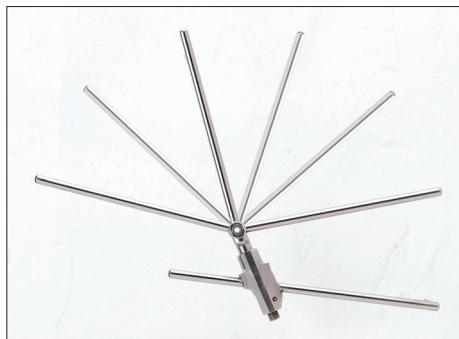
Figure 1

Features & Benefits

- Simplified frame construction
- Integrated hinge designed to replicate the elbow's natural axis of rotation
- Integrated joint distraction mechanism (1-10mm)
- Unilateral or bilateral frame configurations
- Independent pin placement reduces the potential of neurovascular injury
- Compatible with Hoffmann® II Compact™ couplings
- Simple, user friendly instrumentation



The Dynamic Joint Distractor II System



Dynamic Joint Distractor II Body

The DJD II body has been specifically designed to provide strength, reduce bulkiness and weight and simplify use.

- The DJD II body is composed of two 5mm diameter stainless steel rods linked together by a hinge which includes an integrated distraction mechanism to distract the elbow joint.
- The DJD II body's ulnar and humeral rods are compatible with the Hoffmann® II Compact™ couplings, allowing snap-click ease of use. The complex anatomy of the elbow makes independent pin placement a crucial advantage in reducing the potential of neurovascular injury.
- The DJD II body's cannulated hinge allows the positioning of the DJD II body over the 3mm Apex® reference pin which has been inserted into the axis of rotation of the elbow (see operative technique pg. 7). Therefore, the DJD II body hinge is designed to replicate the anatomical axis of rotation and allows natural mobilization of the elbow. The removal of the reference pin at the end of the surgery to reduce the risk of elbow joint infection.
- The DJD II body's distraction mechanism allows distraction up to 10 mm (typically 2-3mm distraction is sufficient to accomplish the goals of the procedure) without any additional components.

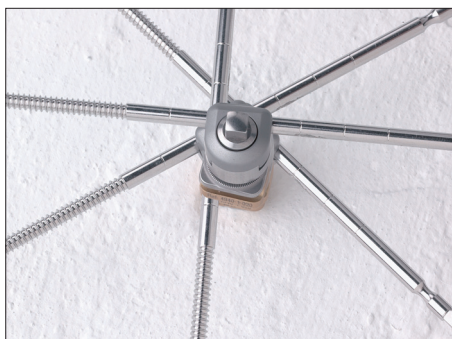
- The DJD II body distraction mechanism includes a graduated scale to allow controlled distraction. Its 5mm square head screw is identical to the 5mm square head screws of the Hoffmann® II Compact™ couplings allowing the use of the same wrench.



Pin-to-Rod Coupling

Independent pin placement is a key factor to successful elbow surgery where complex anatomy dictates the pin insertion areas. The pin-to-rod coupling of the Hoffmann® II Compact™ System has been specifically designed to provide the freedom of single pin placement with ease of use.

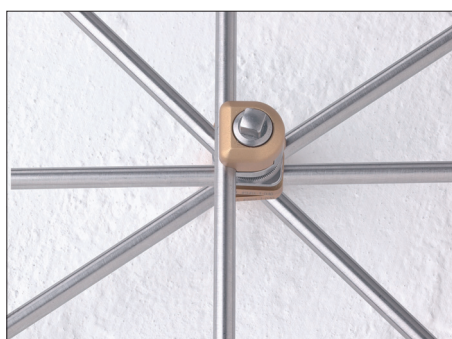
- Designed to accept 3 & 4mm Apex® pins and 5mm rods
- Integrated spring loaded snap-fit mechanism allows easy assembly and temporary fixation during adjustment procedures
- Assemble laterally with a “click effect” of the pin and/or rod
- Radially serrated tooth design provides excellent locking and rotational stability
- Top locking provides easy access via a 5mm square head



Rod-to-Rod Coupling

The rod-to-rod coupling of the the Hoffmann® II Compact™ system connects two 5mm rods to each other. Its anti-rotational snap-fit mechanism ensures a firm grip allowing a good locking of the DJD II body if necessary. Locking may be used to minimize unwanted elbow joint movement during the first 24 hours after the surgery (see operative technique).

- Designed to accept 5mm rods
- Integrated spring loaded snap-fit mechanism allows easy assembly and temporary fixation during adjustment procedures
- Assembles laterally with a “click effect” of the rods
- Radially serrated tooth design provides excellent locking and rotational stability
- Top locking provides easy access via a 5mm square head



Clinical cases

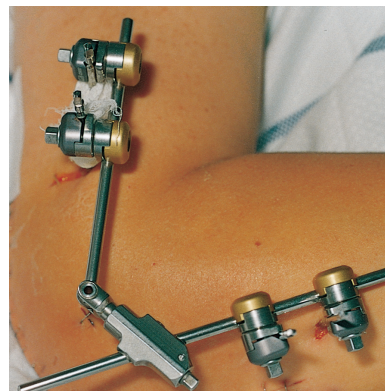
Case 1: Heterotopic bone formation after neurotrauma causing complete ankylosis of the joint.



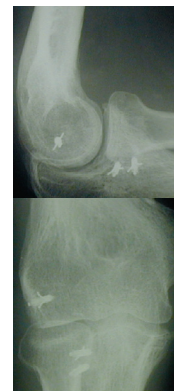
Pre-operative X-ray



Post-operative X-ray



Post-operative
frame



Range of Motion
(ROM): 135°

Case 2: Post-traumatic stiffness after supracondylar fracture.



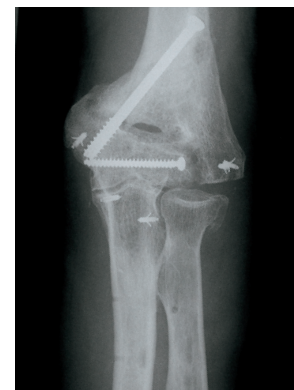
Pre-operative X-ray
ROM: 60°



Post-operative
X-ray

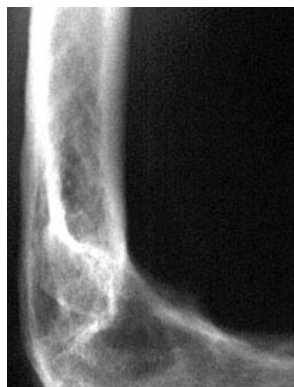


Post-operative
frame



Frame removal at 6 weeks
ROM: 120°

Case 3: Fascia lata arthroplasty. Rheumatoid arthritis: right elbow joint ankylosis since 14 years.



Pre-operative X-ray



Post-operative
X-ray



Post-operative
frame



Operative Technique

Dynamic Joint Distractor – Unilateral Frame

“Universal” posterior skin incision

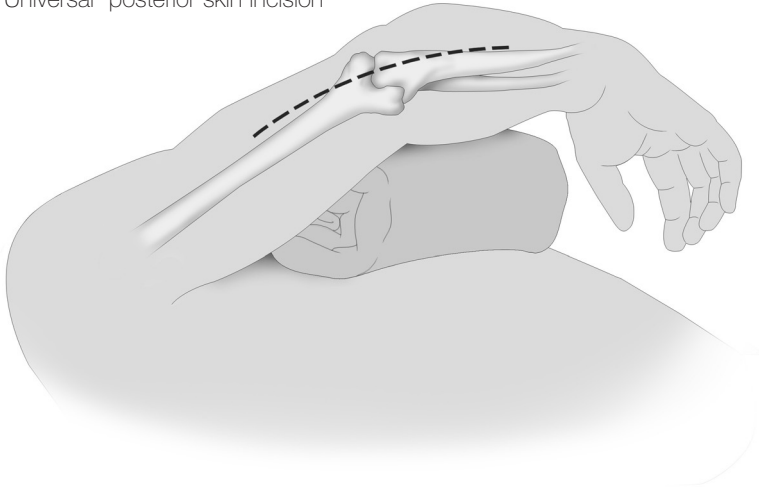


Figure 2

The patient is supine, the arm is brought across the chest.

