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Original Research Article

# Meniscus or not: The radio-humeral synovial folds & its clinical importance

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## Abstract

**Introduction:** Synovial folds present within the humero-radial compartment of elbow joint are prone to chronic inflammation in repeated users of elbow joint, mainly in athletes. Generally, these conditions are well managed with conservative medications, but if not cured, arthroscopic guided resection is suggested by researchers for maximum post-operative painless movement restoration.
**Aim:** Aim of the present study was to find out the incidence of synovial folds of humero-radial part of synovial joint and gross structural variability of these folds along with histological structural details.
**Materials and Methods**: 50 elbows from 25 embalmed cadavers were dissected in between March 2022 to February 2024. Incidence, morphology & morphometry of synovial folds were recorded. Part of the folds dissected out and stained with Hematoxylin eosin stain after tissue processing.
**Results:** Posterolateral synovial fold is present in all the elbows followed by anterior fold which is present in 71% cases. Incidence of lateral fold and olecranon fold was almost similar 28% and 27% in sequence. Postero-lateral folds are largest in dimension, about 26.4 mm in length, 4.8mm in width and 2.9mm in thickness followed by anterior fold and lateral fold. The olecranon fold is smallest in all the dimensions measuring about 3.2mm in length, 2.7mm in width and 1.6 mm thickness. In hematoxylin eosin staining, it was found that all the folds are made up of fibrous tissue (predominantly collagen) without any chondrocytes. More specifically in the lateral synovial folds the collagen fibres are densely packed around an axis with very less amount of loose areolar tissue, but in rest of folds the collagen fibres are arranged loosely.
**Conclusion:** Presence of such fibrous plica within the interposed surfaces of humero-radial part of elbow joint must be kept in mind during diagnosing and managing patients of persistent /chronic lateral elbow pain. Chronic inflammation of these plica or folds results into thickening of the folds which restrict the joint mobility and produces snapping elbow syndrome.

**Keywords:** Synovial fold of elbow joint, Anatomy, Collagen, Resection

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## 1. Introduction

Lateral or the humero-radial compartment of elbow joint is incompletely divided by a meniscus like projection, which is contiguous with the joint capsule peripherally just proximal to the annular ligament.[1,2] The structure was named differently by different authors previously, like “Synovial fringe”, “Synovial plica of radio-humeral joint” and many more, but it is commonly known as synovial fold of radio-humeral joint. Depending upon its location to the joint the Synovial folds of radio-humeral joint are divided into 4 subtypes, Anterior, Lateral, Postero-lateral & Lateral Olecranon.[2] The part of radio humeral synovial fold which projects horizontally anteriorly in between articular surfaces are demarcated as Anterior fold, which is thinnest one has measurements of, length 18.1mm, width-4.3mm & thickness-2.3mm.[1,3] Horizontal meniscoid part of the radio humeral fold, which projects within the radio-humeral part of elbow joint from its lateral side and interposed between superior disc like articular surface of radial head & capitulum of humerus is known as Lateral fold with 13.1mm length,3.6 mm width & 1.7mm thickness.[2,3]

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Posterolateral fold which is most consistent & thickest part of radio-humeral synovial fold measures about - 28.5mm in lenth, 5.2mm in width & 3mm in thickness.[1-3] This fold is present in between superior disc like articular surface of head of radius & angle between the lower sigmoid cavity of ulna with transverse sulcus of the major sigmoid cavity.[1,3] This posterolateral fold is continuous with lateral olecranon fold which extends vertically from the posterolateral fold along the lateral margin of olecranon process. The median dimensions of a lateral olecranon fold in cadaveric specimens are 4.3 mm in length, 3.9 mm in width, and 1.9 mm in thickness.

Amongst all the subtypes the postero-lateral radio-humeral synovial fold is the most consistent one and found in almost 100% cases followed by anterior fold noted in 67% cases recorded by previous authors.[1-3] The least common variety is lateral type, noted in 5-20% cases.[2,3] The lateral olecranon variety was noted in 28-33% cases.

