Original Article
Orthopaedics

SURGICAL MANAGEMENT OF DISTAL HUMERUS FRACTURES WITH INTERCONDYLAR EXTENSION BY USING PLATES

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Article submitted on: 20 February 2017
Article Accepted on: 03 March 2017

Abstract:
Distal humerus fractures are common and represent 2% of all fractures and approximately 30% of those affecting the humerus. The management of distal humerus fractures is complicated by the complex 3-dimensional anatomy of the elbow, the limited bone stock for internal fixation, and often comminuted and osteopenic nature of the articular segment. Surgical treatment should be conducted in a systematic manner to minimize complications.
Using the principles of anatomic articular reconstruction with stable fixation to allow early range to motion, good to satisfactory outcomes can be expected in most patients.

Key words: *distal humerus fracture, open reduction and internal fixation, supracondylar, intracondylar, fracture*

Introduction

Inter-Condylar Fractures of distal end of Humerus are uncommon injuries that account for fewer than 2% of all adult fractures.[1] The complex anatomy of the elbow joint, the adjacent neurovascular architecture and the sparse soft tissue envelop combine to make these fractures difficult to treat. Fractures of distal end of Humerus continue to be challenging problem for today's surgeons despite advances in technique and implants.[2] Acceptable results have been reported in a majority of patients treated by Open Reduction and Internal Fixation. Restoration of painless and satisfactory elbow function after a fracture of the distal humerus requires anatomic reconstruction of the articular surfaces, restitution of the overall geometry of the distal humerus and stable internal fixation of the fractured fragments to allow early and full rehabilitation.[3]

Reconstruction can be done according to two strategies:

Reduction and fixation of articular surfaces followed by attachment to humeral shaft. Reduction and fixation of Medial and Lateral condyles to shaft, then reconstruction of articular surfaces. Depending upon frequency of communition and displacement, Open Reduction and Internal Fixation with 1/3 tubular plate, Reconstruction plates, 'K' wire and double Tension Band wiring can be done individually or in Combination or Elbow Arthroplasty can be chosen. The Aim of the present Study is to evaluate the Functional Outcome of Surgical Management of Intercondylar Fractures of Humerus by Open Reduction and Internal Fixation by using Plates

Among the Surgical Exposure options available, it was concluded that it basically depends upon the Surgeons discretion but a Trans-Olecranon approach gives a better visualization of the Fracture site and an easier articular reconstruction opportunity compared to other approaches like Triceps-Reflecting Anconeus Pedicle, Triceps Splitting or a Para-Tricipital approach.[1]

Objectives Of Study

- To study the functional out-come of Surgical Management of Intercondylar Fractures of Humerus using Plates.
- To study the Advantages and Complications of the Proce-dure.

Materials And Method

- Duration of study from march 2014 to march 2017
- Sample size is 30
- Patients between 20 and 60 years are taken
- Duration of follow up is 2 years

Inclusion Criteria

- Closed distal humerus fracture with intercondylar extension
- Type 1 open fracture

Exclusion Criteria

- Type 2 and 3 open fracture
- Non union
- Pathological fracture
- Medically unfit patients

Discussion

Anatomy

The distal humerus can be thought of as a 2 column structure supporting the articular segment. The distal portion of the lateral column (capitellum) projects anteriorly approximately 35 to 40 degrees. The medial column terminates at the medial epicondyle and, in contrast, does not curve anterior. The anatomy of the trochlea is analogous to that of a spool with distal articular segment oriented at 4 to 8 degrees of valgus relative to the long axis of the humerus.[5] Furthermore, this distal articular segment is internally rotated 3 to 4 degrees relative to the transepicondylar axis. Understanding the ligamentous anatomy is critical during exposure and plate application to avoid iatrogenic injury. The anterior bundle of the medial collateral ligament a primary elbow stabilizer, originates on the anteroinferior aspect of the medial epicondyle and inserts onto the sublime tubercle of the ulna. The medial column and medial epicondyle, therefore, can accommodate plate placement without impinging on the MCL origin.[6] The lateral ulnar collateral ligament, the primary lateral stabilizer, orginates and inserts on thelateral epicondyle and crista supinatoris, respectively. Identification and protection of the lateral collateral ligament origin allows visualization of the posterior aspect of the radiocapitellar joint and safe lateral plate application. Diagnostic modalities are plain radiograph AP and LATERAL view. CT scan of involved part to know fracture anatomy.