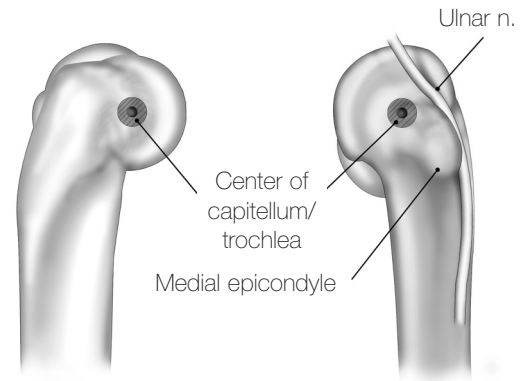


Figure 3

The landmarks on the distal humerus medial and lateral.

Patient Positioning & Anatomical Repair

The patient is supine with a sandbag under the scapula, the arm is draped free with a non-sterile tourniquet and brought across the chest (Fig. 2). The elbow is exposed according to the pathology present. Regardless of the exposure or pathology, identifying the essential landmarks for humeral pin placement in the axis is critical.

On the lateral aspect of the capitellum, a tubercle is present at the site of the origin of the lateral collateral ligament. This tubercle also represents the geometric center of curvature of the capitellum, which is the site of the flexion axis of the elbow, and is the point through which a 3mm Apex® humeral reference pin will pass (Fig. 3). If this anatomic feature has been altered by pathology, then the center of the curvature of the trochlea is identified as the axis of rotation since the ulna rotates on the humerus and rotation on the capitellum is a secondary feature.

On the medial aspect of the distal humerus, the axis of rotation lies just anterior and inferior to the medial epicondyle. The reference pin is placed in this region, or slightly anterior and proximal to this location (Fig. 3). This represents a safe zone relative to the ulnar nerve. If a medial frame is to be applied, the ulnar nerve is identified and protected at the time of insertion of the 3mm Apex® humeral reference pin.

For all frame applications the 3mm Apex® humeral reference pin is drilled or tapped 10-20mm into the distal humerus along the axis of rotation.

Articular Fracture

The articular fracture is approached according to surgeon preference, the specific pathology, and the treatment goals.

Olecranon fractures are easily exposed and the fixator readily applied. Fractures involving the coronoid require more extensive exposures as described on the following page for the release of the stiff elbow.

Distal humeral fractures may be treated by exposure with olecranon osteotomy or a triceps reflection technique. If the fracture fixation device(s) or collateral ligament reattachment precludes the introduction of a 3mm reference pin, a small Kirschner wire is inserted in a manner to replicate the axis of rotation.

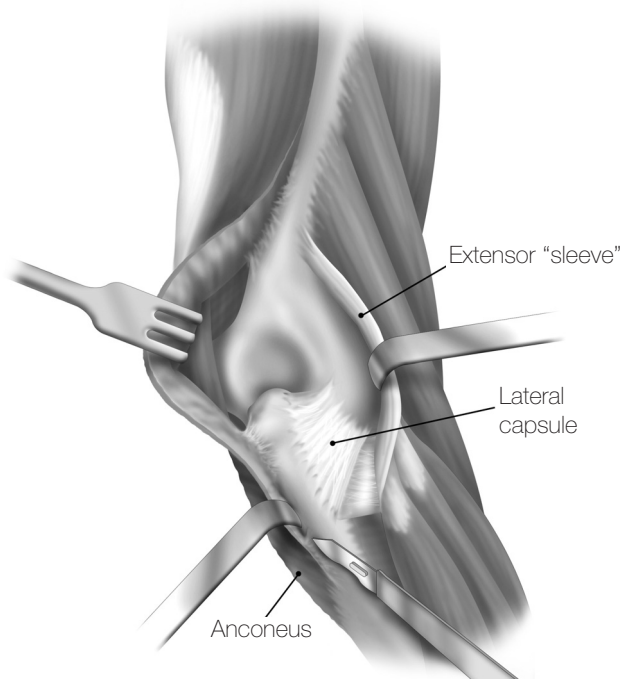


Figure 4
An extensile surgical exposure typically involves releasing of the lateral collateral ligament.

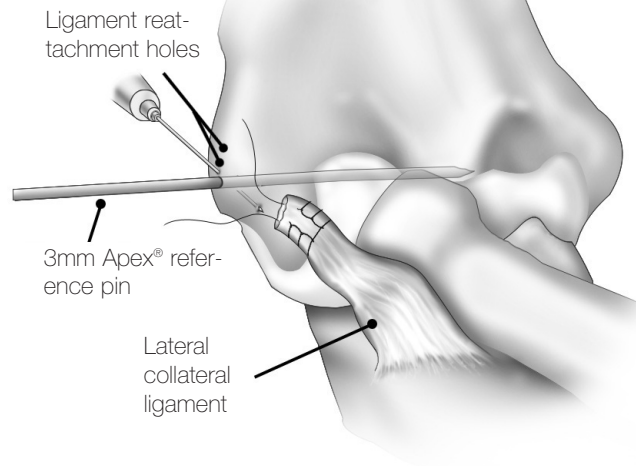


Figure 5
Holes are placed around the axis of rotation, allowing the ligament to be reattached.

The Stiff Elbow

If treating the elbow for stiffness, the previous incision is entered, and an extensile postero-lateral joint release is used.

Typically, the triceps is reflected from the tip of the olecranon. However, in some instances, such as when elbow flexion is normal, the triceps may be left intact. A complete anterior capsular excision is required. The capsule is exposed by releasing the common extensor tendon. If the pathology is extrinsic to the joint, the anterior capsule is excised but the lateral collateral ligament is preserved. If the joint is abnormal and is to be altered, such as with an interposition arthroplasty, the lateral collateral ligament is elevated as a flap of tissue from its origin at the lateral condyle. This is tagged and reflected distally, providing an extensive exposure (Fig. 4), but must be repaired and reattached at closure.

When the pathology involves a joint surface that requires an extensive dissection, the identification and protection of the ulnar nerve is necessary.

Ideally, a single posterior incision is utilized, and a subcutaneous dissection is carried out to the medial aspect of the triceps. If a previous Kocher skin incision has been placed laterally, ulnar nerve exposure is accomplished through a supplemental medial incision.

In any event, the ulnar nerve is identified, but is usually not translocated anteriorly. It is important to protect the nerve, first during the capsular dissection and later at the time of the 3mm Apex® humeral reference pin placement. If ulnar nerve symptoms are present, then the nerve is decompressed with definitive management, according to the dictates of the pathology.

At closure with the 3mm Apex® humeral reference pin in place, 2mm holes are made distal and proximal to the pin for reattachment of the lateral collateral ligament (Fig. 5).

Bunnell sutures or suture anchors are placed through the radial (lateral) collateral ligament and through the holes drilled through the lateral column around the flexion pin.

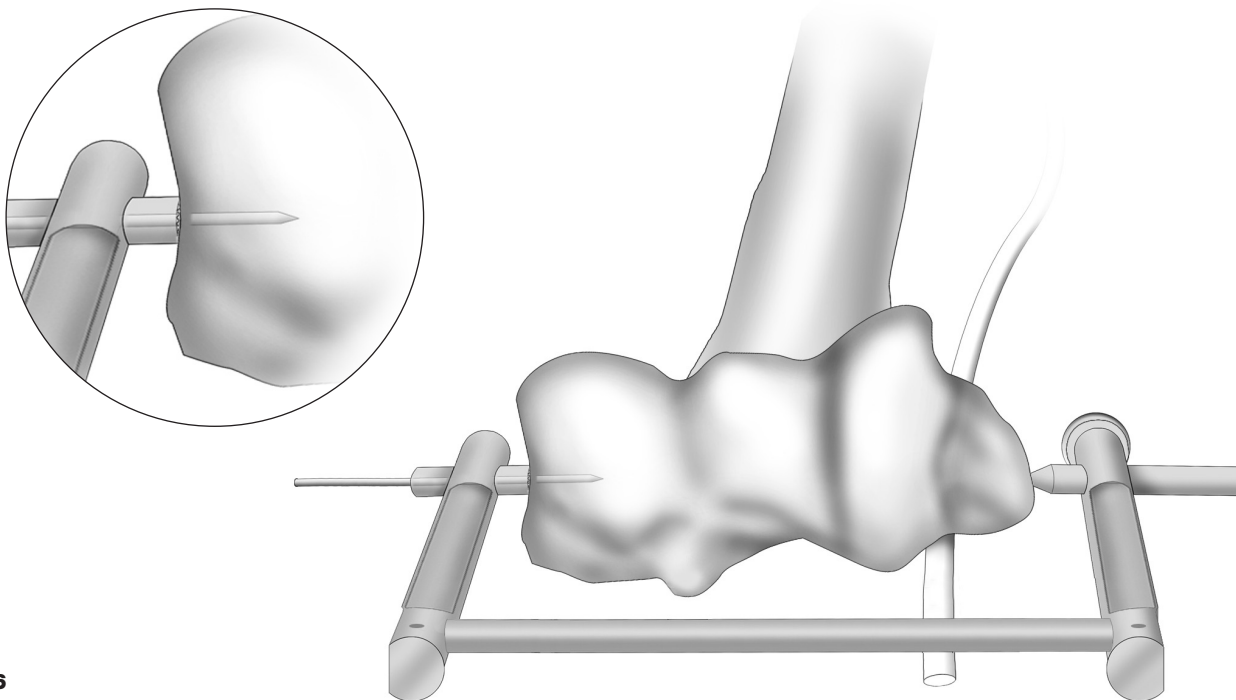


Figure 6

The pointed tip of the humeral axis guide is placed medially under direct vision, allowing accurate orientation of the axis reference pin.

