

The Use of Dynamic External Fixateurs (Compass Hinge) for Complex Elbow Surgery.

Gregory Bain FRACS.

Peter Hallam FRCS(Orth),

Department of Orthopaedic Surgery, The Royal Adelaide Hospital, South Australia and Department of Orthopaedic Surgery, Modbury Public Hospital, South Australia.

Correspondence to Dr G Bain,

196 Melbourne St, North Adelaide, SA 5006, Australia.

+618 8361 8399

+618 82392237

email: greg@gregbain.com.au

www.gregbain.com.au

Introduction

The compass hinge is a dynamic external fixateur which is designed to provide elbow stability as well as allowing isometric passive or active mobilisation. The anatomical axis of the normal elbow passes between the medial and lateral epicondyles of the distal humerus. A Steinman pin is advanced across the anatomical axis and becomes the mechanical axis for the hinge.

Features of Dynamic External Fixateurs

- 1. Stability** All fixateurs utilise external fixation pins to secure the frame to the skeleton. A dynamic fixateur has a hinge mechanism that allows motion of the joint. The Compass Hinge (Smith and Nephew) uses Ilizarov ring which provides greater stability and versatility to the frame. It is constructed with half pins which are inserted into the humerus and the ulna using an open technique because of close proximity to the neurovascular bundles. The Ilizarov system allows infinite variability and allow it to be adapted for complex cases such as those associated with flaps, burns, comminution and in conjunction with internal fixation. Prior to applying a dynamic external fixateur it is important to obtain joint stability with internal fixation or ligamentous repairs. Once stability is obtained the fixateur can be applied to maintain stability. Dynamic external fixateurs should be considered an adjunct to stability. If stability can not be obtained and maintained then a trans-articular pin is required to obtain stability.
- 2. Isometric Mobilisation.** As the axis of motion is through the anatomical axis, the motion is isometric. Controlled passive mobilisation can be controlled by the patient with the aid of a Worm gear. It provides a mechanical advantage that assists with regard to rehabilitation. The gear can be unlocked to allow free active mobilisation of the elbow.
- 3. Distraction.** This is particularly useful for patients who comminuted fractures, as it unloads the joint surface. It is also required for interposition arthroplasty.

4. Radiolucency.

Indications and operative technique.

1. **Acute trauma:** The vast majority of patients with complex fracture dislocations of the elbow can be managed with immediate internal fixation and ligamentous repair without the need for an external fixateur. It is the author's experience that the dynamic external fixateurs are usually only required in the acute cases where there is bone or ligament loss. It rarely has a place in the elbow with extensive comminution.
2. **Subacute trauma:** In the author's experience, this is the most common indication. This is often for a delayed presentation of a fracture-dislocation with persistent instability. In these patients an open reduction, internal fixation and ligamentous repair are also required but the fixateur provides increased stability, and assists with rehabilitation.

In these particular cases, the author uses a global approach^{2,3} which involves a posterior midline incision with full thickness fasciocutaneous flaps. On the lateral side, the Kocher interval (between anconeus and extensor carpi-ulnaris). is identified by a fat strip on the lateral side of the elbow. By separating this interval, the lateral capsular complex can be identified. In those patients with an acute or subacute presentation it is not uncommon to see that the lateral ligament complex has been avulsed from the humerus and is translated distally, exposing the capitellum. The retracted lateral ligament complex sitting on the articular surface of the capitellum rather than re-attaching to the lateral epicondyle. It is the authors' opinion that the persistent late instability is caused by failure of the lateral ligament complex to heal as it is positioned on the capitellum.

If the radial head is required to be excised then the medial collateral ligament stability can be assessed with a valgus stress applied with the elbow in extension. And 30 degrees of flexion. A modular metallic radial head replacement should then be inserted.¹

In those patients requiring a medial exposure, flexor carpi-ulnaris is elevated from the subcutaneous border of the ulnar to expose the medial collateral ligament and the coronoid processes. The medial collateral ligament is usually avulsed from the medial epicondyle and is attached to the adjacent periosteum, which can be repaired with a suture anchor. Coronoid process fractures are important and those with a type 2 or type 3 fracture could be fixed. Because of the relatively small size of the fragment, internal fixation with conventional screws is particularly difficult and unreliable. The author recommends placing drill holes from the subcutaneous border of the ulnar and placing a No 5 permanent suture through the drill hole and into the capsule as it inserts into the coronoid process and then back down to the subcutaneous border of the ulna. This is important to optimise stability as it tightens the whole anterior complex similar to a volar plate arthroplasty in the PIP joint of the finger.

Once stability is obtained then it should be maintained with the compass hinge.

- 3. Chronic Cases:** This includes chronic persistent fracture-dislocations, and advanced primary degenerative arthritis in which an interposition arthroplasty is used. In patients requiring an interposition arthroplasty the joint is debrided and the hardened sclerotic bone of the distal humerus is debrided back to the bleeding subchondral bone. The authors' prefer to use the local joint capsule from the anterior and lateral aspects of the joint as an interposition. The synovium is removed and the capsule sutured to the humerus. This capsule is thick and robust in this type of patient and provides an excellent interposition. In addition the capsule is already partly fixed on one edge, is vascularized and does not require a separate incision. It is the author's experience that this is a much better option than the use of the fascia lata as this tends to be stringy. The compass hinge is applied to provide distraction across the joint, so that a natural joint tends to form between the interposition material and the trochlear groove.

Care is required with regard to the ulnar nerve to ensure that it has been left in a safe position and is not impinging upon any of the pins

4. Optimising Stability with the hinge⁴

Ensure that the joint is reduced at the time of applying the hinge.

Leave the axis pin in situ for 2 weeks

Use the worm gear as an extension block splint, so that the joint is initially in the flexed position and progressively extended

Trans-articular pin

Post-operative regime.

Post operatively the patient has the arm elevated and mobilisation is usually delayed until 1 week. This is to allow swelling to subside prior to mobilisation to minimise the risk of infection.

A heterotopic bone prophylaxis is required. This is either in the form of Indocid for a period of 6 weeks or a single dose of radiotherapy, which can be administered the day prior to surgery.

The dynamic external fixateur can also be used as an extension block splint, allowing the elbow to only be mobilised within a restricted arc of motion within the first few weeks. It is ideal to have the patient mobilise the worm gear.

The dynamic external fixateur is removed at 6-10 weeks post surgery. If there are problems at the pin sites, infections or patient tolerance, then it can be removed earlier. If the patient is struggling with regard to active mobilisation, then the worm gear may assist with regard to providing an increased range of motion.

References

- 1 Bain, GI: A review of complex trauma to the elbow. Australian and New Zealand Journal of Surgery. 1999 69, 578-581.
- 2 Patterson SD, Bain GI, and Mehta.JA: Surgical Approaches to the Elbow. CORR. 2000. 370, 19-33.
- 3 Dowdy, P., Bain, G.I., King, G.J., Patterson, S.D.: The Midline Posterior Elbow Incision: An Anatomic Rationale. J Bone Joint Surg. Vol 77B(5), September 1995: 696-699.
- 4 Bain, G.I., Mehta, J.A., Heptinstall, R.J., Bria, M. Dynamic external fixation for injuries of the proximal interphalangeal joint of the finger. J Bone Joint Surg (Br). 1998, 80-B: 1014-1019.