Chapter 3

Elbow Arthroscopy

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Additional information is available at the end of the chapter

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Abstract

Introduction: Elbow joint is a complex articulation of three bones. It is a hinge joint with three types of motions; flexion-extension, varus-valgus and rotations. With advancement of instrumentations, our knowledge about surgical anatomy and surgical skills, elbow arthroscopy has become an excellent tool to treat a wide range of disorders with minimum risk and complications.

Pathologies such as tennis elbow, OCD, fracture radial head, fracture capitulum, stiff elbow, synovitis, loose bodies, etc, are now easily treated with arthroscopic technique.

Elbow arthroscopy has its role in the management of ligament injuries and instability.

There are three major neurovascular bundles in close proximity of elbow joint, the median nerve on posteromedial aspect, the radial nerve on posterolateral side and the ulnar nerve along with brachial vessels anteriorly.

Materials & Methods: Procedure can be performed either under general or regional anesthesia.

Usually, in young and cooperative patients, regional anesthesia in the form of interscalene, axillary, or Bier's block can be used.

In elderly and non-cooperative patients, general anesthesia with or without regional block for postoperative pain management can be used.

We usually prefer the lateral position with the elbow freely hanging on the support. But there are three positions described for elbow arthroscopy, supine position, prone position and lateral decubitus position.

Conclusion: Elbow arthroscopy is a minimally invasive procedure and provide good to excellent long term results. We can diagnose and treat concomitant intra-articular

pathologies specially posterolateral plica, lateral gutter impingement, loose bodies and posterolateral rotator instability. We can fix fractures, treat tendinopathies, do chondroplasty and stiff elbow release. With the advancement of instrumentations, our knowledge about surgical anatomy and surgical skills, elbow arthroscopy has become an excellent tool to treat wide range of disorders with minimum risk and complications.

Keywords: Instability, Tennis Elbow, Fractures

1. Introduction

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1.1. Materials and methods

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1.2. Conclusion

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2. Elbow arthroscopy

2.1. Introduction

Elbow joint is a complex articulation of three bones. It is a hinge joint with three types of motions; flexion-extension, varus-valgus and rotations.

There are three major neurovascular bundles in close proximity of elbow joint, the median nerve on posteromedial aspect, the radial nerve on posterolateral side and the ulnar nerve along with brachial vessels anteriorly [5].

These things, along with a closely confined space, makes elbow arthroscopy a challenging procedure [4].

With the advancement of instrumentations, our knowledge about surgical anatomy and surgical skills, elbow arthroscopy has become an excellent tool to treat a wide range of disorders, with minimum risk and complications [1,4,5].

Pathologies such as tennis elbow, OCD, fracture radial head, fracture capitulum, stiff elbow, synovitis, loose bodies, etc, are now easily treated with arthroscopic technique [2].

Elbow arthroscopy has its role in the management of ligament injuries and instability [2].

Usually, a standard 4mm 30° arthroscope is sufficient for most of the procedures. In smaller joints, a 2.7mm scope can be used.

Procedure can be performed either under general or regional anesthesia [1].

Usually in young and cooperative patients, regional anesthesia in the form of interscalene, axillary, or Bier's block can be used.

In elderly and non-cooperative patients, general anesthesia with or without regional block for postoperative pain management can be used [1].

Position:-

We usually prefer the lateral position with the elbow freely hanging on the support.

There are three positions described for elbow arthroscopy.

1. Supine position: In 1985, Andrews and Carson first reported on supine positioning with a traction device for elbow arthroscopy. Morrey described supine positioning without a traction device in 1986 [1].

It is the most suitable position from the patient's and anesthetist's point of view.

But it requires special traction device to hold the limb in position. Though the position is best for anatomical orientation, it has certain disadvantages. An additional assistant is needed to support the elbow, elbow manipulation under traction is limited and access to posterior compartment is limited [1].

2. Prone position:- Poehling reported on elbow arthroscopy in the prone position in 1989.

This position greatly overcome the disadvantages of supine position, but is problematic from anesthesia point of view. With the patient in prone position, the elbow can be held on the bolster or arm holder in 90° flexion freely hanging on the side of the table. Accessing the posterior compartment, manipulation and conversion to open procedure is easier. Procedure in this position can be performed only under general anesthesia as maintaining the prone position under regional block will be difficult for the patient[1].

3. Lateral decubitus position: - O'Driscoll and Morrey described the lateral decubitus position for elbow arthroscopy in 1992. This is by far the most preferred position used for elbow arthroscopy [1]. It is easy to hold the arm on the support or bolster just like in the prone position. It has the same advantages as the prone position and avoids anesthesia problems also [1,2].

The procedure can be easily performed under regional anesthesia. With the distension of the joint the anterior neurovascular structures are pushed away making the procedure safer.

Figure 1. Lateral decubitus position

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Portals:-

There are many portals described for elbow arthroscopy, but basically 5-6 portals are the most useful.

i. Basic portals

1. Anteromedial portal

2. Anterolateral portal

3. Midlateral portal

ii. Accessory portals

4. Proximal anterolateral portal

5. Proximal anteromedial portal

6. Posterolateral portal

7. Direct posterior portal

1. Anteromedial portal

This is the first portal made as a viewing portal.

It is 2 cm anterior to the medial epicondyle.

First, a small skin incision is made and a blunt trocar is advanced flush to the anteromedial surface of the humerus, directing toward the lateral epicondyle.

Since the anteromedial portal is anterior to the medial epicondyle, the ulnar nerve is at a minimal risk if the portal is placed properly [4, 5].

2. Anterolateral portal

This portal can be best made by the inside out technique from a anteromedial portal. It is situated about 1 cm anterior and 1cm distal to the lateral epicondyle. It coincides with the radiocapitular joint and is the safest lateral portal.

3. Midlateral portal

It is a direct soft spot portal situated in the anconeus triangle. Just like in knee arthroscopy, the trocar is introduced in the flexion and gently extending the elbow, it is directed towards the olecronon fossa. This portal is useful for viewing the inferior portions of the radial head, capitellum, ulnohumeral articulation, and olecronon fossa.

4. Proximal anterolateral portal

It is about 2 cm proximal and 1 cm anterior to the lateral epicondyle. A blunt trocar is directed toward the center of the joint flush to the anterior surface of the distal humerus.

This portal provides excellent visualization of the anterior compartment.

5. Proximal anteromedial portal (PAM)

Figure 2. Anteromedial portal

The PAM portal is 2 cm anterior and proximal to the medial epicondyle. The medial intermuscular septum is palpated, and the portal is established anterior to the septum.

Just a skin incision is made and a blunt trocar is directed towards the radial head going flush to the anterior surface of distal humerus.

6. Posterolateral portal

It is just proximal to the olecranon and along the lateral border of the triceps tendon. After making a skin incision, a blunt trocar is directed toward the center of the olecranon fossa with the elbow in 45° flexion.