NOTE: Close proximity to nerve

1. Axis of rotation

Determine the external landmarks of the axis of rotation and place the humeral (axis) reference pin guide in line with the axis of rotation. (Typically, the pointed tip of the humeral axis guide is placed on the medial side with the cannulated pin guide on the lateral side.) (Fig. 6).

2. Reference pin placement

The reference pin acts as a guide during frame construction.

Insert laterally the 3mm diameter self drilling/self tapping Apex® pin through the humeral (axis) reference pin guide in the axis of rotation. For unilateral frame construction insert the pin to a depth of

15-20mm. For bilateral frames it is recommended to replace the 3mm Apex® humeral reference pin by a 3mm smooth transfixing Apex® pin which is inserted across the distal humerus (see Bilateral Frame Option).

N.B.: The 3mm pin is a reference pin and is the essential reference required to accurately assemble the DJD II frame and to properly insert the humeral and ulnar pins. It will be removed after frame construction.

OPTIONS: If ligament repair/reconstruction precludes use of a drill bit, a “stylus” guide may be inserted.

3. Remove the humeral (axis) reference pin guide

4. Placement of the DJD II frame on the reference pin

The hollow bored hinge of the DJD II is placed over the reference pin so that its hinge is exactly in the same axis of rotation as the natural axis of rotation of the elbow. Verify that the distraction device is fully compressed before frame construction.

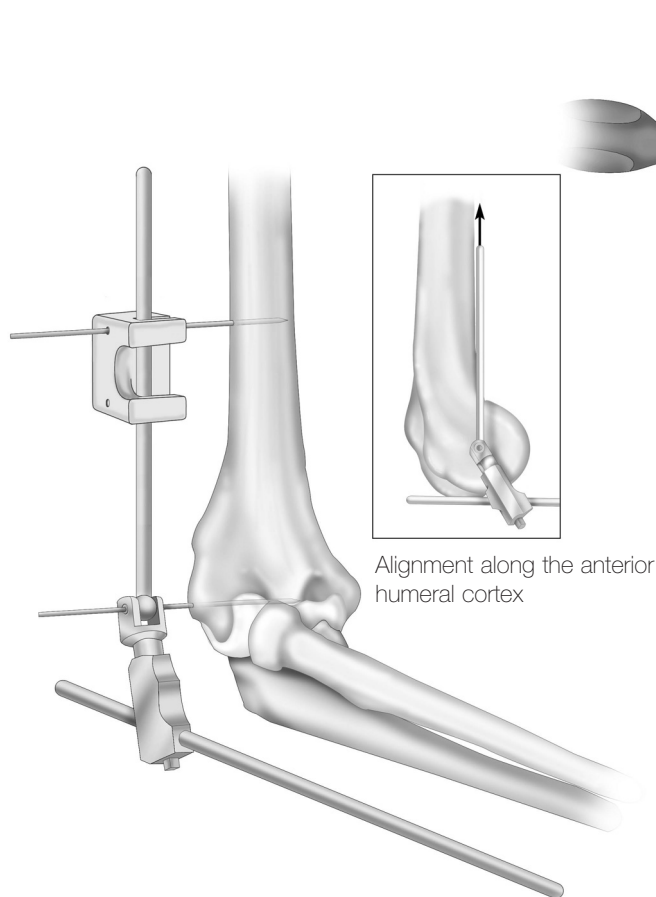


Figure 7

The fixator is placed over the reference pin and using the pin insertion guide a proximal half pin is placed through the lateral and medial humeral cortices.

Care should be taken to identify and protect the radial nerve.

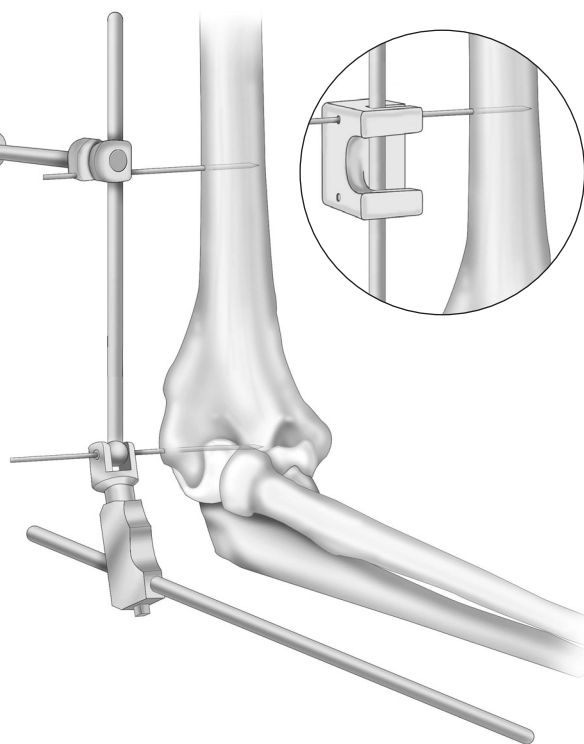


Figure 8

The proximal pin is fixed to the humeral rod with the Hoffmann® II Compact™ pin-to-rod coupling.

5. Pin insertion

At this stage, depending on surgeon preference or features of the case, one may insert either the humeral or the ulnar pins.

6. Humeral pin insertions

6.1 Insert the proximal pin first. According to the pin diameter (3mm or 4mm), place the appropriate pin insertion guide over the humeral rod so that the pin guide holes allow engagement of the lateral humerus (Fig. 7)*.

N.B.: The 5mm humeral rod is aligned to the anterior cortex of the humerus (Insert).

6.2 The proximal humeral self drilling/self tapping Apex® 4mm (or 3mm) pin is inserted into the lateral cortex of the humerus through the pin guide and engaged in the opposite cortex.

N.B.: The second hole of the pin insertion guide indicates the minimum distance between 2 pins. However, it is recommended to increase the distance between the pins by placing the pin guide further from the first pin as described in steps 6.5 and 7.5.

6.3 The pin guide is then removed.

6.4 The proximal pin is fixed to the humeral rod with a Hoffmann® II Compact™ pin-to-rod coupling. This is then tightened using a Hoffmann II Compact wrench (Fig. 8).

N.B.: Hoffmann II Compact pin-to-rod couplings accept pins of both 3mm and 4mm diameter.