Surgical Exposures

The selection of a surgical approach for the management of distal humerus fractures is dependent on several factors. These include the surgeon's experience and preferences, fracture pattern, degree of articular involvement, associated soft tissue injury, rehabilitation protocols, and whether intraoperative conversion to arthroplasty is con-templated. The ideal approach for each individual fracture should provide adequate visualization to allow anatomic reduction and

the application of internal fixation to maintain elbow stability with minimization of soft tissue and bone disruption to permit early motion.[7] Several surgical approaches will be discussed with their strengths and limitations highlighted Approaches to the distal humerus can be categorized intoolecranon osteotomies, triceps sparing (triceps-on), tricepssplitting, and triceps reflecting (triceps-off). Visualization of the distal humerus articular segment varies with each approach. The triceps splitting, triceps reflecting, and olecranon osteotomy expose 35%, 46%, and 57% of the distal articular segment, respectively. A thorough review of elbow anatomy and detailed approaches has been previously documented. However, for this review we will highlight some important issues surrounding each approach.[8]

Olecranon Osteotomy

Most commonly used approach for management of complex intrarticular DHF, as it affords the best visualization of the particular segment. The outcomes after this approach, however, can be complicated by malunion, nonunion, and hardware concerns. The steps required to minimize postoperative complications after the creation of an olecranon osteotomy.[9] These include precontouring and fixation of a 3.5 mm reconstruction plate to the olecranon with screws directed ulnarly to avoid the proximal radioulnar joint, identification of the bare spot through medial and minimal lateral dissection and maintenance of subchondral bone before completion of osteotomy

Triceps Sparing (Triceps-On) or Bilaterotricipital Approach

This approach avoids any disruption of the extensor mechanism insertion on the olecranon using surgical windows along the medial and lateral sides of the triceps. The main advantages of this approach are the avoidance of an osteotomy and maintenance of triceps integrity to allow early active motion. An additional advantage of this approach is that it allows easy intraoperative conversion to a total elbow arthroplasty (TEA) if stable ORIF is deemed unlikely.[10] Distal extension of the lateral window into the Boyd approach assists with intra-articular exposure. The main disadvantage of this approach is the limited visualization of the articular segment. This approach is best reserved for extra-articular fractures or simple intra-articular fractures with minimal comminution.

Triceps Splitting

It involves a distal midline triceps tendon split with equal portions of the triceps tendon and its insertion on the olecranon reflected medially and laterally. In the comparative study of posterior elbow approaches reported that only 35% of the distal humerus articular segment could be visualized with the triceps split, which does limit its usefulness. Comparison between the olecranon osteotomy to the triceps split for DHF found no difference in functional outcomes at follow-up

Intra Op Photograph

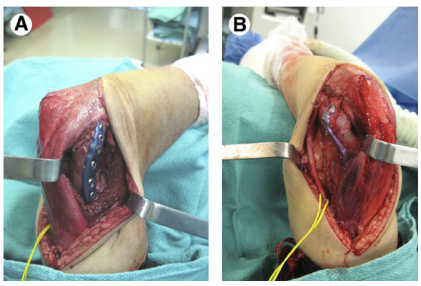


Plate Types

Several different plate types have been used in the past, presently 3 general options exist, 3.5 mm standard straight plates that are intraoperatively contoured, fracture specific precontoured plates, and precontoured locking plates. Thinner plates (one-third tubular) or screw-only fixation are not recommended.