PLP is best for the visualization of the olecranon tip, olecranon fossa, and posterior trochlea, as well as the medial and lateral gutters.

7. Direct posterior portal (DPP)

The DPP is made in the midline posteriorly and 3 cm proximal to the olecranon tip. This portal is excellent for the visualization of the entire posterior compartment.

Examination:

- Inspection :-

The elbow joint is examined from the front, back and sides.

Lateral recess, medial epicondyle, antecubital fossa, and olecranon tip are inspected.

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Prominence of the Olecranon tip may indicate posterior/posterolateral dislocation or triceps avulsion.

Ecchymosis anteriorly may indicate biceps tendon rupture.

Ecchymosis medially may indicate a fracture of the medial epicondyle or avulsion injury

Olecranon bursa should be inspected; if it is enlarged it may represent bursitis either aseptic or septic.

The ulnar nerve subluxation may be visible

- Palpation:-

Bony palpation is done in a step –wise manner:-

- Olecranon
  - Posteromedial tip (impingement)
  - Proximal shaft (stress fractures)
- Epicondyles:- Medial and lateral
  - Fractures
  - Epicondylitis

Medial Epicondylitis (golfer's elbow)

- Palpate medial muslce mass/epicondyle while resisting active pronation
- Pain either within muscle belly or directly over epicondyle

Lateral Epicondylitis (tennis elbow)

- Palpate mobile wad while resisting active supination (extensor carpi radialis brevis is the most common offender)
- Pain within muscle belly or over epicondyle
- Radial head
  - Fractures
  - Dislocations

Active followed by passive range of motion is checked.

Normal ROM in adult is 0 – 140 °(+/- 10°) in sagittal plane and 80-90°of forearm rotation in each direction.

With progressive flexion, the elbow moves into increasing valgus.

Impingement of the posteromedial tip of the olecranon in the olecranon fossa is examined by the vulgus extension and supination movement to diagnose vulgus extension overload (VEO) syndrome [2].

Soft tissues

- Antecubital fossa
  - Mobile wad, biceps tendon, brachial pulse
  - Median nerve not generally palpable
- Medial
  - Flexor-pronator mass
  - Ulnar nerve
  - UCL

Valgus stress test:-

With the patient in supine or prone position, abduct and maximally externally rotate the shoulder.

Elbow is flexed 25°and valgus stress applied.

Assess for end-feel and amount of opening and do not induce any pain in the normal elbow.

The radial collateral ligament and the lateral ulnar collateral ligament make up the lateral ligament complex [3].

Varus stress test;

Apply varus stress with the elbow flexed 15-20°and the arm is internally rotated to prevent shoulder rotation.

Assess any pain or increased varus laxity [3].

- Posterolateral rotator instability (PLRI):-
- Test for PLRI = "Pivot Shift"

Anesthetize supine patient and do forward flexion and external rotation of the shoulder.

Forearm supination and axial load with valgus stress as arm is gradually flexed.

Radial head subluxes posteriorly and "clunks" back into place.

- Stress x-ray

Graded stress x-rays in evaluation of the injury to the UCL of the elbow[3]

MRI:-

Diagnostic arthroscopy:-

After making the diagnosis and having decided for elbow surgery, the patient is prepared for the day care procedure. Preoperative intravenous antibiotics are given. After suitable anesthesia, we usually put the patient in the lateral decubitus position using an arm holder and a

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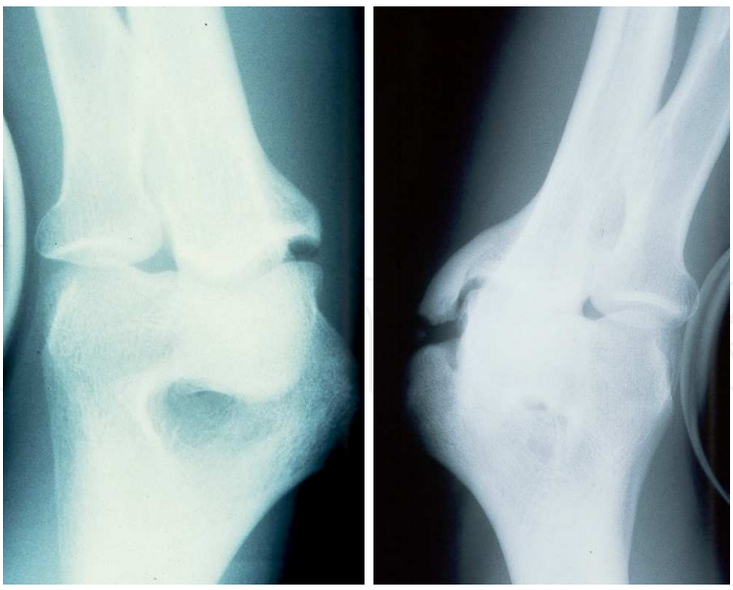

Figure 3. Medial joint opening-valgus stress

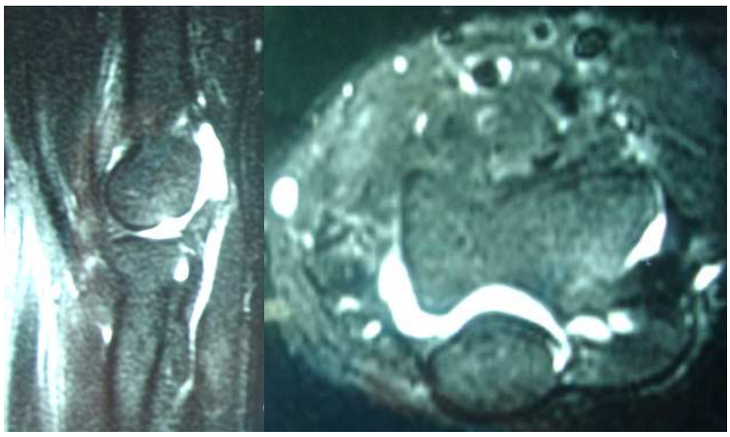

Figure 4. LUCL tear

bolster. The elbow should be positioned and draped so that the arm is supported by the holder at the proximal upper arm; the elbow rests at 90°. Care must be taken to keep the antecubital fossa free from contact with the bolster. The arthroscopy trolley is set on the opposite side of the patient. An examination under anesthesia is performed to determine elbow range of motion and stability. Prepping, draping and exsanguinations are done and the tourniquet is inflated. Surface landmarks of medial, lateral epicondyles, olecronon radial head, ligaments, and portals are marked with the sterile marker pen. The lateral soft-spot portal location is identified and 20 to 30 ml of saline is injected into the elbow joint space. A number 11 blade is used to incise the skin only to make an AM portal and blunt trocar -cannula for the 4-mm arthroscope are introduced toward the radial head maintaining contact with the anterior cortex of the distal Humerus. A 4-mm, 30°arthroscope attached to monitor via camera is then used to examine the capitellum, radial head, anterolateral capsule, coronoid process and fossa.

