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Rheumatoid Wrist and Hand

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Abstract

Rheumatoid Hand disorders continues to be a major disability for patients with rheumatoid arthritis. The evolution of complex deformities, its diagnosis and management remains a challenge to most of the surgeons. This is an appraisal on the different options available at various stages of the disease.

Keywords: Rheumatoid hand, Button hole and Swan neck deformity, Synovitis, Tenosynovitis

Introduction:

Rheumatoid arthritis (RA) is a common systemic inflammatory disorder of multi factorial etiology affecting the synovial layer of joints and tendons through an autoimmune mediated mechanism involving the T- cell [1]. In the upper extremity, the joints of wrist and hand are affected in 70% of all the patients [1]. (Fig. 1) RA follows an inexorable pattern of progressive deformities in the absence of treatment [2, 3].

The aim of this article is to elaborate the evolution and mechanism of development of common deformities of the wrist and hand and its principles of management.

Diagnosis:

The natural history and progress of RA has a specific pattern of involvement which can be differentiated to some extent based on history from other inflammatory conditions

However, for prognostication and specific management, the use of a diagnostic criteria based additionally on investigations becomes vital.

In 2010, American College of Rheumatology (ACR)/European League Against Rheumatism (EULAR) came up with the Rheumatoid Arthritis Classification Criteria [4, 5] (Table 1). The new classification system redefines the disorder by focussing on specific clinical features appearing at an earlier stages of disease that are associated with high risk of chronicity and erosive damage.

Treatment will be required on the basis of individual patient's needs and requirements for activities of daily living.

Investigations:

A part of the diagnostic criteria is the evaluation for laboratory blood investigations which include markers of inflammation (Erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP), hematologic parameters (Complete blood count (CBC) and immunologic parameters Rheumatoid factor (RF) assay, Antinuclear antibody (ANA) assay, anti-cyclic citrullinated peptide (anti-CCP)/anti-citrullinated plasma antibody (ACPA) and anti–mutated citrullinated vimentin (anti-MCV) assay markers [6]. RF is a traditional nonspecific marker which is an IgM antibody against FC portion of the IgG antibodies, and is associated with several autoimmune and chronic infectious diseases. Anti-CCP is present in 60%-80% of rheumatoid arthritis patients [7]. A high volume of ACPA or RF, increased ESR or CRP with additional radiological evidence of erosion or progression of erosions are indicative of poor prognosis [4, 6].

Decreased joint space with erosion and peri-articular osteopenia are the hallmark of RA in radiography apart from other features (fig. 2).

Nerve conduction studies are generally done in the presence of entrapment neuropathies at the wrist, elbow and the knee [7, 8] Ultrasonography (USG) and MRI are very useful for evaluation of early arthritis and follow up though more recent updates do not support its use for routine follow up to assess the progress of the disease [7].

Management principles for hand and wrist deformity:

The priorities for treatment in RA are to (1) alleviate pain, (2) improve function, (3) retard progression of the disease/prevent loss of function, and (4) improve appearance [1, 2, 7, 8]. The surgeon works closely with the rheumatologist and hand therapists, to provide the best care possible for these patients. The treatment will depend on

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Figure 1: The typical deformity of flexion and ulnar deviation at Metacarpophalangeal joints. Also note the swan neck deformity of the little finger and the button hole deformity of the thumb.

Figure 2: Radiograph showing marked periarticular osteopenia around wrist and MP joint. Right side picture shows marked destruction of the wrist, distal radio-ulnar joint, MP joints and IP joints. Note the ulnar translocation of the carpus, radial deviation of the metacarpals and the ulnar deviation of the MP joint.

the stage of the disease. Depending on the status of the disease the patient is often admitted for a detailed work up and simultaneously undergoes therapy which includes local heat, mobilization exercises and splinting. In the absence of remission, a shared decision is made by the treating team and patient on the need for surgery or the next line of medical therapy. DMARDs particularly the biologic medications may compromise healing and place the patient at risk of post-operative infection and hence may need to be temporarily withdrawn in co-ordination with the rheumatologists [1, 4]. In general, surgery is staged to correct the pathology of more proximal joints before distal joints [1].