*Care should be taken to identify and protect the radial nerve

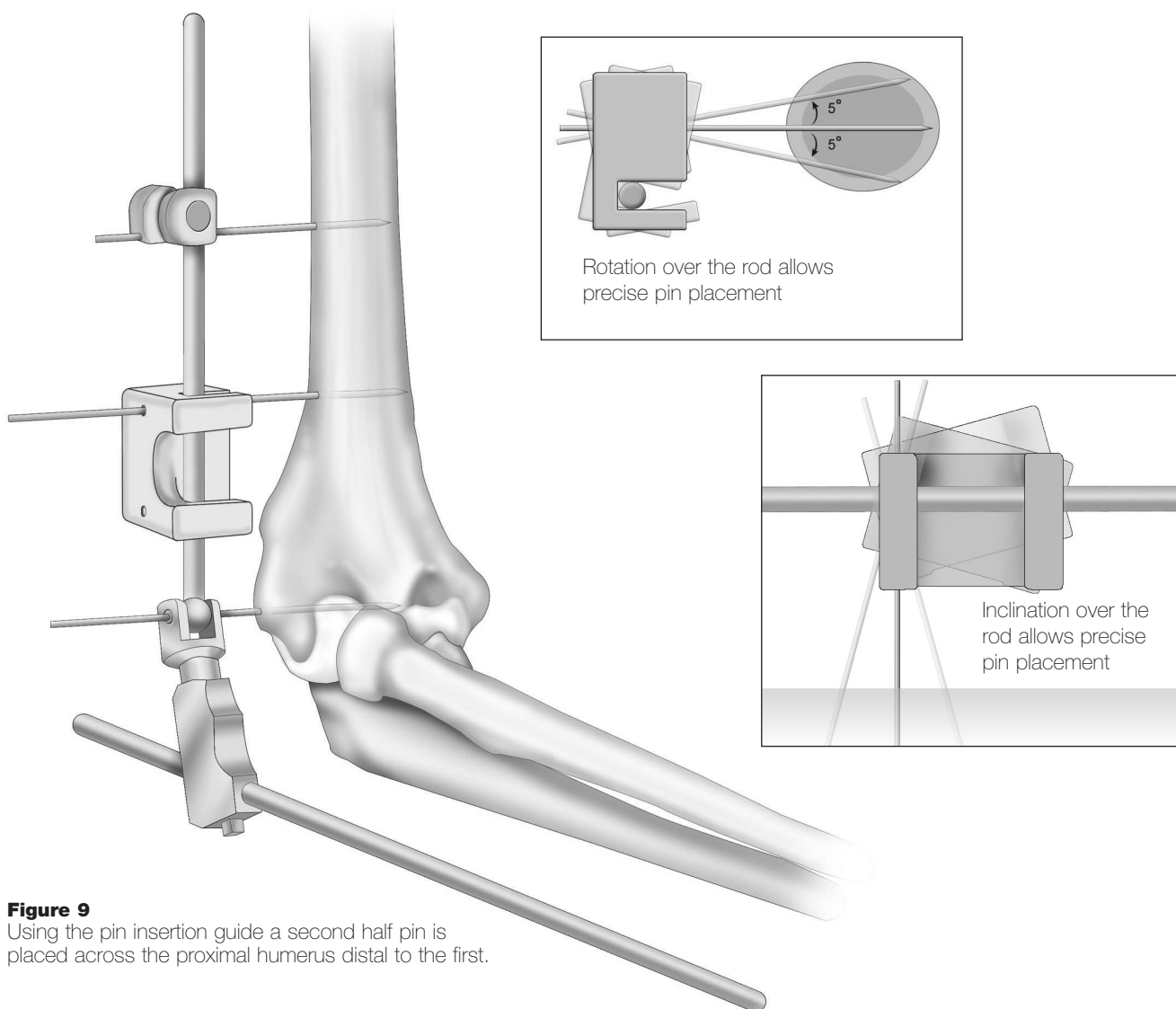


Figure 9

Using the pin insertion guide a second half pin is placed across the proximal humerus distal to the first.

6.5 Place the pin guide over the humeral rod more distally (closer to the hinge).

6.6 The second 4mm (or 3mm) self drilling/ self tapping Apex® pin is now inserted more distally through the pin guide (Fig. 9).

N.B.: The pins need not necessarily be parallel.

If a different pin insertion angulation is required to access a more adequate area on the humerus, slightly rotate and/or incline the pin guide over the humeral rod until the desired pin insertion area can be reached. By providing proper pin-rod distance, the system allows an independent pin placement (Insert).

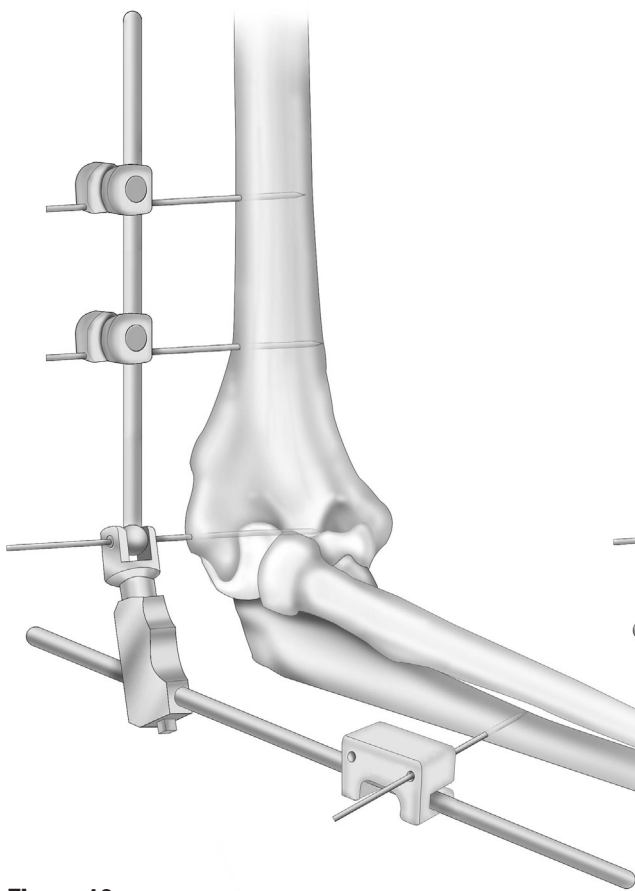


Figure 10

The distal ulna pin is applied with the use of the pin insertion guide.

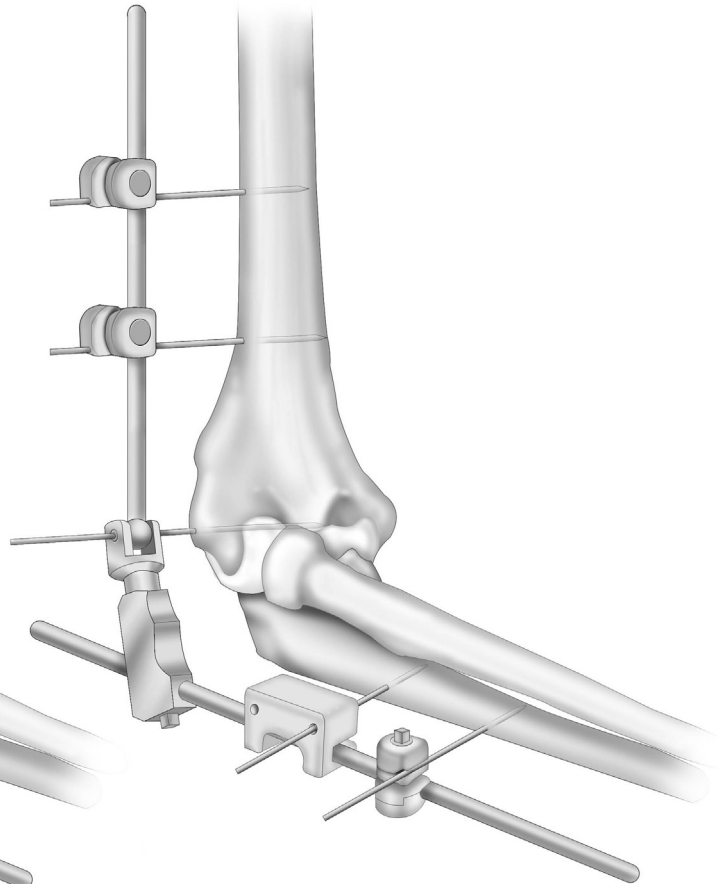


Figure 11

A second pin is placed proximally using the pin insertion guide.

6.7 The pin guide is then removed.

6.8 The distal pin is fixed to the humeral rod with a Hoffmann® II Compact™ pin-to-rod coupling which is then tightened using a Hoffmann II Compact wrench.

7. Ulnar pin insertions

7.1 According to the pin diameter (3mm or 4mm), place the appropriate pin guide over the ulnar rod to access the lateral aspect of the ulna.

N.B.: 3mm pins are usually preferred as the ulna diameter is smaller.

7.2 The distal ulnar 3mm (or 4mm) self drilling/self tapping Apex® pin is inserted into the lateral cortex through the pin guide and pierces the medial ulnar cortex (Fig. 10).

7.3 The pin guide is then removed.

7.4 The distal pin is fixed to the ulnar rod with a Hoffmann® II Compact™ pin-to-rod coupling which is then tightened using a Hoffmann II Compact wrench.

