Introduction and Aim of Work

Rheumatoid Arthritis (RA) is a complex autoimmune and progressive inflammatory disease that involves the joints and leads to their destruction with functional disability. It mostly involves the finger joints in the hands and wrist joint. The prevalence of rheumatoid arthritis (RA) is 1% in the general population worldwide ***(Fattahi and Mirshafiey, 2012).***

Rheumatoid arthritis (RA) is characterized by proliferative hypervascularized synovitis resulting in bone erosion, cartilage damage, joint destruction and long term disability. Until recently, the absence of effective treatment to prevent joint destruction has limited the need for more sensitive imaging techniques. Availability of these powerful and expensive drugs has create new demands on radiologists to identify patients with aggressive RA at an early stage to affect the therapeutic management of these patients ***(Boutry et al., 2007).***

In Rheumatoid arthritis, hyperemia caused by vasodilatation is one of the detectable pathologic alterations at the beginning of joint inflammation, and angiogenesis, as one of key prerequisites for pannus formation, plays a

crucial role in the initiation and perpetuation of synovitis ***(Strunk et al., 2004).***

Musculoskeletal US is a powerful tool not only for evaluating joints and related structures but also for assessing disease activity.US in rheumatology has rapidly evolved and been incorporated into routine clinical practice over the past decade. Moreover, technological development of equipment has made it more accessible for rheumatologists ***(Wakefield et al., 2012).***

Diagnosing RA begins with a thorough medical history of the patient, focusing on the presence, location and duration of joint pain and stiffness as well as physical assessment of synovitis. Since there is no single test to diagnose RA, clinicians use a number of tests to support the clinical diagnosis ***(Alitaha et al., 2010).***

This traditionally include rheumatoid factors, anti-citrullinated peptide (anti-ccp), ESR, CRP (c-reactive protein) levels as well as imaging using radiographs of the hands, wrists and feet, in addition imaging with ultrasound (US) and magnetic imaging resonance (MRI) has increased the ability to diagnose the disease earlier or when clinical synovitis is equivocal ***(Whiting et al.,2010).***

In the last decade, musculoskeletal US has played an increasingly important role in the evaluation and

monitoring of patients with chronic inflammatory arthritis.US can evaluate synovitis, a pathological hallmark of RA, at both the anatomic and vascular levels. There are 2 US techniques that are of use:

(i) B-mode or gray scale US: imaging of anatomic structure, which enables visualization of synovial hypertrophy and/or effusion.

(ii) Power Doppler US (PDUS): blood flow detection, which allows visualization of the movement of blood vessels, therefore detecting increased microvascular blood flow seen in active synovitis ***(Martinoli et al., 1998).***

In visualization of bone erosions in the fingers and toe joints, US has been reported to be more sensitive than radiography and comparable in sensitivity with MRI ***(Wakefield et al., 2000).***

Aim of the Study

To study the role of gray scale ultrasound and Power Doppler ultrasound, in assessment of bone erosion and synovial thickening in the wrist joints and small joints of the hands in RA patients.

Wrist and Hand joints Anatomy

The wrist is the link between the forearm and the hand, it is comprised of the distal radius, the distal ulna, the proximal and distal carpal rows and the five metacarpal bases ***(Hove et al., 2014).***

The wrist joint is considered to be the most complex articulation in the human body. However, its anatomy can be simplified into three major compartments: the distal radioulnar joint (DRUJ), the radiocarpal joint, and the midcarpal joint ***Thomas et al., (2008);*** they often intercommunicate through a common synovial cavity ***(Isenberg et al., 2004).***

Anatomy carpal bones:

The eight carpal bones are commonly described as being arranged in two rows, the proximal carpal row and the distal carpal row (Fig. 1, 2). From radial to ulnar side, the proximal carpal row contains the:

- Scaphoid (also known as the navicular).
- Lunate
- Triquetrum
- Pisiform

The distal row is composed of the:

- Trapezium
- Trapezoid
- Capitate
- Hamate

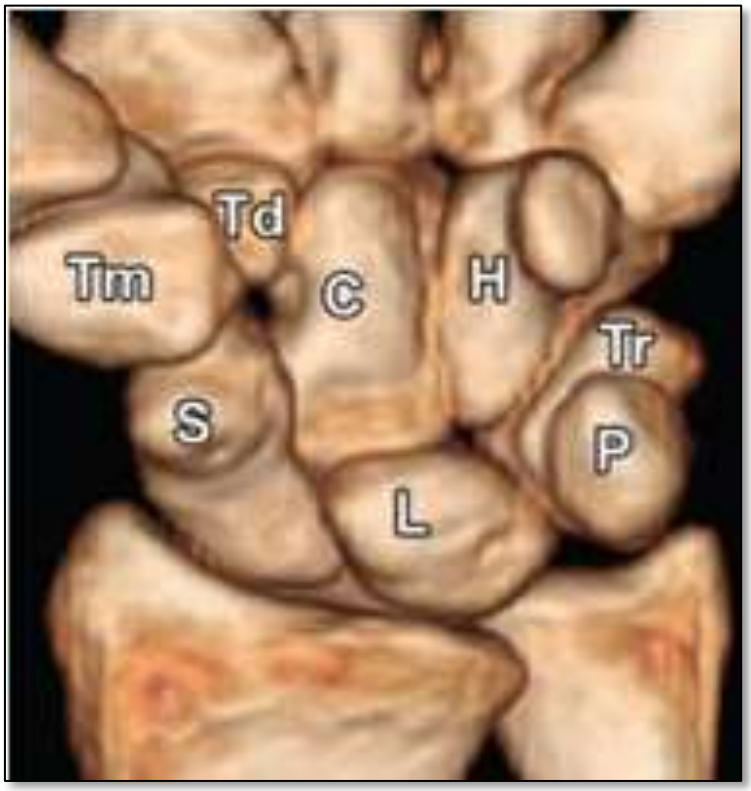

Fig. (1): Carpal anatomy, three-dimensional (3D) CT images show the normal wrist. C = capitate, H = hamate, L = lunate, P = pisiform, S = scaphoid, Td = trapezoid, Tm = trapezium, Tr = triquetrum ***(Rathachai et al, 2008)***.

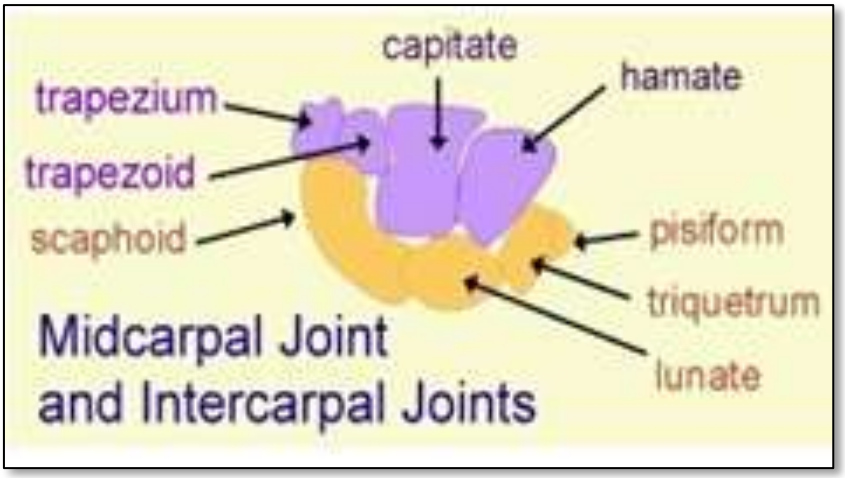

Fig. (2): Carpal bones, mid carpal, and inter carpal joints ***(Neumann, 2002).***

Carpal arcs (Gilula arcs or lines) (Fig. 3) are three smooth arcs.

- **Arc I** outlines the proximal surface of the scaphoid, lunate, and triquetrum.
- **Arc II** represents the smooth arc that defines the distal surface of these same three carpal bones.
- **Arc III** outlines the proximal surface of the capitate and hamate.