When these synovial folds are exposed to repetitive injury more likely during particular sports activity like tennis, golf players and javelin or discus throwers or any direct blow, results into chronic inflammation. If this chronic inflammatory condition is not treated properly in due time it results into inflammatory thickening of the synovial plica, which generally interposed & impacted between articular surfaces producing particular snapping.[4-6] In long run this degenerating synovial plica if left untreated will ultimately result into chondromalacia in capitulum of humerus & head of radius.[5,7]

Though the initial phase of elbow plica syndrome may be treated conservatively but arthroscopic excision of inflamed thickened plica should be done in proper time to prevent early degenerative changes in articular cartilage.[5] It has been reported by many authors that arthroscopic resection of plica and associated fibrosis or synovitis and repair of chondral defects lead to excellent outcomes.[4,8]

## 2. Materials and Methods

An observational cross-sectional study was conducted in the Department of Anatomy, NRS Medical College and Hospital, Kolkata between March 2022 to February 2024 on donated cadavers for betterment and contribution in medical research. Informed consent was taken from all the donors' prior death about use of the donated body for medical research purpose. 50 upper elbows of 25 well embalmed cadavers of both sexes above the age of 18 years from Eastern India was dissected in dissection hall after taking proper ethical clearance from institution. All cases with congenital anomalies, deformities, injuries and operations in and around elbow joint were excluded from the study.

### *2.1. Steps of dissection*

After dissecting the cubital fossa following standard techniques the elbow joint was dissected. At first all the muscles attached to the joint capsule, i.e., brachialis anteriorly and triceps posteriorly, were dissected off the joint capsule. Superficial flexor & extensor muscles those which arises from medial and lateral epicondyle respectively were removed from their origins. Supinator muscle was also detached from its attachment. After removing all the muscles reinforcing the joint, the elbow joint ligaments became clearly discernable. After identifying ulnar and radial collateral ligaments which reinforces the elbow joint capsule, the elbow joint cavity was opened by a 'H'-shaped incision in the anterior aspect of capsule. Then humeroradial part of joint capsule is resected along with annular ligament (2) and presence or absence of radio-humeral synovial folds were noted followed by detail measurement of the folds using digital caliper. Following that parts of different synovial folds were resected from the joint capsule and tissue processing done followed by histological sections. After tissue processing slides are prepared and stained with Hematoxylin Eosin stain.

### *2.2. Parameters studied*

#### *2.2.1. Gross morphometric*

1. Synovial folds-present/absent
2. If present - Anterior/Lateral/Postero-lateral/Olecranon.
3. Measurements-length, width & thickness of 4 synovial folds of elbow.

#### *2.2.2. Microscopic anatomy*

1. Hematoxylin and Eosin staining findings of individual synovial folds.

## 3. Results

Gross anatomical findings:

**Table 1:** Showing incidence & measurements of synovial folds in present study.

| | **Anterior Fold** | **Lateral fold** | **Postero-lateral fold** | **Olecranon fold** |
|---|---|---|---|---|
| Present in | 71% | 28% | 100% | 27% |
| Length | 17.6mm | 12.5mm | 26.4mm | 3.2mm |
| Width | 3.5mm | 3.2mm | 4.8mm | 2.7mm |
| Thickness | 2.2mm | 1.8mm | 2.9mm | 1.6mm |

In present study Postero-lateral fold is present in all the cases (100%), followed by anterior fold which is present in 71% cases. Incidence of lateral fold and olecranon fold is almost similar 28% and 27% in sequence (**Table 1**).

Postero-lateral folds are largest in dimension, about 26.4mm in length, 4.8mm in width and 2.9mm in thickness.

Length and thickness of anterior synovial fold is also significantly high, nearly 17.6mm and 2.2mm in average respectively. According to our study thinnest synovial fold is the olecranon fold measuring about 3.2mm in length, 2.7mm in width and 1.6 mm thickness.

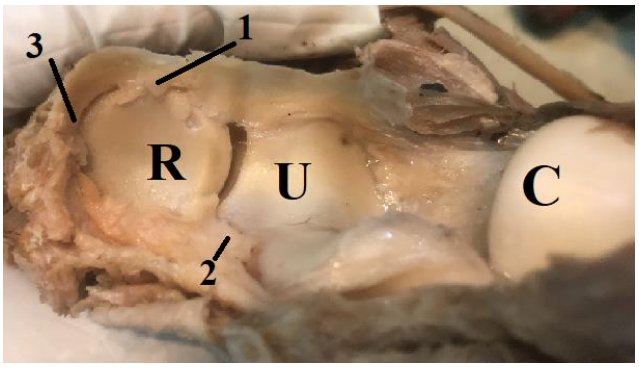


**Figure 1:** Superior articular surface of head of Radius (**R**) with degenerative change, Superior articular surface of Coronoid process of Ulna (**U**), Capitulum of Humerus (**C**), Fringe like anterior synovial fold (**1**), Plica like posterolateral (**2**) and lateral (**3**) synovial folds.