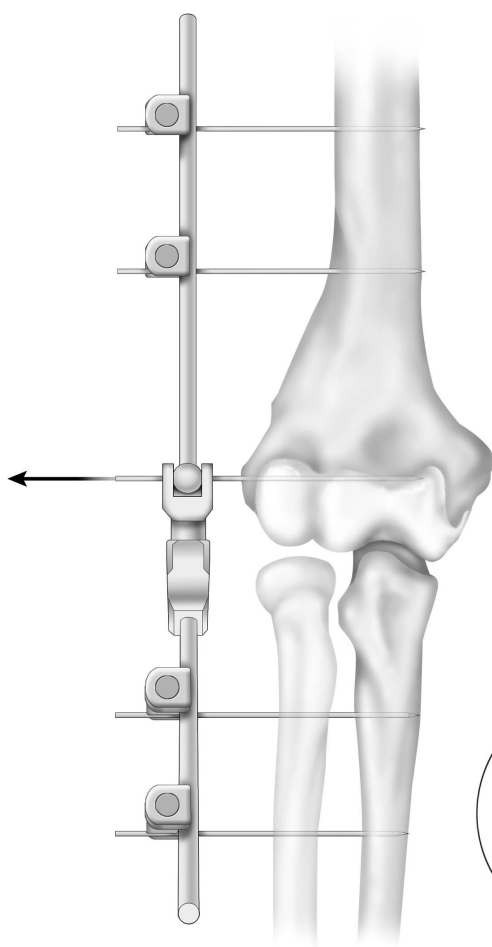


Figure 12

Apex® axis reference pin removal.

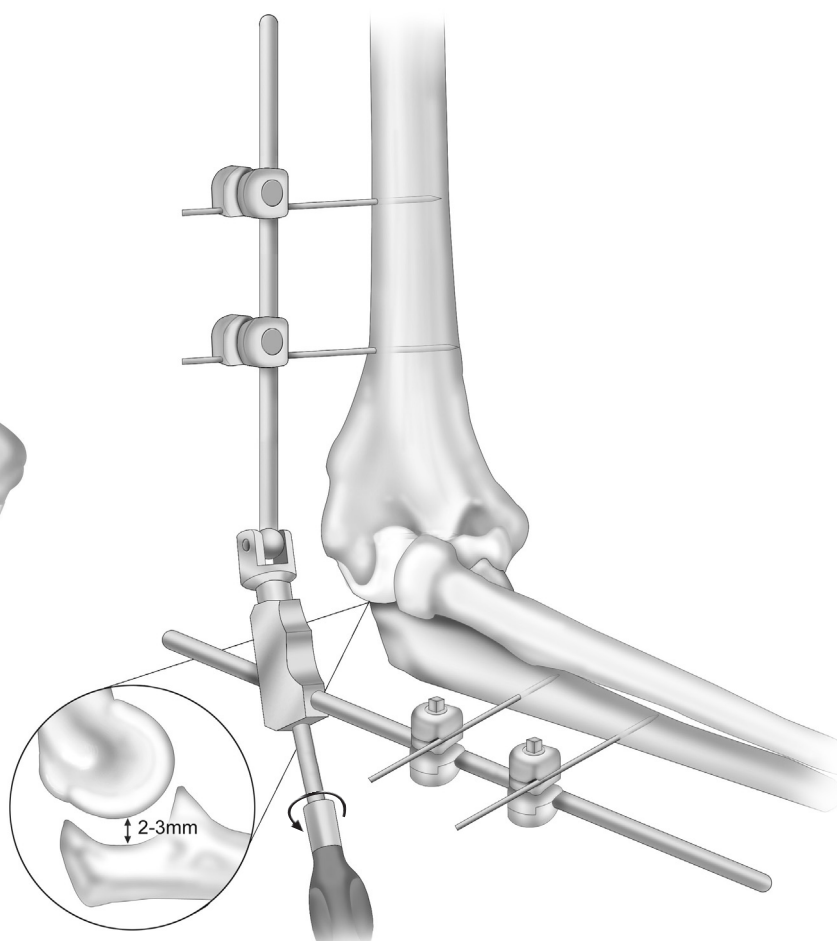


Figure 13

Using a Hoffmann® II Compact™ wrench the elbow joint is distracted generally 2-3mm.

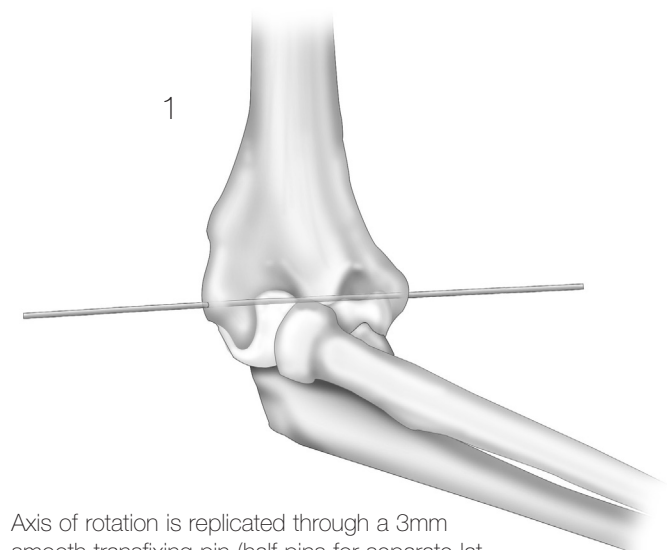
7.5 Place the pin guide over the ulnar rod more proximally i.e. between the distraction mechanism and the distal pin (Fig. 11).

7.6 The proximal self drilling/self tapping Apex pin can now be inserted through the pin guide.

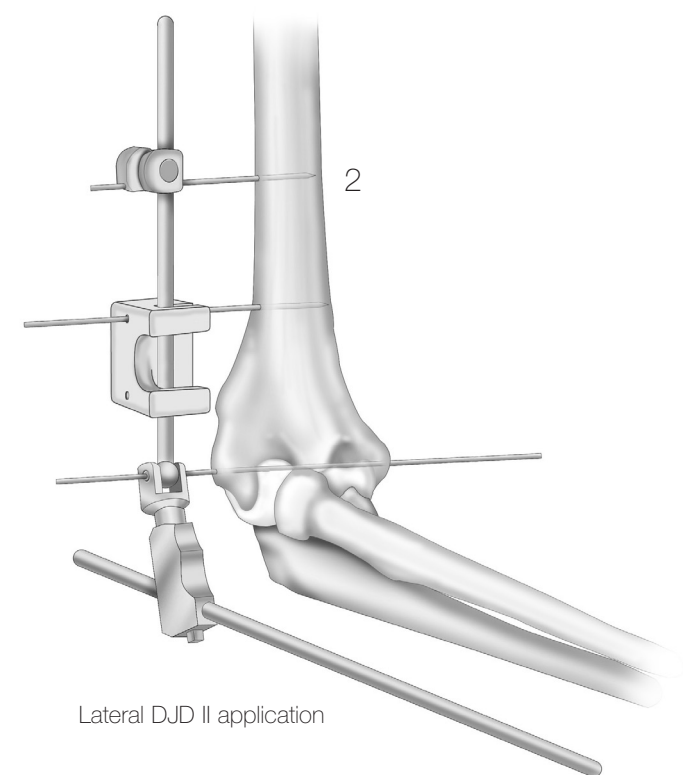
7.7 The pin guide is then removed.

N.B.: As with the humerus, the pins do not necessarily need to be parallel. If a different pin insertion angle is required to access a more adequate pin insertion area, slightly rotate the pin guide over the ulnar rod until such a pin insertion area can be reached. By providing proper pin-rod distance, the system allows an independent pin placement (see Fig. 9).

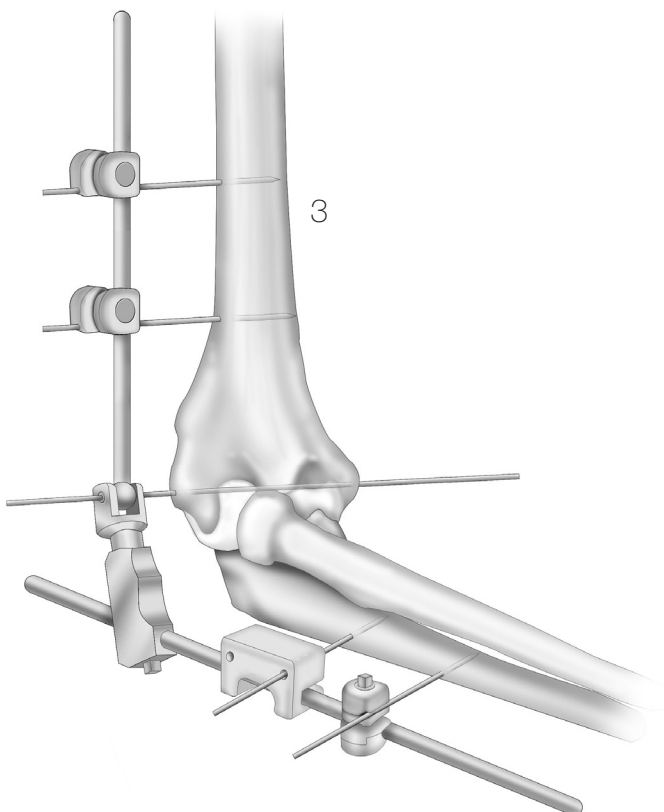
Dynamic Joint Distractor II – Bilateral Frame Option