The continuity of the carpal arcs should be assessed on all frontal wrist radiographs. Disruption of one of these arcs suggests an abnormality at that site. In the evaluation of the neutral lateral radiograph, a normal coaxial alignment of the radius, lunate, and capitate should be expected ***(Rathachai et al., 2008).***

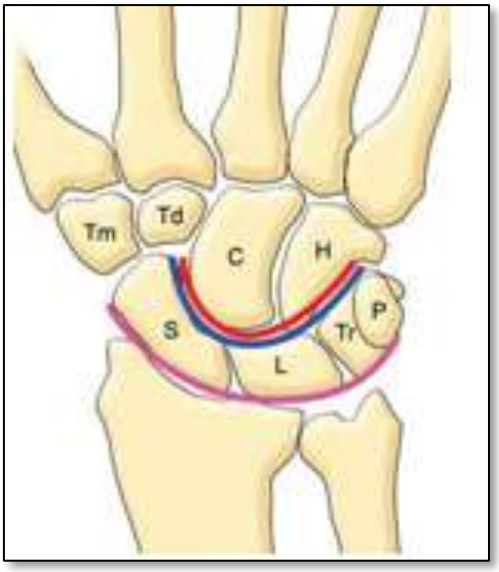

Fig. (3): Normal anatomy of the carpal bones. Diagram of the wrist (frontal view) shows the eight carpal bones and the three carpal arcs (Gilula arcs), which are shown as pink (arc I), blue (arc II), and red (arc III) lines. C = capitate, H = hamate, L = lunate, P = pisiform, S = scaphoid, Tm = trapezium, Td = trapezoid, Tr = Triquetrum ***(Rathachai et al., 2008).***

Mid carpal joint:

The midcarpal joint is the S-shaped joint space separating the proximal and distal rows of carpal bones (Fig. 4) ***(Platzer & Werner, 2004).***

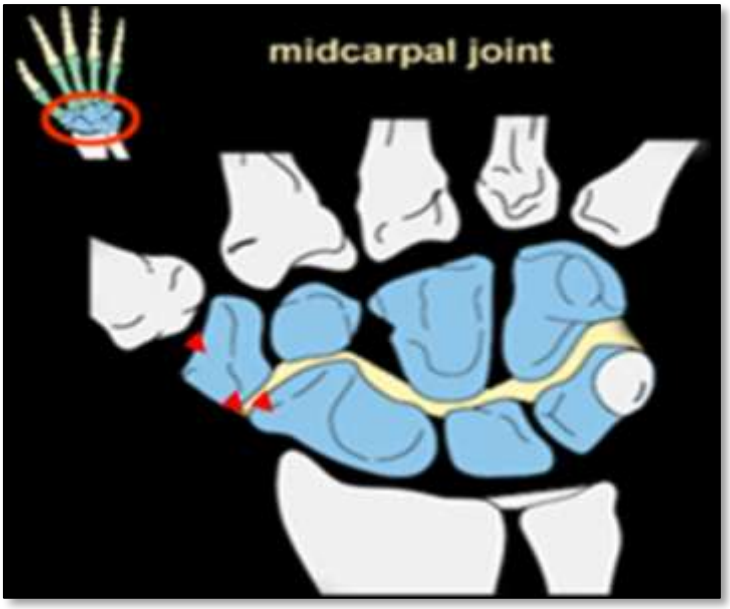

Fig. (4): Midcarpal joint; It consists proximally of the scaphoid, lunate, and triquetrum articulating with the distal carpal row: the trapezium, trapezoid, capitate, and hamate ***(Lorie & Janice, 2007).***

Radio-carpal joint:

The radio-carpal joint or wrist joint is an ellipsoid joint formed by the radius and the articular disk proximally and the proximal row of carpal bones distally **(Fig. 5)**. The capsule is continuous with the midcarpal joint and strengthened by numerous ligaments, including the palmar and dorsal radiocarpal ligaments, and the ulnar and radial collateral ligaments ***(Platzer & Werner, 2004)***.