With pronation and in supination movements the radio-capitellar joint can be examined.

Now the anterolateral portal can be established by the inside out technique with Wisinger rod from the anteromedial portal directed towards the radial head. Or by the outside-in technique using a spinal needle introduced at about 1 cm anterior and 1cm distal to the lateral epicondyle. It coincides with radiocapitular joint and is the safest lateral portal. After this, using a Wisinger rod and sheath, a 4mm, 30°arthroscope is introduced through the anterolateral portal and medial capsule, trochlea, and coronoid can be examined.

The posterior compartment is examined by making a posterolateral portal just proximal to the olecranon and along the lateral border of the triceps tendon. After making a skin incision, blunt trocar is directed toward the center of the olecranon fossa with the elbow in 45° flexion. The olecronon process and fossa, medial and lateral gutters, and posterior radio-capitellar joint and capsule are examined.

Now through the soft spot midlateral portal, the posterior radial head, capitellum, and ulnohumeral articulation can be visualized. Direct posterior portal can be made for instrumentation if any pathology is found posteriorly.

Once the procedure is complete, portals are closed, compressive dressing applied, and the tourniquet is released.

Depending upon the procedure performed, a splint or brace is applied. An exercise program for the specific disorder is started on day two to be continued at home [1,2].

3. Medial elbow instability

The medial collateral ligament (UCL/MCL) is the only primary static stabilizer on the medial side in 30-90° flexions [6]. Though the common flexor muscles, radio-capitellar articulation, and ulnohumeral articulation provide secondary restrains, UCL is the main medial support in throwing, backhand tennis or badminton serve, golf, and activities of daily living requiring flexion-valgus movements of the elbow [6]. Repetitive valgus stresses to the elbow occurring during the throwing can lead to MCL incompetence, ulnar neuritis, and vulgus extension overload [7].

Acute injury to the MCL (UCL) can occur with a fall of an outstretched hand with the elbow in valgus and supination [6].

MCL consists of the anterior bundle, posterior bundle, and transverse segment.

The anterior bundle is the primary restraint to valgus stress at the elbow.

In cases of MCL insufficiency due to repeated micro trauma, pain is localized to the medial elbow generally in throwing, backhand serve, underarm throw in cricket, etc. Since it's a cumulative injury over time, the patient does not remember the injury [7]. Associated ulnar neuritis causing paresthesias in the posteromedial elbow to the ring and small fingers may be the first complaint [7].

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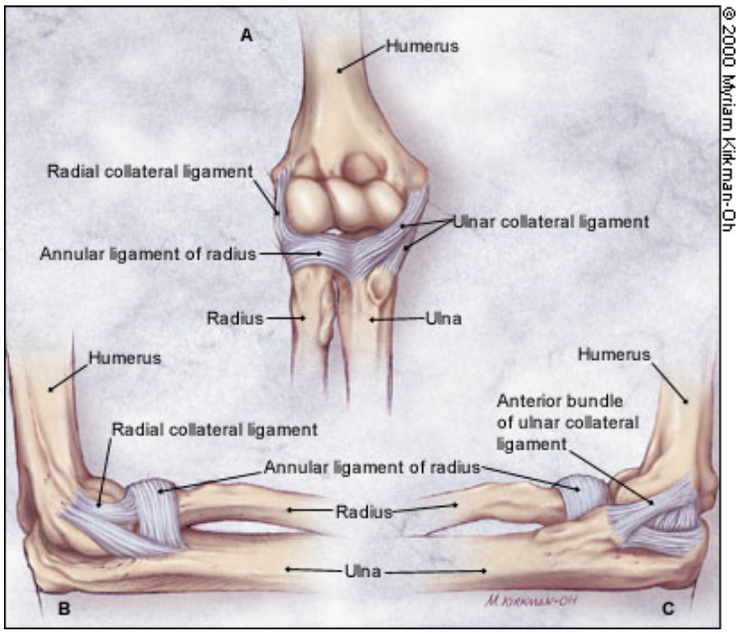

Figure 5. Medial collateral ligament-anatomy

But in acute traumatic injury, there is an event followed by a "pop" sensation, pain, swelling and inability use the elbow with without bruising [6,10].

Complications of chronic instability:-

Ulnar neuritis, posteromedial olecranon impingement (VEO), and ulnohumeral arthritis [7].

Examination:-

Inspection:- Swelling and bruising along the medial aspect.

Palpation: - Tenderness along the MCL course; may feel gapping, restricted and painful ROM.

Valgus stress test: valgus load applied to the elbow with the elbow flexed 20°. Positive results means the reproduction of medial elbow pain and valgus laxity greater on the injured side as compared to contra lateral side.

Moving valgus stress test: Rrapid extension from full flexion while maintaining a constant valgus stress. Positive result means the reproduction of medial elbow pain.

Milking maneuver: Patient or examiner pulls on the patient's thumb creating a valgus stress, with the patient's forearm supinated and elbow flexed 90°. Medial elbow pain indicates medial elbow instability.

Xray / MRI

X-rays are generally normal, but may show MCL calcification, medial humeral osteophytes, ulnar osteophytes, posterior olecranon spurring, or loose bodies [8].

Valgus stress x-rays: > 3 mm medial opening on side-to-side comparisons is diagnostic of valgus instability [8].

Figure 6. Valgus stress X-ray- medial opening.

MRI: 3 Tesla MRI will accurately show the MCL tear; T- sign of ulnar avulsion, humeral MCL avulsion or midsubstance tearing [8].

CT arthrography: Rarely needed in todays world with the availability of high resolution MRI [8].

Treatment

Primary treatment for the player is rest from throwing and for others to avoid repetitive elbow valgus extension movement. Taping and physical therapy with lateral stretching, flexor-pronator strengthening and modalities are also applied. Gradual arm and forearm muscle strengthening and sports specific rehabilitation are done after 10-12 weeks [6, 7].

If after the above schedule the patient fails to improve through conservative treatment, he/she will need MCL repair, MCL reconstruction +/-capsular placation.

Arthroscopy: Elbow arthroscopy is performed as a surgical adjunct performed in concert with open surgical procedures and arthroscopic elbow instability assessment can provide valuable information [4]. Medial joint opening and ligament laxity can be demonstrated and documented [9]. It is indicated for those patients who maintain symptoms of posteromedial impingement despite non-operative management.

Reconstruction:- A palmaris longus or semitendinosus tendon is harvested and prepared.

Medial approach:- The approach to the elbow is a muscle-splitting technique described by Thompson. Medial skin is incised from the medial epicondyle to 5 cm distally along the medial

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Figure 7. Palmaris longus tendon harvest.