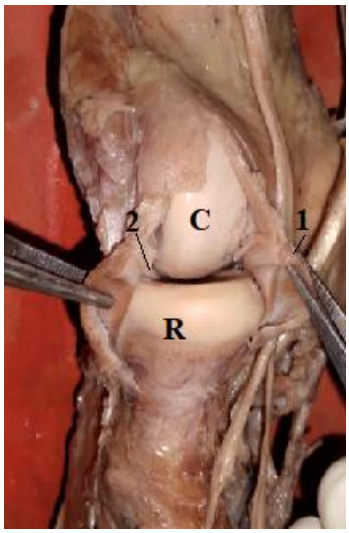


**Figure 2:** Showing dissected right elbow of a 64 years old male from anterior aspect showing anterior synovial fold (1), lateral synovial fold (2) Impinged between Capitulum (C) and head of Radius (R).

In few cases the anterior synovial fold was fringe type (**Figure 1**). Lateral fold when present, looks like disc shaped which is triangular in cross section (**Figure 2**).

Microscopic findings: Histological studies showed the tissue is mainly fibrous tissue with few loose areolar tissues and moderate vascularization. These folds are covered by synovial membrane on their free surface. No cartilage cells were noted. But the arrangement of fibrous tissue was different. In lateral synovial folds, fibrous tissue, mainly collagen fibers were densely packed with scanty adipose tissue & vascular tissue was more (**Figure 3**).

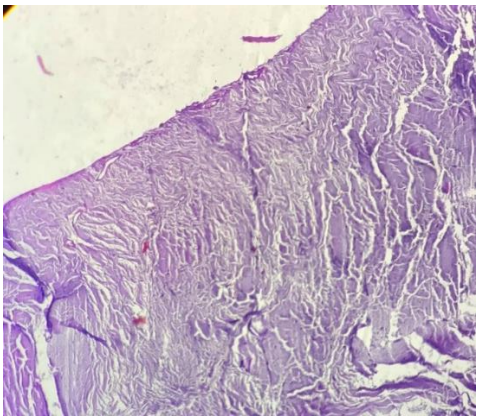

**Figure 3:** Photomicrograph of lateral synovial fold showing densely packed fibrous tissue (collagen) without any chondrocyte (100x).

Other type of folds, i.e. anterior, postero-lateral variety & olecranon, presented as fibrous tissue axis with plenty of loose connective tissue filling (**Figure 4**, **Figure 5**)

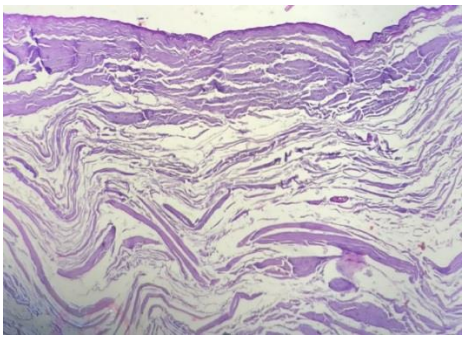

**Figure 4:** Photomicrography of anterior synovial fold dissected out from the elbow joint of a 60 years old male cadaver showing loosely packed fibrous tissue filled with plenty of loose areolar tissue but without any chondrocyte (100x).

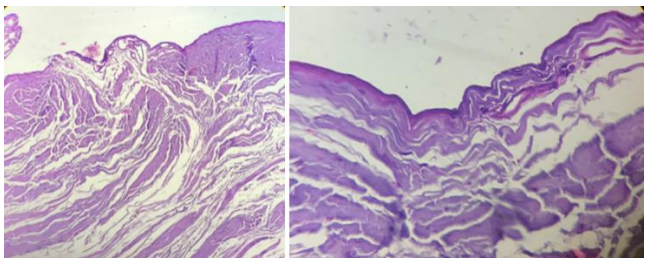

**Figure 5:** Photomicrograph of posterolateral synovial fold (100x magnification) resected from a 67 years old male cadaver shows loosely packed fibrous tissue with neurovascular bundle near its margin. Surface of the fold show presence of a layer of flattened epithelium (squamous)(400x magnification).

## 4. Discussion

Two decades ago Isogai et al conducted a study in 179 adult and 40 embryos. He found that the synovial folds were more homogenous in embryos in comparison to adult specimens. According to the author, with progression of age due to

repeated utilization of the synovial folds during joint movements degenerative changes are noted in samples from elderly population.[1]

Depending on histomorphological findings these synovial folds were divided into two basic types, one group demarcated as villous or villous-fringed or fringed variety where hypertrophy of synovial covering was noted associated with highly vascular loosely arranged fibres with plenty of areolar tissue. Another group which was defined as plicate group, the synovial fold is made up of tightly packed thick fibre bundles parallel to the axis of the fold and the fibres are continuous with the fibres of annular ligament.[1]

Many studies[9,10] suggested that these synovial folds are actually meniscus but authors like Duprac et.al did not find any fibrochondroid tissue and the surfaces of the folds are covered by a synovial folds. So he suggested that these folds are synovial folds and not meniscus. Antuna and O'Driscoll[7] conducted histological study of these synovial folds and they also noted that no fibrocartilage was present in these folds or plica, rather focal regions of degeneration or chondroid metaplasia can be seen within thick hard synovial folds.