There are various options for surgery depending on the stage of disease. They are divided into prophylactic and therapeutic surgeries [1]. Prophylactic procedures like synovectomies and tenosynovectomies remove inflamed synovial tissue in an attempt prevent tendon rupture to improve joint function. Therapeutic procedures like joint fusions and joint replacements becomes necessary in the presence of joint destruction and tendon rupture and aim for relieving pain and improving function.

Wrist deformities:

Three factors are involved in the pathologic process of wrist deformities: 1) synovial pannus invasion, 2) cartilage destruction, 3) ligamentous laxity [8].

The synovial proliferation causes cartilage thinning, bony erosion with development of sharp bony edges and stretching of the extrinsic and intrinsic ligaments of the wrist. This results in destruction starting from DRUJ and spreading across radio-carpal and mid-carpal joints [7, 8].

Radiocarpal involvement by proliferative synovitis begins beneath the radioscaphocapitate ligament. The scaphoid assumes a volar-flexed (vertical) position. There is secondary loss of carpal height and radial rotation of the carpus and metacarpals on the

Figure 3: Note the marked prominence of the bilateral wrist swelling in the dorsum. Also note the prominent swelling arising from the distal radio-ulnar joint on the right side. Features of 'caput ulnae syndrome'

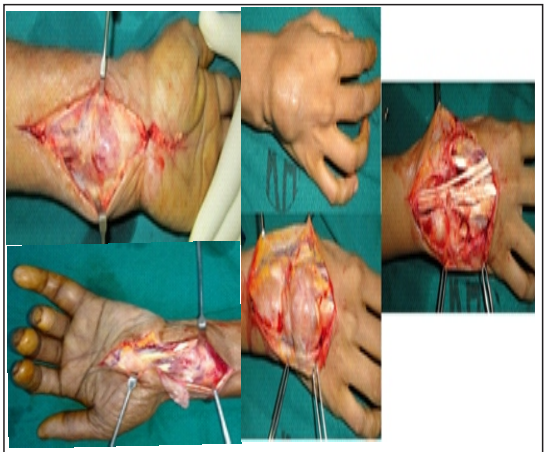

Figure 4: Carpal tunnel release demonstrating extensive synovitis and Flexor tendon rupture. The dorsal side picture shows the compound palmar ganglion with extensor tendon attrition.

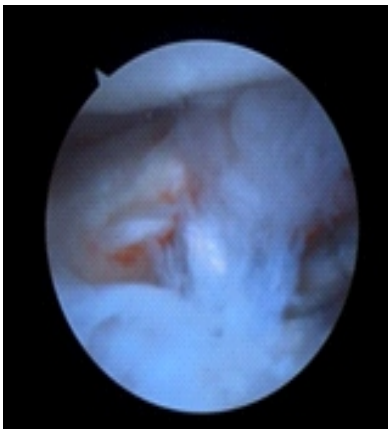

Figure 5: Arthroscopic synovectomy: Note the proliferative tenosynovial tissue lying on the radial side inferiorly. Also note the carpal bone erosion on the superior side

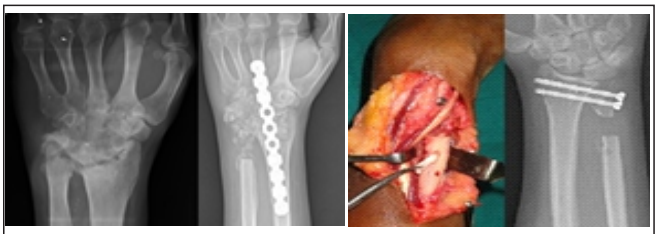

Figure 6: Rheumatoid wrist arthritis

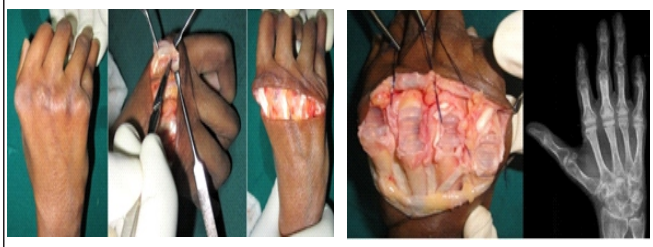

Figure 7: The flexed ulnar deviated MP joint, Option for MP joint deformity

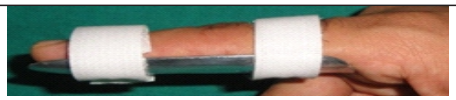

Figure 8: The stack splint is useful as a night splint for mallet finger as well as Buttonhole deformity