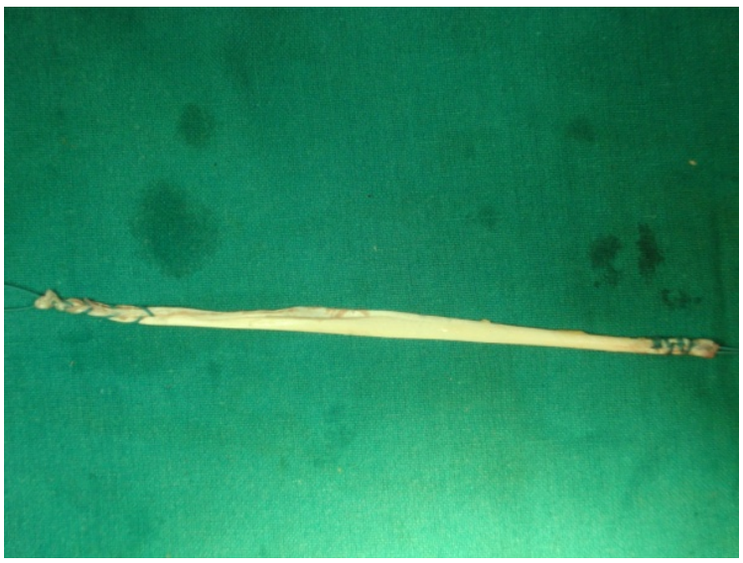

Figure 8. Graft preperation

border of ulna is made. Blunt dissection is used to develop a plane in line with the fibers of the flexor Carpi ulnaris, beginning at the medial epicondyle down to the sublime tubercle of the ulna [7, 10]. The muscle is retracted to expose the native UCL and care is taken not to injure the ulnar nerve. The UCL is incised in line with the muscle fibers and the fascial incision. Anterior and posterior leaflets are created by sharply dissecting the ligament off of the ulna, exposing the sublime tubercle. A safe zone has been described as 1 cm distal to the insertion of the UCL two, 4.5 mm tunnels are made around, unicorticaly, and then connected to each other using large towel clip [11].

After making the ulnar tunnes, humeral tunnels are made. The anterior band of the UCL originates at the anterior and inferior portion of the medial epicondyle and the posterior band from the posteroinferior portion. The tunnel is made at the isometric point between these two bundles. To expose the anterior surface of the medial epicondyle, a separate fascial incision is

made proximal to the medial epicondyle. The muscle fibers are gently elevated off the bone. A total of three tunnels are made in the medial condyle; first at the isometric point at the base of medial epicondyle, second anterosuperiorly, and third posterosuperiorly by a 4.5mm drill bit [11]. The inferior tunnel is enlarged and all three tunnels then interlinked using a towel clip.

Graft is passed in the ulnar tunnels using No. 5 Ethibond as a relay and then through the humeral tunnels and exiting one anterosuperiorly, and another posterosuperiorly. The sutures are pulled, and the graft tensioned and tied at the desired flexion angle of the elbow about 60°–70° of flexion [7, 11].

The wound is closed in layers and a splint is applied at 70° flexion [11].

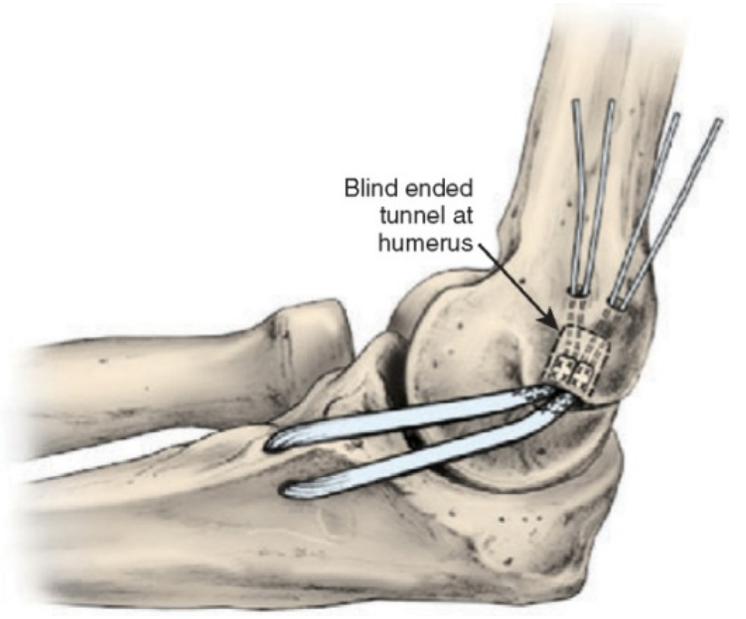

Figure 9. Two ulnar and three humeral tunnels.

Postoperative Rehabilitation :-

A splint is applied in 60°-70° of flexion for 3 weeks. Initially, 0°-30°of movement is restricted for 4 weeks.

The range of 60°-90° of movement is started from 1st two weeks, 40°-100° of movement from 3- 5weeks and 20°-110° from 6-8 weeks.

After about two months, full range of movement is started along with isotonic strengthening, concentric flexor-pronator and eccentric elbow flexor exercises.

After 3 months, sports specific training, arm and forearm muscles strengthening and proprioceptive exercises are started.

The athlete can return to sports after 6- 8 months, depending upon elbow strength and overall fitness status.

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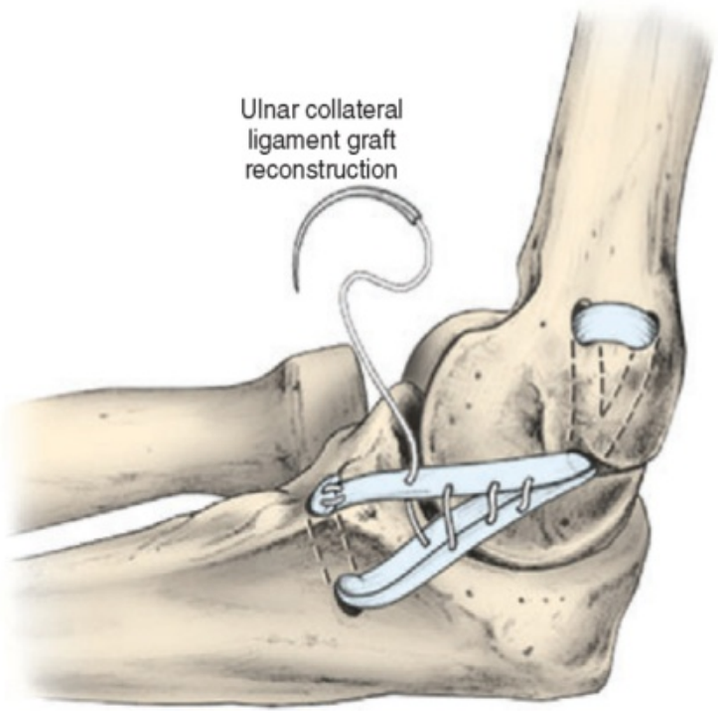

Figure 10. Docking technique.