Fixation Approach

A principle-based approach to the management of distal humerus fractures is recommended. This form of treatment relies on 2 basic principles: articular reconstruction followed by column reconstruction

Articulator Reconstruction

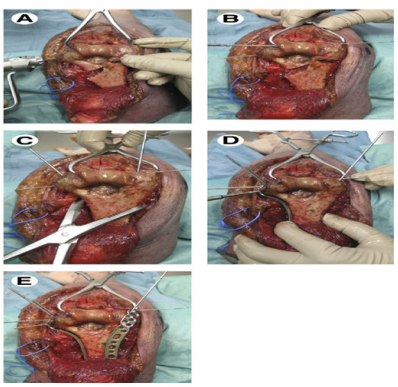
The principles of peri-articular fracture fixation include restoration of the articular segment, column realignment and rigid fixation to allow for early mobilization. Preliminary fixation of the articular segment may be performed with Kirschner wires (K-wires). SeveralK-wires may be required for temporary fixation, therefore, they should be placed strategically taking in to consideration final plate and screw position. The main fragments of the articular segment can be fixated by 2 methods.[3]

The first method involves the placement of a central spool screw down the axis of the trochlea to fixate the 2 main fragments. Another method involves provisional fixation of the articular segment with K-wires followed by definitive fixation with screws placed through medial and lateral plates applied in a parallel manner. In cases with articular comminution, the comminuted minor fragments can be fixated to the major fragments with threaded Kwires, headless compression screws or bioabsorbable pins. Coronal shear fractures of the capitellum, trochlea,

or both may occur in association with distal humerus fractures. These coronal shear fragments can be visualized by internally rotating each condyle. This allows fixation of the coronal shear fracture and then subsequent fixation of the primary sagittal plane articular fracture. In situations where articular segments are absent, a principle-based approach is once again important. Restoration of joint range of motion is primarily dependent on the medial and lateral ridges of the trochlea. Therefore, loss of the midportion of the trochlea or the posterior articular surface, although important, is not entirely necessary for stability

Column Reconstruction

Once the articular segment has been provisionally fixed, it must be rigidly linked to the humeral diaphysis. Provisional fixation of the articular segment to the diaphysis may be performed with K-wires inserted retrograde from distal to proximal. As mentioned, several different plating techniques exist, including orthogonal plating (90:90), parallel plating, and triple plating[4]. All 3 techniques have been supported clinically and none have demonstrated clinical superiority. Following surgery the elbow is placed through a range of motion to ensure there is no impingement, hardware rominence or instability. Intraoperative fluoroscopy is also recommended to ensure all hardware is extra-articular



Plating Technique

Orthogonal Plating (90:90).

The AO group has recommended an orthogonal (perpendicular or 90/90) plate configuration to maximize stability and allow early mobilization. Once preliminary distal articular fixation has been achieved, plate application follows. The key component of the posterolateral plate involves distal application without contacting the posterior articular cartilage of the capitellum[2]. Medial column fixation involves placement of a sagittal plate along the supracondylar ridge that curves around the medial epicondyle. The proximal lengths of the plates should be variable to avoid the formation of a stress riser in the humeral diaphysis. The sequence of fixation should be tailored to each fracture configuration. Initial stabilization of large fracture fragments permits easier reduction of more comminuted Segments.[11]