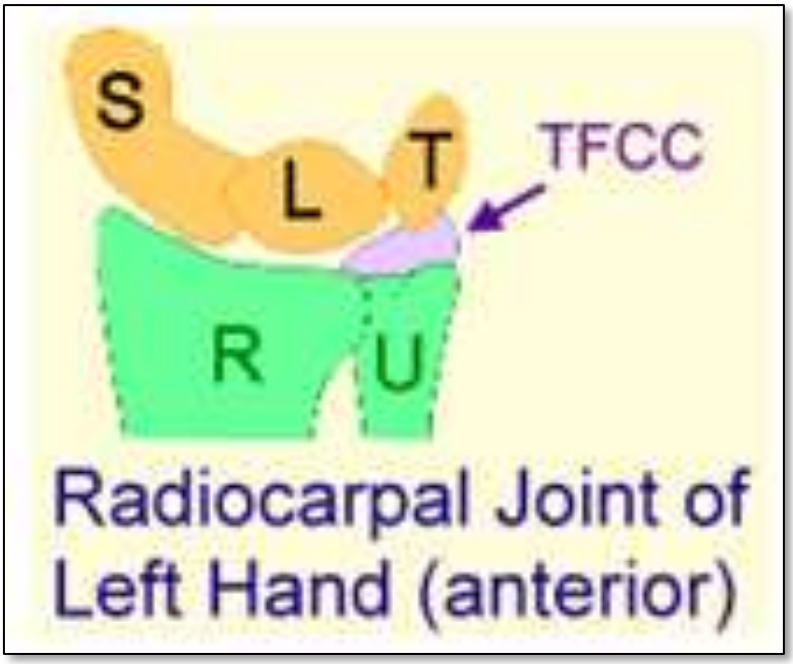

Fig. (5): Radiocarpal joint ***(Neumann, 2002).***

Distal radioulnar joint

The distal radioulnar joint is formed by the head of ulna and the ulnar notch of radius, this joint is separated from the radiocarpal joint by an articular disk lying between the radius and the styloid process of ulna **(Figs. 6, 7, 8)** ***(Platzer & Werner, 2004)***.

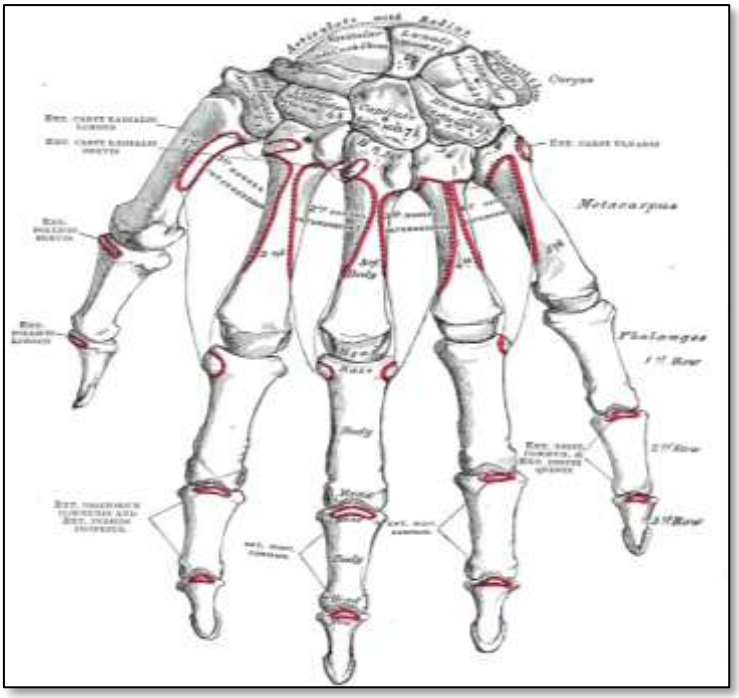

Fig. (6): Bones of the left hand from the dorsal aspect ***(Standring, 2005).***

Fig. (7): Distal radioulnar, radiocarpal, and mid carpal joints ***(Neumann, 2002).***