Full speed pitching, strong backhand serve, and powerful golf swing is not recommended for 12 months after reconstruction [7, 11].

Medial elbow instability is most often a chronic attenuation and insufficiency of UCL due to repeated micro trauma in throwing athletes, baseball players, and workers involved in repeated throwing activities [7].

Valgus stress test and milking maneuver can clinch the diagnosis, but MRI is the investigation of choice to diagnose the tear. Arthroscopy helps in treating concomitant pathologies [9].

UCL reconstruction using Palmaris longus or semitendinosus tendon graft, provide good medial stability and with proper rehab, a player can return to sports in 6- 8 months [6].

4. Lateral instability and Posterolateral Rotatory Instability (PLRI)

Posterolateral rotatory instability is the most common pattern of elbow instability, particularly that which is recurrent.

Posterolateral rotatory instability can be considered a spectrum consisting of three stages according to the degree of soft tissue disruption [12].

Patients typically present with a history of recurrent painful clicking, snapping, clunking, or locking of the elbow and careful examination reveals that this occurs in the extension portion of the arc of motion with the forearm in supination [12, 13].

Deficiency of LUCL and laxity/tear of the posterolateral capsule leads to the abnormal rotation of the ulna posteriorly taking the radius along with it. It is an initial stage in the pathology of unstable elbow. Radial head excision or any lateral bony loss further aggravates the instability [12, 13, 15].

Figure 11. Tenderness over LUCL

Pain along the posterolateral aspect of the elbow is the main symptom. The patient usualy has pain in standing from the sitting position with hand resting on chair arms, in lifting weight, and in throwing. In severe cases, patients also complain about instability [12, 13].

Examination:-

Patients had varus instability in 30° flexion, tenderness over PL elbow, and chair test and push-up test were positive in most of the patients.

Chair test:

Ask the patient to stand up from the armed chair with both elbows taking the upper body weight.

At about 20°- 30°extension, patient feels pain and sudden click or instability due to posterolateral subluxation of the ulna.

Push up test:

Similar symptoms can be produced by asking the patient to do push ups. At about 20°-30°extension, patient feels pain and sudden click or instability due to posterolateral subluxation of the ulna.

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Figure 12. Chair test

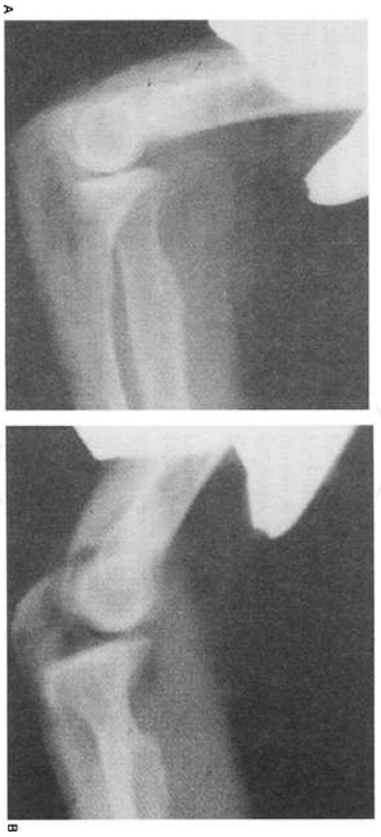

Figure 13. Varus stress x-ray

5. Surgical details

The pivot shift test which was negative in all on OPD examination was positive under anesthesia in all. Stress x-ray showed significant lateral opening. MRI is an effective tool in the preoperative, noninvasive diagnosis of posterolateral rotatory instability [12, 16].