Parallel Plating

This plating technique also involves bicolumn fixation, however, the plates are applied in a parallel fashion rather than orthogonally. In comparison with posterolateral plating, the lateral plate is applied along the supra condylar ridge in the sagittal plain and is contoured in a "J" distally to accommodate the anterior angulation of the lateral epicondyle. The position of the plates is not directly medial or lateral, rather they are offset dorsally plate application and provisional fixation is complete, medial and lateral proximal cortical screws are inserted to hold the plate. This is followed by the insertion of distal articular screws through the plate An attempt is made to place each screw through a hole within the plate, involve as many articular segments as possible and engage the condyle on the contralateral side. Compression with a large reduction clamp across the articular segment obviates the need for lag screws. In situations of distal bone loss, articular compression is not advised as it may shorten the mediolateral width of the trochlea. Final compression across the supracondylar fracture site can be obtained by large reduction forceps from the contralateral articular side to the ipsilateral diaphyseal side.[3] This is performed when an eccentric screw is placed in to the plate to allow dynamic compression. The remaining screw holes are then filled and an attempt is made to place 4 to 6 screws across the articular segment.

Triple Plating.

Triple plating is a combination of the above techniques. It is used in cases with severe comminution where additional fixation is required. Typically, the third plate is placed laterally to provide additional support for the lateral column. In special circumstances with severe metaphyseal bone loss, strategies, such as bridge plating, bone rafting, or supracondylar shortening ostectomy may be used

Complications

1 infection (3-5%)
2 elbow stiffness (10%)
3 ulnar neuropathy (8%)
4 heterotopic ossification (5-6%)
5 nonunion (7-9%)
6 malunion
7 mechanical failure (7-16%)

Similar Study

- In early 2012, Joaquin Sanchez-Sotelo compared the outcome of Open Reduction and

Internal Fixation of distal end of Humerus with Elbow Arthroplasty and found that Internal fixation is the preferred choice of treatment unless specific indications for elbow arthroplasty existed.

- In 2011, Aaron Nauth et al and Babhulkar et al concluded that dual plate fixation with placement of a separate strong plate on each column and orientation of the plates either at 90^0 or 180^0,is indicated for all adult fractures involving both columns of distal part of Humerus.
- In 2010, Sang-Jin Shin et al conducted a comparative study between the two different plating techniques available and concluded that although both orthogonal and parallel plate provide adequate stability and anatomic reconstruction, parallel plating holds a slight advantage over orthogonal plating in terms of having better long-term results.
- In 2009, Atalar et al conducted a study on around 21 patients with distal end of humerus fractures and functionally evaluated the outcome and concluded that results are satisfactory when fractures are treated with stable osteosynthesis and parallel plate technique that allows early motion, in congruence with other studies conducted around that time.
- In 2000, David Ring and Jesse B. Jupiter advocated the use of two 3.5mm reconstruction plates for the T and H shaped fractures of the distal humerus. They reviewed the result of treatment in 13 patients and obtained results which are comparable with other recent series.

Results

8 patients (25%) had excellent, 9 patients (30%) had good and 9 patients (30%) had fair outcome according to MAYO performance score. Nonunion is not encountered superficial infection in 5% cases treated by daily dressing and IV antibiotics

Mayo Performance Score

Function	Points	Definition	Points
Pain	45	None	45
		Mild	30
		Moderate	15
		Severe	0
Motion	20	Arc>100°	20
		Arc 50-100°	15
		Arc<50°	5
Stability	10	Stable	10
		Moderate instability	5
		Gross instability	0
Function	25	Comb hair	5
		Feed	5
		Hygiene	5
		Wear shirt	5
		Wear shoes	5

Total score = 100, Excellent result = >90, Good result = 75-89, Fair = 60-74, Poor result = <60

Pre op xray

Immediate post op

3 months post op

6 months post op

Clinical Photographs

Conclusion

The complex geometry of the distal humerus compounded with the increasing number of fractures in the elderly patients will continually challenge orthopaedic surgeons. Advance-ments have been made in imaging, surgical techniques, and fracture specific implants, however, time will determine whether patient outcomes have been improved and complications decreased. The management of distal humerus fractures should be approached in a systematic way, understanding the fracture type, its natural history, using the principles of fracture care and incorporating patient-related factors. The goals of treatment are an approach that provides adequate exposure, anatomic reduction of the joint, stable fixation to allow for early rehabilitation, and the minimization of complication.

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