Axis of rotation is replicated through a 3mm smooth transfixing pin (half pins for separate lateral or medial applications are acceptable)



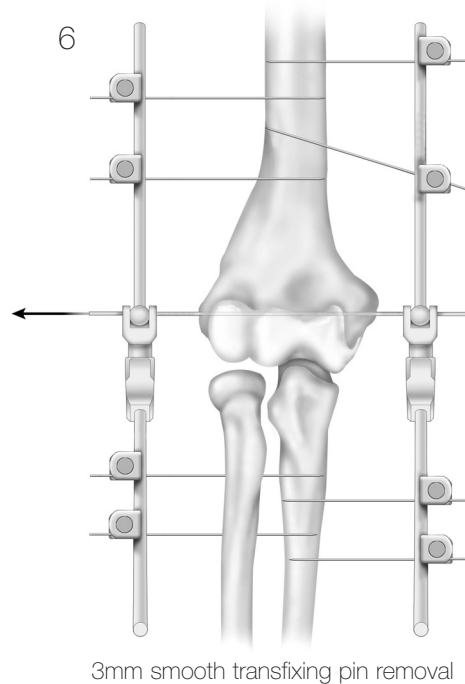
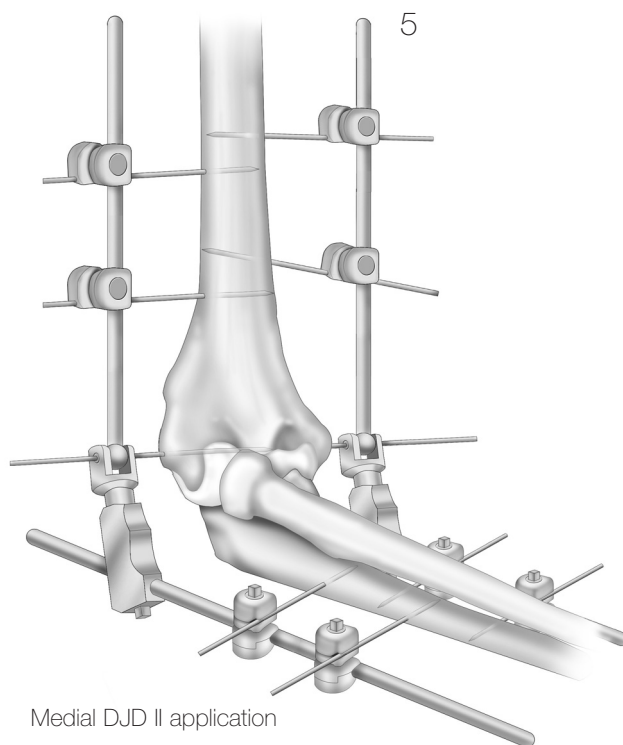
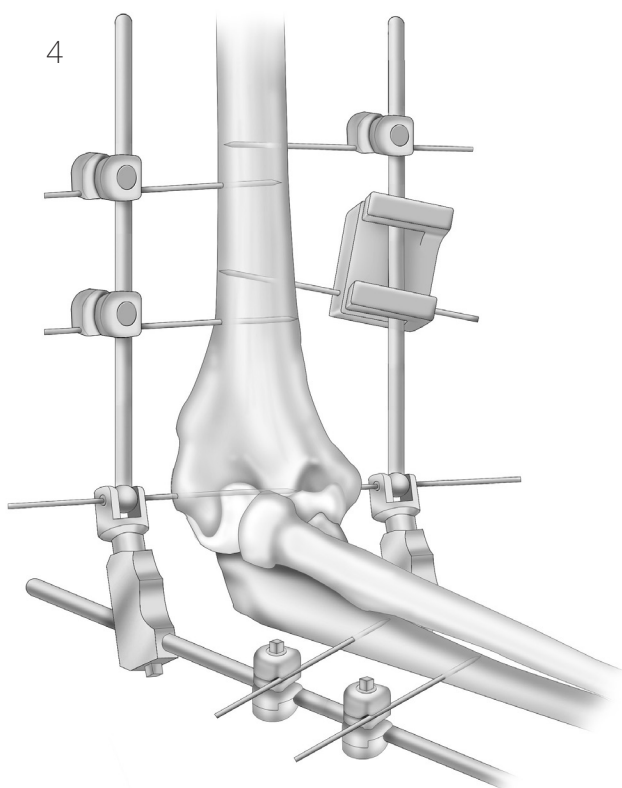
Lateral DJD II application



7.8 The proximal pin is fixed to the ulnar rod with a Hoffmann® II Compact™ pin-to-rod coupling which is then tightened using a Hoffmann® II Compact™ wrench.

7.9 If the indication requires the use of the proximal ulnar pin in the olecranon, it can be inserted through the pin guide. Once again, this pin will be once again

attached to the ulnar rod with a Hoffmann® II Compact™ pin-to-rod coupling which is then tightened.



8. Axis reference pin removal

The 3mm Apex[®] humeral reference pin is then removed (Fig. 12).

Dynamic Joint Distractor II – Medial Frame Option

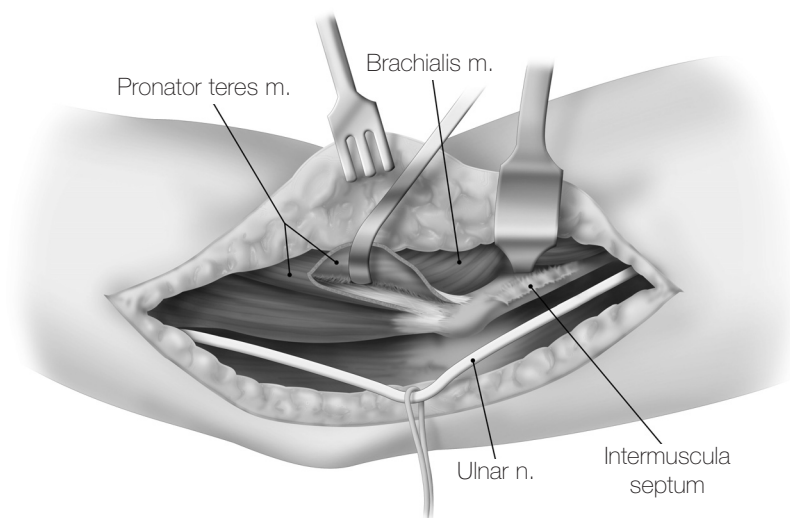


Figure 14

After identification of the medial intermuscular septum the brachialis and soft tissues are swept from the anterior aspect of the distal humerus.

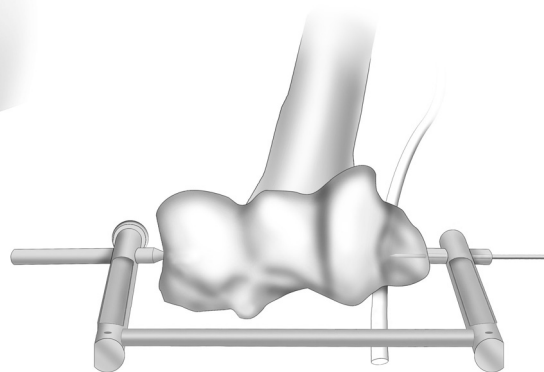


Figure 15

3mm Apex® reference pin inserted medially

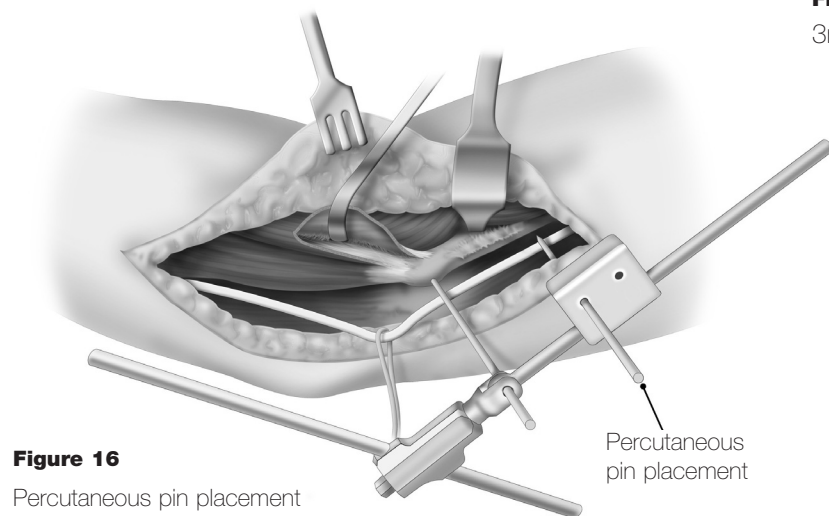


Figure 16

Percutaneous pin placement

9. Distraction

The ulna is separated from the humerus by turning the distraction screw using a Hoffmann® II Compact™ wrench.