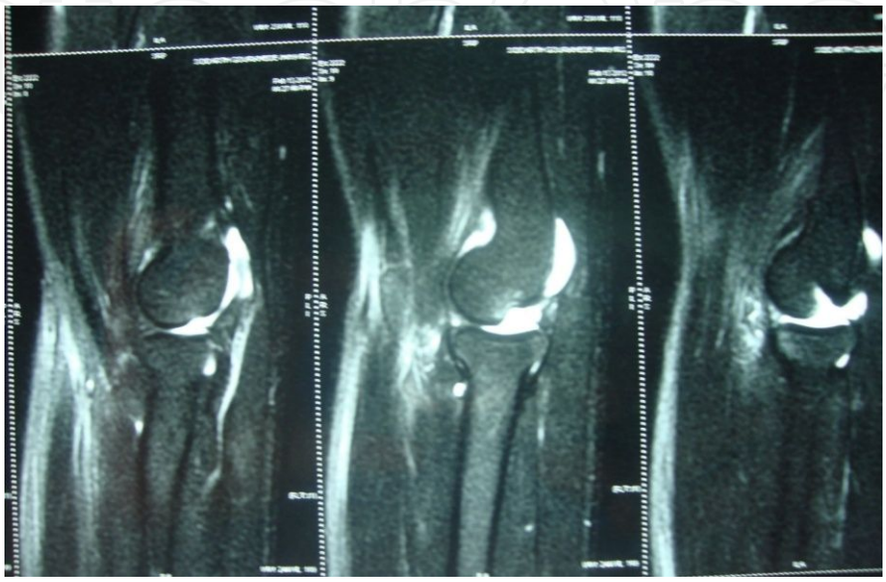

Figure 14. Sagital T2 MRI-showing LUCL and posterior capsular tear

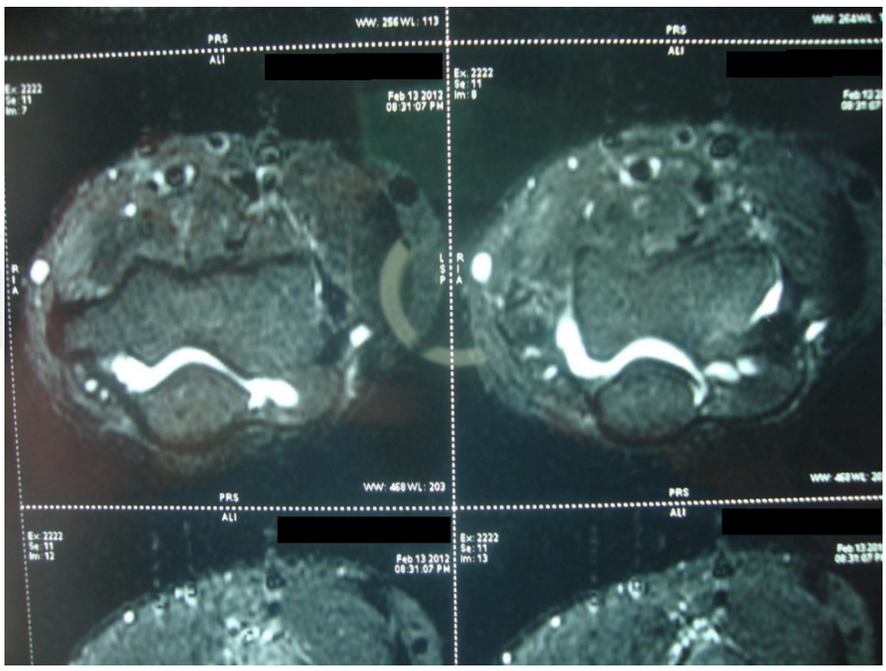

Figure 15. Axial section T2 MRI- showing LUCL tear

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6. Arthroscopy

The patient is placed in lateral decubitus position with the elbow free and arm supported on a bar. Tourniquet is applied well proximally for free access [15]. Anteromedial and anterolateral portals are used with special attention to the median and the radial nerves. Anteromedial was used as a viewing portal and the anterolateral as the working portal. Cartilage flakes are removed, debridement done using a shaver through anterolateral portal and chondroplasty is done. You will see the torn or stretched capsule posterosuperior to radial head. Lateral ulnar collateral ligament tear or attenuation will be seen and the area around its origin can be debrided and marked for open reconstruction [13, 14]. Arthroscopy is helpful in not only diagnosing the condition but also treating other pathologies that coexist with PLRI [14].

Figure 16. Lateral position

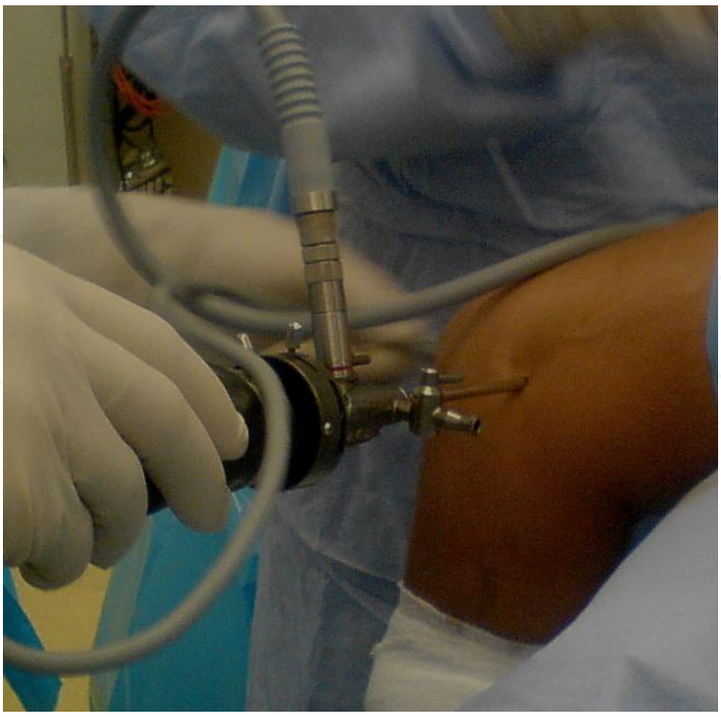

Figure 17. Anteromedial viewing portal

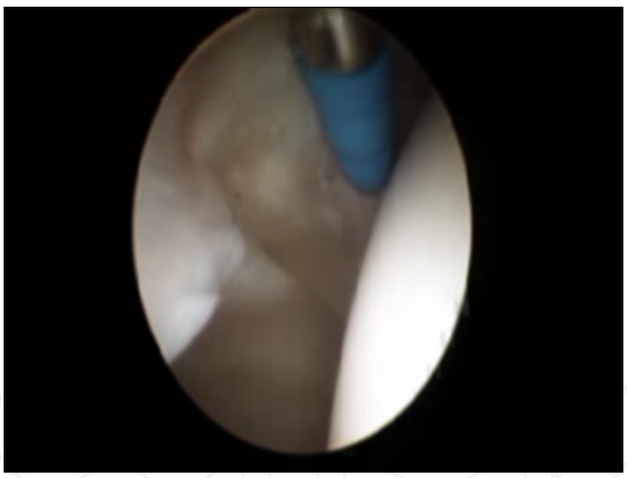

Figure 18. Arthroscopic view of humeral attachment of LUCL

7. Open procedure

7.1. Graft harvest

Patient made supine and painting and redrapping is done. Reconstructive procedure started with harvesting palmaris longus graft from the same side [15, 16]. A 1 cm incision is made in

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the palmer wrist crease. The palmaris longus graft is identified, released gently, and harvested using a tendon stripper. In one patient, it was absent so gracilis tendon was harvested instead. The graft was prepared using No.2 Ethibond. The graft is wrapped in wet gauze with amikacin, and kept in a bowl.

Figure 19. Palmaris longus tendon harvest- incision.

Figure 20. Palmaris longus tendon- isolated.

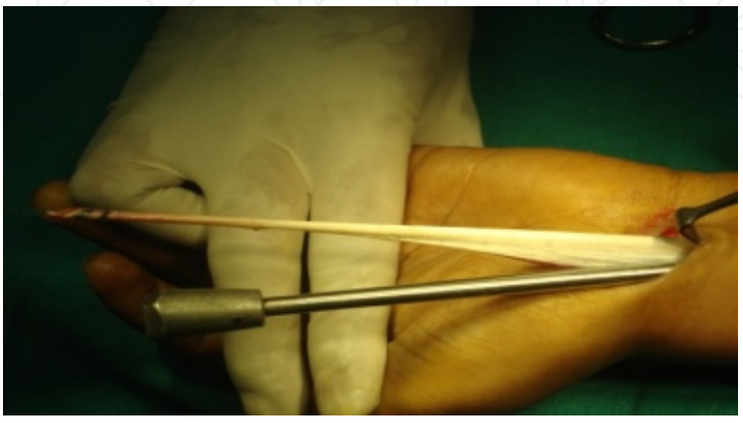

Figure 21. Palmaris longus tendon- harvested.

7.2. Kocher's approach

7.2.1. Reconstruction of LUCL

Kocher's approach was used to do ligament reconstruction and capsular surgery. Begin skin incision over the lateral epicondyle (or proximal to it) and continue it distally and obliquely directly over lateral epicondyle to end at the proximal ulna. Incise through the fascia overlying the anconeus and the extensor carpi ulnaris. Keep this dissection in line with the fibers of the extensor carpi ulnaris (not the axis of the arm) in order to preserve the fascial contributions of the extensor carpi ulnaris to the posterolateral ligamentous complex [12, 16].