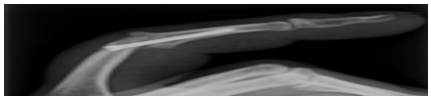

Figure 9: Fusion of PIP using Headless screws in severe fixed deformities of PIP joints

Figure 10: the extensive volar side digital tenosynovitis. Early tenosynovectomy may help in preventing the swan neck deformity.

radius [1, 7-9] (Fig. 3). In the ulnar compartment, synovitis stretches the TFCC and result in changes called as the "caput ulna syndrome." This syndrome results in dorsal prominence of the distal ulna, supination of the carpus on the hand, and volar subluxation of the ECU [1,7-9] (Fig. 3).

Features of 'caput ulnae syndrome'

The combination of volar subluxation of the ulnar carpus, and dorsal subluxation of the distal ulna produces supination of the wrist relatively in relation to the distal forearm. This sequence of wrist collapse causes imbalance of the extensor tendons, radial shift of the metacarpals, and ulnar deviation of the fingers [1,7-9]. As the ECU tendon subluxates volar ward, it becomes more as a deforming flexor thereby allowing the wrist to deviate radially and setting the stage for attrition ruptures of the ulnar extensor tendons [1].

In the early stages, splinting program using a wrist brace along with judicial use of intra-articular steroids has not found support in literature unlike in the knee joint [1].

Table 1	
JOINT DISTRIBUTION (0-5)	
1 large joint	0
2-10 large joints	1
1-3 small joints (large joints not counted)	2
4-10 small joints (large joints not counted)	3
>10 joints (at least one small joint)	5
SEROLOGY (0-3)	
Negative RF* AND negative ACPA*/ACCP*	0
Low positive RF OR low positive ACPA	2
High positive RF OR high positive ACPA	3
SYMPTOM DURATION (0-1)	
<6 weeks	0
≥6 weeks	1
ACUTE PHASE REACTANTS (0-1)	
Normal CRP* AND normal ESR*	0
Abnormal CRP OR abnormal ESR	1
Score of ≥6 = definite RA	

Tenosynovectomy, Synovectomy and Carpal Tunnel Release

Tenosynovectomy of the tendon and synovectomy of the joint is ideal in patients with early disease (Fig. 4). Tenosynovectomies has been suggested to prevent impending tendon rupture, decrease systemic level of inflammatory mediators and achieve pain relief [1]. Rupture of the FPL and index FDP is well known as seen with Manner felt lesion [1,7-10]. This is attritional rupture of the tendons due to chronic irritation of bony spur entering the carpal tunnel (Fig.4). Volar osteophyte formation from scaphoid in conjunction with tenosynovitis can contribute to tendon rupture. In such situations flexor digitorum superficialis tendon transfer is a good option. Rupture of the extensor tendons to little finger is very common at zone 6 and 7 [1, 4, 5, 13]. This is the typical Vaughan – Jackson lesion which is attritional rupture due to DRUJ subluxation and irritation due to deformed ulnar head [1,7-10] (Fig 4). They are either plicated to the adjacent intact tendon or a tendon transfer from the indicis would be a good option. Tenosynovitis and joint synovitis in the volar wrist can result in carpal