Synovium, the specialized collagenous tissue lining the inner aspect of fibrous capsules of synovial joints can be of 3 different types; Areolar synovium with loose collagenous tissue or Fibrous synovium with more dense collagenous tissue or Adipose synovium, which is made up of fats mainly and also known as intra-articular fat pad.[11]

Lateral elbow pain may be manifested in different disease pathologies like lateral epicondylitis, osteoarthritis, Tennis elbow, Loose bodies within joint, Radio-humeral synovial plica syndrome, tear of tendon extensor carpi radialis brevis due to degeneration etc.[2,4,7]

Choi S H conducted a retrospective review of prospectively collected data of Magnetic resonance imaging of patients who underwent arthroscopic surgery for Posterolateral synovial plica syndrome.[12] They noted that in all the symptomatic cases the dimensions of posterolateral synovial fold were larger & prevalence is higher than the asymptomatic controls. In plica group or symptomatic patients, the mediolateral and sagittal dimensions of synovial plica were 7mm and 7.4mm respectively whereas in asymptomatic patients they were 3.8mm and 4.7mm respectively. Another parameter studied by Choi S H was coverage of radial head by synovial plica and the criteria set for prevalence of plica was more than 30% area and it was found that coverage criteria is more specific for symptomatic plica group as prevalence is much greater in the plica group than in asymptomatic cases (64% vs 18%).

Posterolateral synovial fold syndrome is an important differential diagnosis of lateral elbow pain and must be thoroughly evaluated with proper history, clinical features and radiological imaging modalities.[13] In advanced cases arthroscopy guided surgical resection of the synovial fold is suggested with disappearance of pain and snapping. All the patients returned to normal physical activity post-operatively without any loss of motion. Rajeev A et al.[14] conducted a reviewed the post-operative outcome of 121 patients who underwent arthroscopy guided excision of lateral synovial fold due to persistent lateral pain in elbow joint even after corticosteroid injections and found that all the patients restored normal pronation supination movement and more than 66% patients were pain free in 3 months. Based on modified elbow scoring system he reported that excellent postoperative outcome are noted in 70% in 3 months, 74% in 6 months and 76% in 12 months. He suggested rigorous post-operative exercise gives excellent outcome.

Huang GS et al.[15] reported that histopathological examination of removed meniscus like fold from elbow joint in a case of snapping elbow shows the fold is made up of fibrous tissue (mainly collagen) without any chondrocyte but with focal myxoid degeneration. Collagen fibers are oriented along annular ligament and surfaces of plica are not covered with any synovial membrane which is similar to the structure of menisci.

In present case we also found that the folds are mainly made up of collagen fibres but their arrangement varies depending upon its location. No chondrocytes are present, but surfaces of such folds are covered with a layer of flattened epithelium like that of synovial membrane which contradicts to define the structure as a meniscus.[16]

**Table 2:** Showing comparison of incidences among different authors

| Author | Country | Sample size | Incidence |
|---|---|---|---|
| Isogai et al.[1] | Japan | 179 Adult<br>40 Embryo | 100% |
| Duparc et al.[2] | France | 28(14cadavers) | 86% |
| Koh et al.[3] | Japan | 49(Cadaveric USG) | 100% |
| Awaya et al.[17] | Philadelphia, USA | 5(Cadaver)<br>164(MRI) | 80% |
| Bonczar et.al[18] | Poland | 216(MRI) | 74.5% |
| Present study | India | 50(Cadaveric dissection ) | 100% |

## 5. Conclusion

Like the knee joint prepatellar synovial folds, folds made up of predominantly collagen tissue is present within the elbow joint which may be responsible for lateral elbow pain and snapping elbow syndrome which is resistant to conservative management in most of the cases. But, presence of such fold and inflammation of such folds must be kept in mind before excluding other differential diagnosis of lateral elbow pain. Though there is plenty of debate about whether these folds are menisci or not, but depending on histological structures recorded by present researcher, it can be said that these structures are synovial plica and not meniscus.

## 6. Limitations of Study

As the study was conducted from cadaveric sample so, detailed history was not available and findings cannot be correlated properly. Data from the same population of present study was not available, so comparison with studies within same geographic boundary.

## 7. Conflict of Interest

None.

## 8. Source of Funding

None.

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