Figure 22. Lateral approach

Keep the arm pronated during this dissection in order to avoid injury to the posterior interosseus nerve (PIN); bluntly dissect through this interval and dissect down to the joint capsule. The interval between these muscles is more easily found distally, since these muscles share a common proximal fascial origin. The extensor carpi ulnaris and a portion of the supinator are elevated off capsule and are elevated anteriorly. PIN is protected at this point by the ECU and EDC. Sub-periosteally dissect the aconeus off its humeral origin in order to expose joint capsule.

8. Lateral collateral ligament complex

At this point the LCL should be exposed [13,16, 18]. Visualization of the LCL, is achieved through anterior retraction of the extensor digitorum communis and extensor carpi ulnaris. LCL complex will be seen torn or attenuated. Capsular incision should be made anterior to radial humeral ligamentous complex. Incision over the radial head in line with the radius should avoid the LCL remnants. Two 4.5 mm tunnels are made at the insertion point of LUCL over the ulnar crest in line just distal to the radial head [17, 18].

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Figure 23. LUCL and posterior capsular tear

Figure 24. Two ulnar tunnels

Three tunnels are made in the lateral epicondyle in a triangle fashion [14,17, 18]. Lower one at the isometric point at the base of epicondyle and other two anterosuperior and posterosuperior part of the epicondyle. The graft is passed through the ulnar tunnels and then through the humeral tunnels.

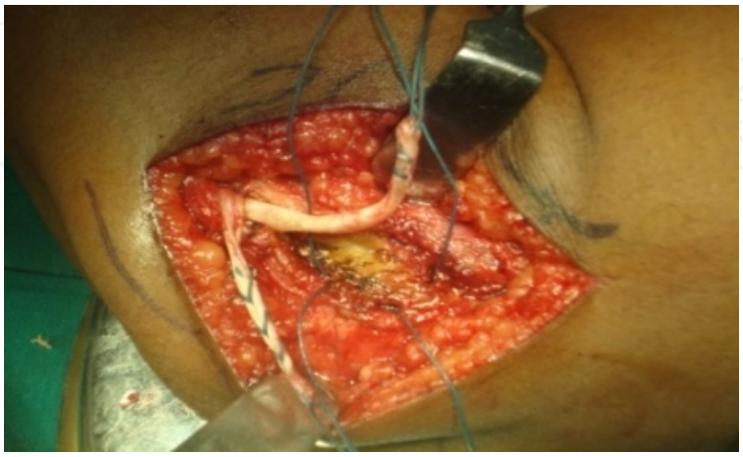

Figure 25. Graft being passed.

The lateral ulnar collateral ligament was reconstructed using the docking technique and graft was tied with the elbow in 30° flexion, valgus and internal rotation.

Figure 26. Graft passed through 3 humeral tunnels

Capsular repair was done, [13, 15, 16] and wound closed in anatomical layers.

Postoperatively all patients were applied with a hinge elbow brace for 6 weeks [16].

Initially restricted range of movements were allowed from 30°- 100° for 2 weeks, and then 15°-110 ° for another 2 weeks.

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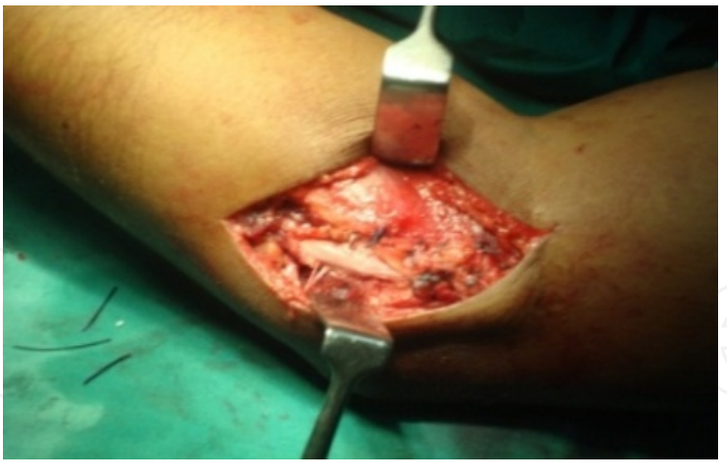

Figure 27. Graft tied with elbow in 20-30° flexion, valgus and pronation.

Figure 28. Final repair

Figure 29. Brace with elbow in 60°- 70° flexion

Full range of movement to be achieved by 6 weeks, followed by strengthening exercises [12, 13]

Figure 30. Hinge elbow brace

Routine activities such as lifting, pulling, pressing, etc were allowed after 3 months and sports activities after 5- 6 months after assessing muscle strength and agility [12, 15, 17].

Stability was obtained as the patient had good functional result as per Mayo elbow performance scores [16].

There is no difference in results as per age, sex or sidedness [13, 17].

Capsular repair and plication provides excellent rotational and varus stability in addition to LUCL reconstruction as seen by Mayo performance scores with a mean of 88.

Figure 31. Postop hypertrophic scar in one of the patient.

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Figure 32. ROM

Capsular surgery is important in PLRI, as it is an important posterolateral structure assisting LUCL [12, 15, 17].

Surgical treatment of PLRI was mainly ligament repair or augmentation. In our technique after complete evaluation, we performed elbow arthroscopy that helps in diagnosing the instability and treat additional pathologies such as chondral injury, loose bodies, gutter impingement, and marking correct humeral attachment [14, 17]. Taking palmaris longus graft from the same side, decreases the morbidity. Only when it is absent, we use semitendinosus graft. This type of reconsruction with capsular repair gives excellent stability and we can start early rehabilitation. Most of the patients can return to normal work in 3- 4 months. For a sports person, it takes 7- 8 months to return to competitive sports [16].

9. Lateral epicondylitis

It is one of the common elbow disorders we encounter in daily orthopaedic clinics.

Females are more commonly involved, specifically those doing household chores.

It is most famously known as tennis elbow because of its early association with lawn tennis. It is usually due to chronic repetitive trauma to the common extensor muscle origin near the lateral epicondyle. Involvement of the extensor carpi radialis bravis is the main source of pain and disability [18, 21].

Symptoms:-

Patients usually have pain in supination extension movements. Passive wrist extension recreates symptoms.

Treatment:-

Conservative treatment usually involve avoiding provocative activities such as sweeping, chapatti making, squeezing clothes, tennis forehand serve, heavy cricket/ baseball bat etc.

Anti-inflammatory drugs, tennis elbow support and physical therapy usually, give relief to 90% of the patients [19].

Even after this about 5% - 10% of patients develop chronic symptoms [19, 22]. These patients will need some form of intervention in the form of percutaneous, open, radiofrequency, or arthroscopic procedures. Combining ESWT with eccentric loading appears to show superior results. Low-dose thermal ablation-RF- devices helps in angiogenesis and growth factor stimulation [21, 22].

PIN entrapment, radiocapitellar degenerative, C7 radiculitis, anconeus muscle compartment syndrome, posterolateral plica, and posterolateral rotatory instability has to be ruled out before embarking on an intervention [20, 23].