Table 2 Surgery of the wrist	
Prophylactic	**Therapeutic**
Synovial excision: • Arthroscopic wrist synovectomy • Open synovectomy by dorsal approach • Tenosynovectomy of dorsal extensor and volar flexor tendons	Tendon transfer / grafting
Carpal tunnel release	**Salvage procedures:** • Darrach's or Sauve-Kapandji Procedure for Distal radio-ulnar joint • Limited carpal fusion • Wrist arthrodesis • Ulnar head replacement • Wrist Joint replacement Arthroplasty

Table 3 Option for MP joint deformity	
Early: MCP synovitis with little or no extension lag or ulnar deviation.	Medical treatment / splinting Relative motion orthosis
Late: Articular destruction or joint subluxation, or both. Increased extension deficit (may be passively correctable), ulnar deviation, and extensor tendon displacement.	Synovectomy with centralization of the zone 5 extensor: plication of the radial sagittal band and release of ulnar sagittal band, crossed intrinsic transfer
Very late: Joint destruction, fixed palmar subluxation or dislocation, severe ulnar deviation, and ulnar and palmar displacement of the extensor tendons.	Silicone MCP arthroplasty Tupper volar plate arthroplasty

tunnel syndrome which has been reported to have an incidence of as high as 80% in patients with RA requiring carpal tunnel release (Fig 4).

Early joint synovectomy may preserve cartilage and ligament function with predictable pain relief attributed partly to sensory denervation. Recently arthroscopic synovectomy have resulted in improved function, decreased pain, with improvement in grip strength and range of motion [1] (Fig 5). Compared to open synovectomy, it has shown similar pain relief, but can result in higher recurrence rates of synovitis and radiographic progression of RA [1].

Distal radioulnar joint (DRUJ)

The most established surgical option for DRUJ disease in RA is resection of the distal ulnar head Darrach's procedure with good reported outcomes [1,7-10] (Fig 6). An alternative is the Sauve-Kapandji procedure which creates a radio ulnar arthrodesis at neutral or slightly negative ulnar variance after removal of a segment of ulna proximal to the ulnar head [1]. The ulnar head provides support to the carpus preventing ulnar translation. This procedure will be useful in the presence of a preserved ulnar head cartilage which unfortunately is affected much early in the disease. Hence Darrach's procedure is reserved for cases with ulnocarpal arthritis. (Fig. 6). Note gross destruction of radiocarpal, midcarpal and distal radio-ulnar joints. Wrist arthrodesis with Darrach's procedure was done. Right side image shows the Sauve-Kapandji procedure. Note the stabilization of the proximal side cut end of the ulna being stabilized with the FCU tendon slip and distal end being fused to the sigmoid notch of radius with cancellous screws (Fig 6).

Radio-carpal arthritis

Progression of the disease in the wrist will subsequently results in joint destruction and instability for which partial or complete wrist fusion or total joint arthroplasty will be needed [1]. Radiolunate and radioscapholunate fusion are the commonly done for limited disease of the radiocarpal joint which spares the midcarpal joint and ulnar translation of the carpus and have shown favourable outcomes [1,7-10].

In advanced arthritis, joint fusion is the procedure of choice (Fig. 6). The ideal position of wrist arthrodesis is in 100 extension and ulnar deviation but in some patients, neutral position may allow for a better forearm rotation and balance of the extensor and flexor tendon excursion [1]. In bilateral wrist arthritis, the dominant side is positioned in extension and the non dominant side in neutral or slight flexion which has been shown to give optimal outcome in most patients [1].

Total wrist arthroplasty has the benefit of preserving joint motion but it has not become popular in view of higher revision rates [1,7].

Pathogenesis of MP joint deformity:

RA of the wrist result in an obligatory radial deviation of the metacarpals. To compensate this deviation, the extrinsic extensor and flexor tendons affect ulnar drift [1,10]. The flexors normally are placed more towards the ulnar side and have a ulnar and volar shifting effect at the MP joint Proliferative synovitis at MP joint stretches the capsule and ligamentous structures resulting in fraying, fragmentation and loosening of the collateral ligaments along with the radial sagittal bands [1, 10]. This results in ligamentous instability and extensor lag. The deforming forces of flexors, extensors and the intrinsics now pull the proximal phalanx to the volar and ulnar side producing the hallmark