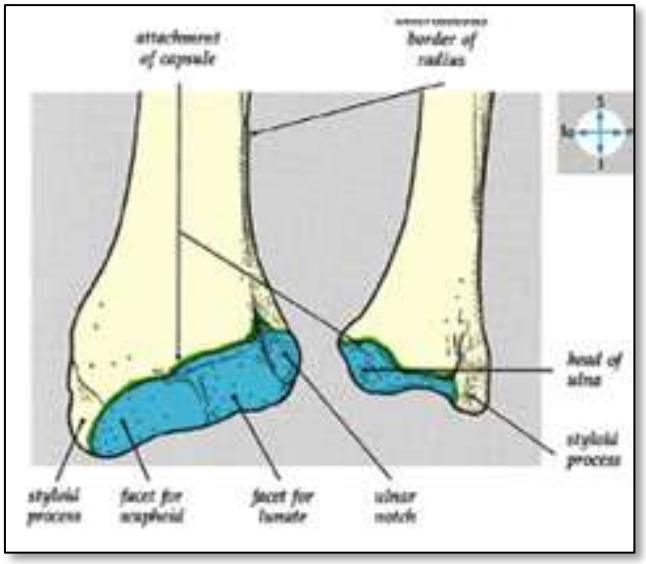

Fig. (8): The articular surface of the distal end of the radius and the adjacent triangular cartilage are exposed by removal of the carpal bones ***(Stoller et al., 2007).***

Triangular fibrocartilage complex

The TFCC is the primary stabilizer of the DRUJ. It also cushions the ulnar head and lunate during axial loading of the wrist. It is composed of the articular disk, the triangular ligament, the meniscal homologue, the volar and dorsal radioulnar ligaments, the volar ulnolunate and ulnotriquetral ligament, and the sheath of the extensor carpiulnaris tendon (Figs. 9) ***(Yoshioka et al., 2003).***

Four osseous structures border the TFCC. The head of the ulna and the sigmoid notch of the radius form the proximal border of the TFCC. The articular disk, which is composed of fibro-cartilage, is triangular in shape and

situated on a horizontal, crescent shaped articular surface of the ulnar head. It inserts on the radius at the prominence of the sigmoid notch distally**.** The ulnar portion of the disk is broader, inserting at the base of the ulnar styloid process and the adjacent ulnar fovea through the upper and lower lamina of the triangular ligament ***(Nakamura & Makita, 2000).***

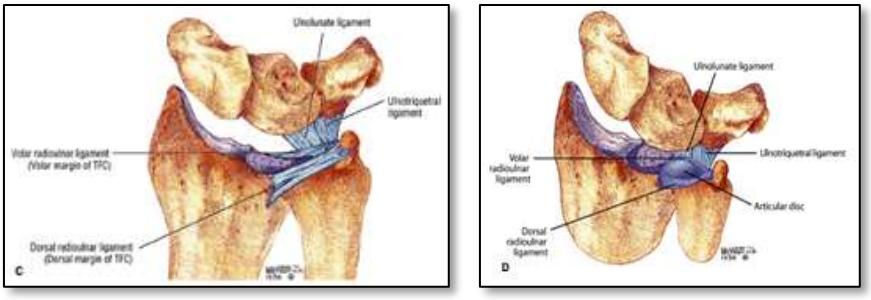

Fig. (9): TFC complex. (A,B) Volar view of the ligaments of the ulnar side of the carpus. The meniscus homologue and meniscus reflection are shown. In this dorsal view, the ulnar and dorsal aspect of the TFC complex is invested by a thick ligamentous layer (the meniscus reflection) with proximal attachment to the TFC complex and ulna and distal attachment to the base of the fifth metacarpal. The dorsal views of the TFC complex show the dorsal and volar radioulnar ligaments as separate from the articular disc of the TFC. ***(Stoller et al., 2007).***

Ligamentous anatomy

The carpal ligaments may be classified as either extrinsic or intrinsic. The extrinsic ligaments link the carpal bones to the radius and ulna. The intrinsic or intercarpal ligaments connect the individual carpal bones ***(Michael & Joel, 2004).***

Volar extrinsic ligaments

The most functionally significant of the extrinsic ligaments are the volar radiocarpal ligaments**.** These ligaments are the most important stabilizers of wrist motion (Figs. 10) ***(Michael & Joel, 2004).***

Dorsal extrinisic Ligaments

There are two main ligaments at the dorsum of the wrist that make a lateral V shaped configuration, the dorsal radiocarpal ligament and the dorsal intercarpal ligament (Fig. 11) ***(Anastasios et al., 2008).***