Intervention:

10. Percutaneous needling technique

- Followed by platelet rich plasma (PRP) injection is associated with less morbidity and fairly good results in term of pain and functional improvement on American shoulder elbow society(ASES) scale [1]. Growth factors are stored in the alpha granules of the platelets. Platelets are the first to arrive at the injury site and they mediate the healing response. Platelet-rich therapies allow for an opportunity to utilize the body's own healing (growth) factors to improve the quality and speed of recovery from injury. Even with the limited published scientific data, PRP appears to be the most attractive option available, with minimal side effects; the relative ease of preparation, cost effectiveness and the ability to complete the procedure as a day care procedure goes in favor of PRP. Leukocyte-reduced PRP may be the optimum preparation to stimulate superior healing without scar tissue formation.
- But inadequate resection and the inability to address intra-articular pathology are the main causes of failures in some patients and in 11% to 19% of cases there is intra-articular involvement.

11. Extracorporeal Shock Wave Therapy(ESWT)

Combining ESWT with eccentric loading appears to show superior results. It acts by inducing trauma to degenerated tendon through shock waves and 5- 8 settings for 15 minutes at weekly intervals show encouraging results. It induces the inflammatory response to aid natural healing of the lesion.

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12. Radiofrequency probes

These can be used through a small incision to induce the inflammatory response to aid natural healing of the lesion. It acts by inducing trauma to degenerated tendon through Radiofrequency waves. It is in its early stages and long-term results are still awaited.

13. Open procedure

With debridement of ECRB origin and in severe cases anconeus transfer provide long-term relief from the symptoms [23]. With gradual physical therapy, and rehab, the patient can return to sports.

14. Arthroscopic release of ECRB

This is a minimally invasive procedure and provide good to excellent long term results. We can diagnose and treat concomitant intra-articular pathologies specially posterolateral plica, lateral gutter impingement, loose bodies, and posterolateral rotator instability. In two recent series, we found that at 2-year follow-up, patients treated with arthroscopic ECRB release subjectively reported feeling "much better" to "better" in 83% to 95% of cases [21, 22].

15. Other elbow pathologies

- Osteochondritis dissecans (OCD) is a disease whose cause is unknown, although overuse, microtrauma, and ischemia caused by repetitive valgus movements can be considered as causes [24, 25]. In OCD there is a separation of a portion of articular cartilage and is a source of loose bodies that ultimately can cause painful mechanical symptoms in the elbow. The most common site of OCD in the elbow is the capitellum [24].

In earlier stages, treatment consists of conservative management with avoidance of activities, bracing, and physical therapy.

In later stages, treatment options include arthroscopic joint debridement, abrasion chondroplasty, removal of loose bodies, drilling of lesions, and fixation of large OCD fragments [24].

- Elbow synovitis can occur as a localized disease, such as an inflamed lateral synovial plica or commonly, as proliferative and generalized disease, such as rheumatoid arthritis, synovial chondromatosis, pigmented villonodular synovitis, and hemophilic synovitis [26, 27].

Initially it causes pain and gradual restriction of movements. Later on there is articular cartilage involvement, periarticular soft tissue injury, and in the end subchondral bone erosion and loss. Articular and subchondral bony loss result in severe pain and instability [26].

Disease is can be treated with conservative nonoperative treatment such as medications, splinting, physiotherapy, and steroid injections.

Arthroscopic synovectomy is needed in chronic cases not responding to conservative medical line of treatment. It reduces disease load, improve ROM, and provide pain relief.

Arthroscopic synovectomy has many advantages over open procedure: it is minimally invasive, thorough debridement in all compartments is possible, other pathologies can be addressed, decreased postoperative pain, and earlier rehabilitation [26, 27].

- Elbow impingement:

Synovial plica can cause elbow impingement adjacent to the radiocapitellar joint. The patient usually complains about painful locking or catching of the elbow relieved by gentle manipulation. It is most commonly misdiagnosed as lateral epicondylitis or tennis elbow.

Another cause of elbow impingement is valgus extension overload [29].

In this condition, excessive valgus force applied to the thrower's elbow can cause impingement of the posteromedial olecranon into the olecranon fossa during extension. Gradual chronic medial elbow instability due to UCL insufficiency can lead to chondromalacia, osteophyte formation and loose bodies to develop [29].

There is pain in the terminal extension and gradual restriction of extension.

A thorough clinical history, specific tests, and investigations are needed to differentiate isolated valgus extension overload from MCL insufficiency.

Elbow arthroscopy is a boon in these conditions [29]. Arthroscopic excision of olecronon osteophytes, olecronon tip, clearing the fossa and debridement gives good results if followed by medial stabilization, if present [29].

- Stiff elbow

Restricted movements of the elbow can be traumatic, non traumatic, inflammatory, or non inflammatory. It can be extra-articular or intra-articular. Even in intra-articular pathologies, there is some element of extra-articular involvement [30].

In most of the cases, some form of modalities, such as ultrasonic heat and physiotherapy along with anti-inflammatory medications improves the ROM. But in severe elbow stiffness surgery is generally needed [31].

Manipulation under anesthesia after inflating the joint with saline can be done in a controlled manner in less severe contractures. But it is a risky procedure with complications such as muscle tear, fractures, neurovascular, and ligament injury [30, 31].

Arthroscopic capsular release and intraarticular debridement improves ROM in refractory cases provided there is no bony pathology causing a block in the elbow motion. Arthroscopic release is a technically demanding procedure in a stiff joint with neurovascular structures nearby [31, 32].

Open contracture release is a morbid procedure and causes further trauma to soft tissues. But in severe contractures where entry into the joint is difficult, in bony involvement, and inexperienced surgeons, open release is a treatment of choice [30]. Extensive lateral approach can provide access to both posterior and anterior compartments. Occasionally, medial approach needed.

- Fractures

Elbow arthroscopy is expanding its horizon to newer indications. Smaller, delicate instrumentations, improved clinico-anatomical knowledge, and surgical skills are making it possible to treat various intra-articular fractures [34].

Fractures of radial head, coronoid, trochlea, capitulum,, and olecronon can be treated with elbow arthroscopy [33, 34].

Radial head and capitellum fractures are the most common intra-articular fractures treated arthroscopicaly [33].

16. Conclusion

Elbow arthroscopy is a minimally invasive procedure and provide good to excellent long-term results. We can diagnose and treat concomitant intra-articular pathologies specially posterolateral plica, lateral gutter impingement, loose bodies, and posterolateral rotator instability. We can fix fractures, treat tendinopathies, do chondroplasty, and stiff elbow release. With the advancement of instrumentations, our knowledge about surgical anatomy, and surgical skills, elbow arthroscopy has become an excellent tool to treat a wide range of disorders with minimum risk and complications.

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