Typically 2-3mm of distraction is sufficient to accomplish the goals of the procedure (Fig. 13). Skin closure is usually deferred until the distraction is applied.

If greater stability of the external fixator is desired, a second half frame is applied over a 3mm smooth transfixing pin or over a medial reference half pin on the medial aspect. Independent medial half pins are then applied on both the humerus and the ulna as described in steps 6 and 7 (see Fig. 1).

Percutaneous Application

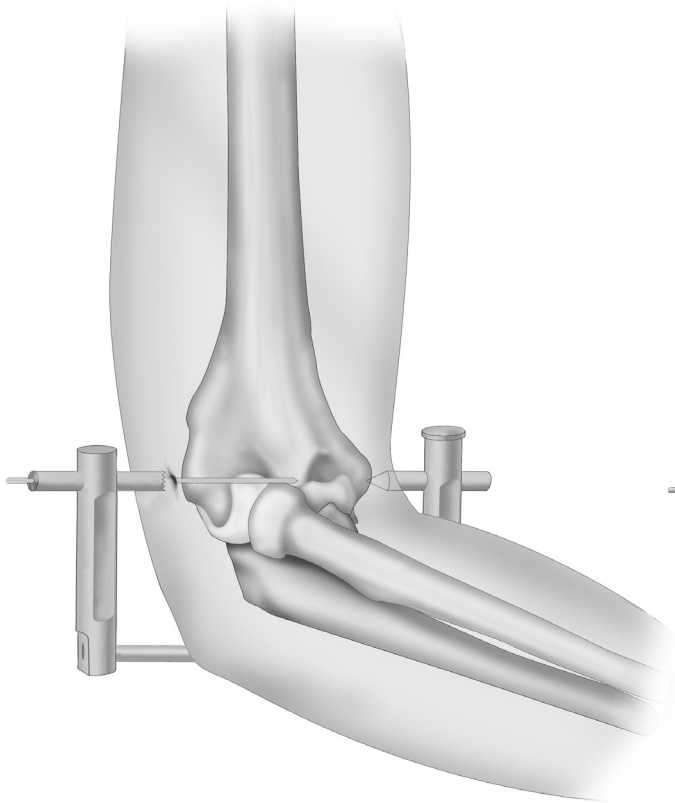


Figure 17

Percutaneous application directs the 3mm Apex® humeral reference pin from the lateral epicondyle towards the medial epicondyle.

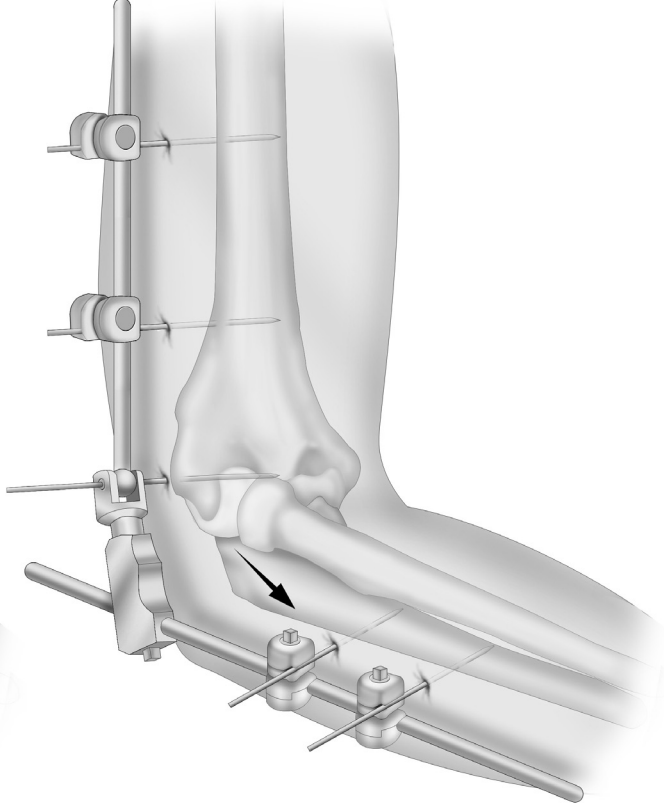
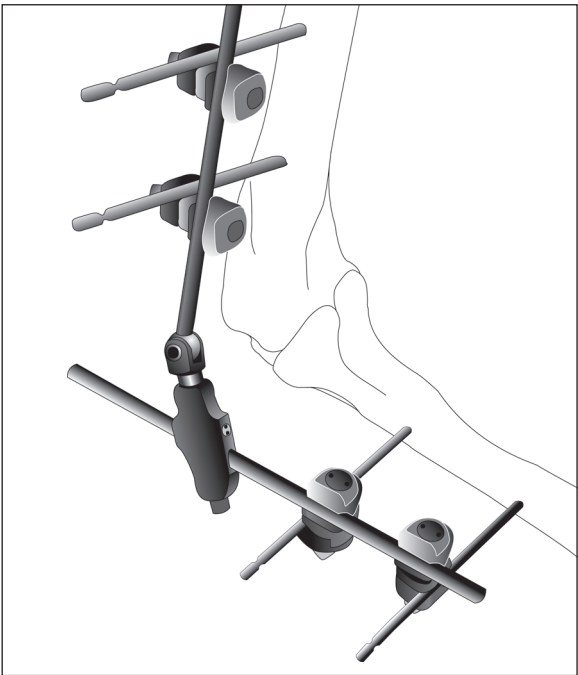


Figure 18

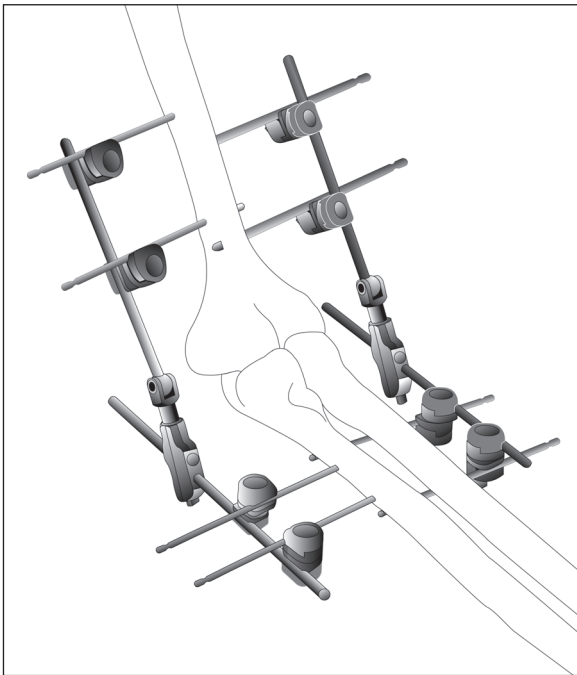
Once the frame is applied the distraction device may sometimes be used to help reduce the glenohumeral joint.

As with the unilateral frame configuration, the 3mm smooth transfixing pin which replicates the axis of rotation of the elbow is removed at the end of the surgery to reduce the risk of joint infection.

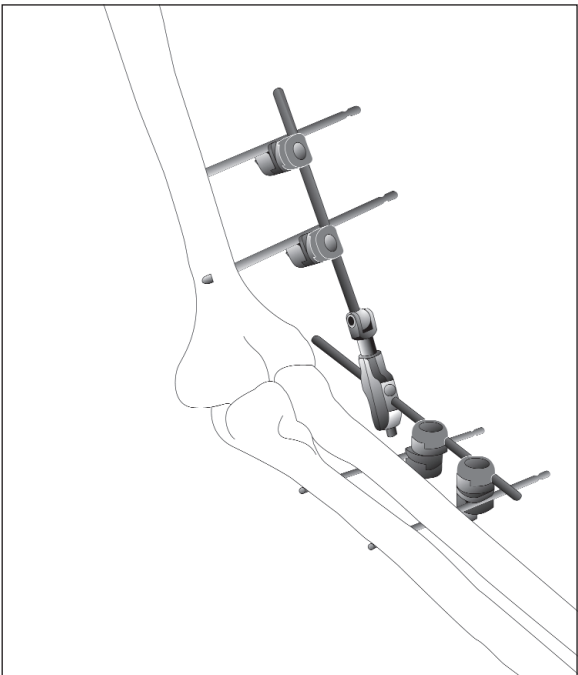
Dynamic Joint Distractor II Frame Reference Guide



1. Unilateral frame (Lateral)



2. Bilateral frame



3. Unilateral frame (Medial)

Component Configuration

Example				Quantity
	1.	2.	3.	
DJD II body (Cat No 5195-0-010)	1 ea.	2 ea.	1 ea.	
Pin-to-rod coupling (Cat No 4940-1-020)	4 ea.	8 ea.	4 ea.	
Apex® pins	4 ea.	8 ea.	4 ea.	