Table (1): Extrinsic and intrinsic ligaments of the wrist ***(Kuo and Wolfe, 2008).***

	Volar	Dorsal
Extrinsic ligaments	Radioscaphocapitate	Intercarpal
	Long radiolunate	Radiocarpal
	Short radiolunate	
	Radioscapholunate	
	Ulnolunate	
	Ulnocapitate	
Intrinsic ligaments	Lunotriquetral	Intercarpal
	Trapeziotrapezoid	Trapeziotrapezoid
	Scaphotrapezial	Capitotrapezoid
	Scaphotrapezoidal	Capitohamate
	Scaphocapitate	Triquetrohamate
	Capitotrapeziod	
	Triquetrohamate	
	Triquetrocapitate	
	Capitohamate	

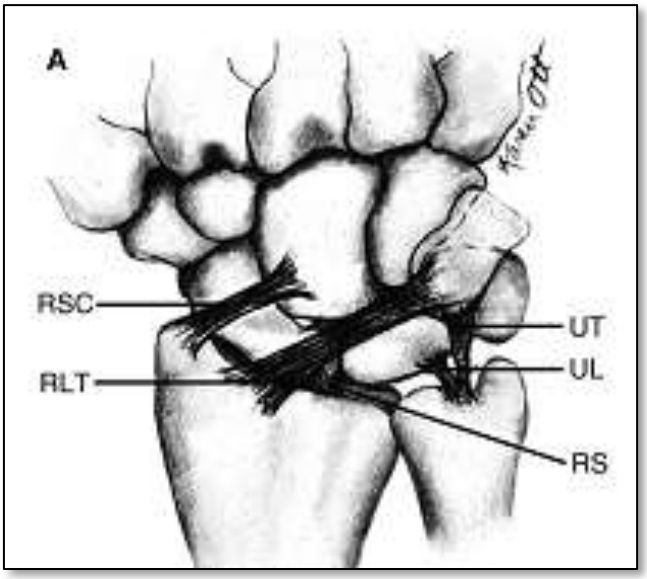

Fig. (10): Diagram illustrating the volar radiocarpal and ulnocarpal ligaments. RLT, radiolunatotriquetral ligament; RSC, radioscaphocapitate ligament; UL, ulnolunate ligament; UT, ulnotriquetral ligament ***(Michael & Joel, 2004).***

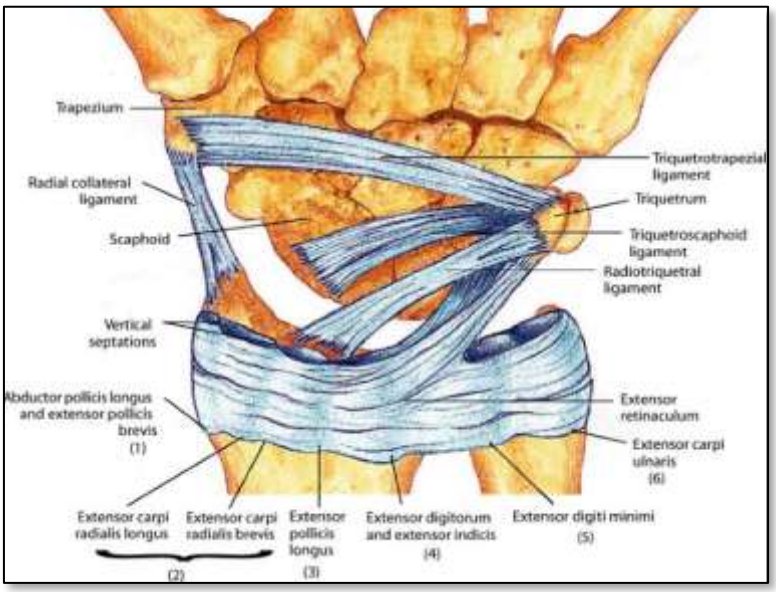

Fig. (11): Diagram illustrates the extensor retinaculum and dorsal carpal ligaments ***(Stoller et al., 2007).***