Table 4 Option for Boutonneire deformity	
Stage	**Treatment**
I - Mild active extension lag (less than 30 degrees), full passive PIP extension, and loss of DIP flexion with the PIP extended	Dynamic splinting,
II - More than a 30-degree active extension deficit at the PIP joint and full passive extension	steroid injection or synovectomy of the PIP joint -Correct any wrist flexion -Extensor reconstruction - Fowler's tenotomy: division of the terminal extensor tendon for DIP joint flexion.
III – Stiff PIP joint with fixed deformity – joint preserved	Supervised neglect Fowler's tenotomy
IV - Articular destruction	Arthrodesis Arthroplasty

Table 4- Options for swan neck deformity		
Type	**Characteristics**	**Treatment options**
I	Full range of motion No intrinsic tightness No functional limitations	Splinting Reconstruction of ORL
II	Intrinsic tightness Limited PIP motion with an extended MCP joint with ulnar deviation corrected	Splinting Intrinsic release , reconstruction of ORL*, dermodesis
III	Stiff PIP in all positions of MP joint Radiograph good	MP joint soft tissue release, lateral band release and mobilization
IV	Severe arthritic changes	Arthrodesis or PIP joint arthroplasty
*ORL – Oblique Retinacular Ligament		

deformity [1, 10] (Fig. 1, 7).

Management of MP joint deformities

Although most of the patients compensate remarkably to this deformity, the inability to extend and open the fingers limits their ability to hold larger objects. Various options have been described as per the stage of the disease. Note the flexed ulnar deviated MP joint. Middle figure shows synovectomy with intrinsic release and transfer to the radial side of adjacent finger MP joint radial collateral ligament (described by Flatt et al). right side figure shows the position of finger after synovectomy, intrinsic release, transfer to radial side of adjacent finger and radial sagittal band repair. The two right images side features of silicon arthroplasty for the MP joint (Table 3)(Fig. 7).

Option for finger deformities:

Since the wrist and hand joints are linked, the deformities at wrist and MCP joints should be addressed before correction of the commonly encountered boutonniere or swan-neck deformities [1, 7-10]. A swan-neck deformity is more disabling as the patient is not able to make a fist due to the hyperextension at the proximal interphalangeal (PIP) joints [1]. In contrast, a buttonhole deformity permits full fist and the concern is mainly due to cosmesis [1].

Buttonhole deformity:

Two groups of patients can be differentiated for the purposes of management considerations: 1) those with a passively correctable deformity and, 2) those with a fixed joint deformity [7] (Fig. 8). The stack splint is useful as a night splint for mallet finger as well as Buttonhole deformity. Various options are available and are mentioned in Table 4. Options for Boutonneire deformity (fig. 8, 9).

Swan neck deformity correction:

In Swan neck deformity, it is important to identify the pathology at the causative joint. For patients with a flexible deformity, treatment is aimed at soft tissue reconstruction (Fig. 10) (Table 5). A concomitant DIP joint arthrodesis is often a necessity. In fixed deformities, arthrodesis of PIP joint is an acceptable option with satisfactory results [7, 10] (Fig. 9).

Thumb deformities:

Six varieties of deformity have been described for manifestations in the thumb [7]. Type 1 is the commonest which is a boutonniere deformity in which MCP joint is flexed and the IP joint hyperextended. This is followed by the less frequent type III variant swan-neck deformity in which the MCP joint is extended and the IP joint is flexed. In boutonniere deformity attempt is made to preserve the MP joint motion. In early stages synovectomy with EPL rerouting has been suggested [1]. However most of the patient present when MCP joint is diseased and stiff and hence its fusion is advocated provided the other two joint movements is relatively preserved. If two adjacent joints are involved motion is preserved in at least one of them with arthroplasty. In swan-neck deformity, the etiology is at the carpo-meta-carpal (CMC) joint, for which arthrodesis of CMC joint or an arthroplasty procedure with either a tendon or suspensionplasty may be advised [1]. Surgeries in the thumb have the best option of achieving gratifying results as it participates in 50% of the hand functions [1].

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