Postoperative Management Recommendations

The medial aspect of the triceps is identified along with the ulnar nerve. The nerve is not necessarily transposed unless appropriate for the case. The intermuscular septum is identified proximal to the epicondyle and followed anteriorly to the humerus. The soft tissues are elevated from the distal humerus and the pronator attachment is released from the anterior superior aspect of the medial epicondyle. Elevating the soft tissue sleeve allows exposure of the anterior medial capsule (Fig. 14).

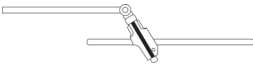
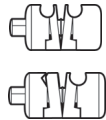
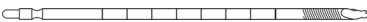
To apply the fixator, place the humeral (axis) reference pin guide in line with the axis of rotation.

The guide stylus is placed medially and the pointed tip is placed laterally at the axis site located at the lateral tubercle. Insert medially the 3mm Apex® humeral reference pin (Fig. 15). The application proceeds as with the lateral frame option (see page 7).

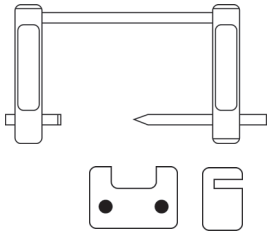
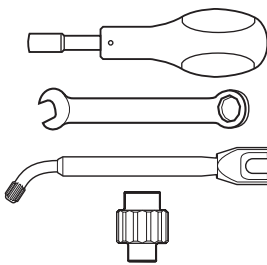
However, care must be exercised to observe and protect the ulnar nerve and anterior neuromuscular bundle at the time of humeral pin insertion. This is best done by directly observing the entrance site of the pins at the humerus. (Fig. 16).

Post-op Management	Time Period
Analgesia	Recovery room to 48 hours
Continuous Passive Motion (CPM)	Day 1-21 for stiffness Day 1-42 for fracture
DJD II removal	3 weeks for stiffness 6 weeks for fracture
Flexion and extension splints program	12 weeks: 21 hr/day during 3 weeks 18 hr/day during 3 weeks 15 hr/day during 6 weeks
Long-term splints	Maintenance at night during 3 months (longer as needed)

Components

	Catalogue Number	Description
	DJD II component	
	5195-0-010	DJD II body
	Hoffmann® II couplings	
	4940-1-010	Hoffmann® II Compact™ rod-to-rod coupling
	4940-1-020	Hoffmann® II Compact™ pin-to-rod coupling
	Recommended Hoffmann® II Compact™ rod	
	5049-5-250	Stainless Steel connecting rod 5mm x 250mm
	5049-5-525	Carbon connecting rod 5mm x 250mm
	Recommended Apex® 3 & 4mm pins	
	Self drilling/self tapping	
	5038-5-080	Pin diameter 3mm, length 80mm, thread length 20mm
	5038-2-110	Pin diameter 3mm, length 110mm, thread length 25mm
	5023-2-090	Pin diameter 4mm, length 90mm, thread length 20mm
	5023-3-120	Pin diameter 4mm, length 120mm, thread length 30mm
	5023-5-150	Pin diameter 4mm, length 150mm, thread length 40mm
	Blunt	
	5036-2-080	Pin diameter 3mm, length 80mm, thread length 20mm
	5036-2-110	Pin diameter 3mm, length 110mm, thread length 25mm
	5027-2-090	Pin diameter 4mm, length 90mm, thread length 20mm
	5027-3-120	Pin diameter 4mm, length 120mm, thread length 30mm
	5027-4-150	Pin diameter 4mm, length 150mm, thread length 40mm
	Smooth transfixing pin (bilateral frame construction)	
	5045-5-200	Smooth transfixing diameter 3mm, length 200mm

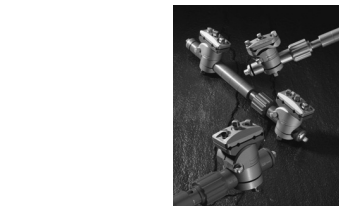
Instruments

Catalogue Number	Description	
DJD II specific instruments		
5195-1-010	Humeral guide	
5195-1-020	3mm pin insertion guide	
5195-1-030	4mm pin insertion guide	
Hoffmann® II Compact™ standard instruments		
4940-9-030	5mm wrench/3 & 4mm pin driver	
5150-9-005	5mm spanner wrench	
4940-9-010	Stabilization/reduction wrench	
4920-9-020	Thumbwheel	
Tray		
5195-9-100	Storage and sterilization case	

Notes

Dynamic Joint Distractor II

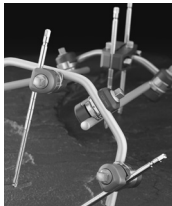
External Fixation System



Monotube® TRIAX™

External Fixation System

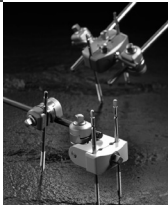
Unilateral frame system designed to handle a wide variety of fractures and limb-lengthening applications. This simple, color-coded system offers both dynamic and carbon tubes for individualized performance and economy. True simplicity, versatility, and economy.



Hoffmann® II**

External Fixation System

Modular frames which allow for true independent pin placement. Completely compatible with Original Hoffmann® components, this new system improves flexibility and ease-of-use, while enhancing frame economics through minimal componentry. It's external fixation with a "snap."



Hoffmann® II Compact™

External Fixation System

Designed to complement the anatomy of the distal radius by allowing independent movement of its clamps in multiple planes. Standard unilateral or bi-lateral bridging frames for intra-articular fractures and peri-articular non-bridging frames for extra-articular fractures. Fully compatible with the Hoffmann® II system, based on a spring-loaded snap-fit mechanism that improves flexibility and ease-of-use.



Dynamic Joint Distractor II

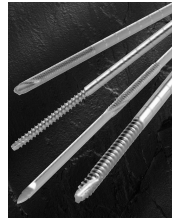
The DJD II is a Dynamic Elbow Joint Distractor. Fully compatible with the Hoffmann® II Compact™ System, it is designed to treat post-traumatic elbow stiffness as well as acute elbow trauma fractures.



Apex® ****

Pin Fixation

Every Fixator incorporates the high quality pin-to-bone interface provided by Apex® Pins. The Apex® Pin cuts more sharply with less torque, friction and heat upon insertion improving purchase while minimizing the risk of pin tract problems. Available in self-drilling and blunt tip designs, only from Stryker!



REFERENCES

1. Kenwright J, Richardson JB, Cunningham JL, White SH, Goodship AE, Adams MA, Magnussen PA, Newman JH. Axial movement and tibial fractures. J Bone Joint Surgery 1991;73b.
2. Hart MB, Wu JJ, Chao EYS, Kelly PJ. External skeletal fixation of canine tibial osteotomies. Compression compared with no compression. J Bone Joint Surgery 1985; 67 A:598.

Hoffmann® II Swiss Patent Application: 01-709/94-3. Other Patents Pending. * Patents: EU 385,929; 374,093; Canada 1,193,506; U.S. 5,160,335 and 5,207,676. ** Swiss Patent Application: 02-709/94-3. Other Patents Pending. *** Patents: EU 190,990; U.S. 4,784,125; 5,095,919. **** Patents: EU 230,856; Swiss CH 671,150; U.S. 4,978,350. †Data on file at Stryker USA.

The information presented in this brochure is intended to demonstrate the breadth of Stryker product offerings. Always refer to the package insert, product label and/or user instructions before using any Stryker product. Surgeons must always rely on their own clinical judgment when deciding which treatments and procedures to use with patients. Products may not be available in all markets. Product availability is subject to the regulatory or medical practices that govern individual markets. Please contact your Stryker representative if you have questions about the availability of Stryker products in your area.

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325 Corporate Drive
Mahwah, NJ 07430
t: 201 831 5000

www.stryker.com