Dynamic Joint Distractor II
External Fixation System
Dynamic Joint Distractor II

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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).

**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

**Figure 1**
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 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.

Case 2: Post-traumatic stiffness after supracondylar fracture.

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

Dynamic Joint Distractor – Unilateral Frame

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.
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 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.
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 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**
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.
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).
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.
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.

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).

7.7 The pin guide is then removed.
Dynamic Joint Distractor II – Bilateral Frame Option

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).
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).
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.

**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.
Dynamic Joint Distractor II Frame Reference Guide

1. Unilateral frame (Lateral)

2. Bilateral frame

3. Unilateral frame (Medial)

Component Configuration

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<tr>
<th>Example</th>
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<th>2.</th>
<th>3.</th>
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<td>Apex® pins</td>
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**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).

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

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<td><strong>Hoffmann® II couplings</strong></td>
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<td><strong>Recommended Hoffmann® II Compact™ rod</strong></td>
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<td>5049-5-250</td>
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<td>5049-5-525</td>
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<td><strong>Recommended Apex® 3 &amp; 4mm pins</strong></td>
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<td><strong>Self drilling/self tapping</strong></td>
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<td><strong>Smooth transfixing pin (bilateral frame construction)</strong></td>
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## Instruments

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<td><strong>Hoffmann® II Compact™ standard instruments</strong></td>
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<td>4940-9-030</td>
<td>5mm wrench/3 &amp; 4mm pin driver</td>
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<td>5150-9-005</td>
<td>5mm spanner wrench</td>
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<td>4940-9-010</td>
<td>Stabilization/reduction wrench</td>
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<td>Thumbwheel</td>
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<td><strong>Tray</strong></td>
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<tr>
<td>5195-9-100</td>
<td>Storage and sterilization case</td>
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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