

# **Sonographic Evaluation of Synovium of Wrist Joint in Rheumatoid Arthritis Patients during Activity**

*Thesis*

*Submitted For Partial Fulfillment Of Master Degree In  
Radiology*

**by**

**Nesma Abdel Hakim Mohamed Saleh**

*M.B.B.CH.-Ain Shams University*

**Supervised by**

**Assis. Prof. Dr. Ayman Mohamed Ibrahim**

*Assistant Professor of Radiodiagnosis  
Faculty of Medicine  
Ain Shams University*

**Dr. Haytham Mohamed Nasser**

*Lecturer of Radiodiagnosis  
Faculty of Medicine  
Ain Shams University*

**Faculty of Medicine  
Ain Shams University  
2018**



## ACKNOWLEDGEMENT

*First of all, all gratitude is due to **Allah** almighty for blessing this work, until it has reached its end, as a part of his generous help, throughout my life.*

*Really I can hardly find the words to express my gratitude to **Dr. Ayman Mohamed Ibrahim**, Assist. Prof of Community Health Nursing, Faculty of Nursing - Ain Shams University, for his supervision, continuous help, encouragement throughout this work and tremendous effort she has done in the meticulous revision of the whole work. It is a great honor to work under her guidance and supervision.*

*I would like also to express my sincere appreciation and gratitude to **Dr. Haytham Mohamed Nasser**, Lecturer of Community Health Nursing, Faculty of Nursing - Ain Shams University, for her continuous directions and support throughout the whole work.*

*Last but not least, I dedicate this work to my dear family, whom without their sincere support and love, pushing me forward this work would not have ever been completed.*



*Nesma Abd El Hakim Mohamed*

# List of Contents

	Page
Acknowledgment .....	--
List of Abbreviations .....	i
List of Figures .....	ii
List of Tables .....	v
Introduction .....	1
Aim of The Study .....	4
Review of Literature .....	5
• <b>Chapter 1:</b> Anatomy of the Wrist and Hand Joints ..	5
• <b>Chapter 2:</b> Sonographic Features of Normal Joints and their Related Structures.....	26
• <b>Chapter 3:</b> Pathology and Clinical Aspects of Rheumatoid Arthritis .....	48
• <b>Chapter 4:</b> Ultrasound and Power Doppler in Rheumatoid Arthritis .....	60
Patients and Methods .....	78
Results .....	83
Illustrative Cases .....	91
Discussion .....	98
Summary and Conclusion .....	105
References .....	107
Arabic Summary .....	--

## **List of Abbreviations**

ACPA .....	Anti-citrullinated protein antibody
Anti-CCP .....	Anti-cyclic citrullinated peptide
CDUS .....	Colour Doppler Ultrasound-
CTR .....	Carpal tunnel release
CTS.....	Carpal tunnel syndrome
DIP .....	Distal interphalangeal
FDP .....	Flexor digitorum Profundus
FDS .....	Flexor digitorum superficialis
GSUS .....	Gray scale ultrasound
IFN- $\gamma$ .....	Interferon gamma
MCP .....	Metacarpophalangeal
PACS .....	Picture archieving and comunication system
PD-US .....	Power Doppler ultrasonography
PIP .....	Proximal interphalangeal
RA .....	Rheumatoid arthritis
RF .....	Rheumatoid Factor
VEGF .....	Vascular endothelial growth factor

## List of Figures

<b>Fig.</b>	<b>Title</b>	<b>Page</b>
1	Bones of the left hand from the dorsal aspect	5
2	Carpal anatomy, three-dimensional (3D) CT images show the normal wrist	6
3	Carpal bones, mid carpal, and inter carpal joints	7
4	Carpal arcs	8
5	Radiocarpal joint.	9
6	Extensor Tendons.	11
7	Wrist flexors	13
8	volar extrinsic ligaments	14
9	Dorsal intrinsic ligaments	15
10	Intrinsic ligament of the wrist	16
11	Distal radioulnar joints	17
12	Distal radioulnar joints	18
13	Mid carpal joint	19
14	Midcarpal joint	23
15	Diagram illustrates the inter phalangeal ligaments	25
16	The Extensor Tendons	30
17	The Extensor Tendons	30
18	The Extensor Tendons	31
19	The flexor tendons and carpal tunnel	32
20	Intrinsic wrist ligaments	34
21	medial nerve	35
22	The Ulnar Nerve	36
23	Flexor Tendons	38
24	Flexor tendons	39
25	Flexor tendons	40
26	Extensor tendons	42
27	Inter-phalangeal joint fluid	43

<b>Fig.</b>	<b>Title</b>	<b>Page</b>
28	The cartilage	45
29	Diagram demonstrates effect of rheumatoid arthritis on joints	51
30	Pathogenesis of RA	53
31	Pathogenesis of RA	54
32	Demonstrates the joint deformity in the hands	59
33	US assessment of synovitis	63
34	US assessment of synovitis	63
35	Power Doppler assesmnet of synovium	64
36	Joint effusion	66
37	Joint effusion with rice bodies and PD assessment	66
38	Bone erosions	69
39	Bone erosions	69
40	Bone erosions	70
41	Tenosynovitis.	72
42	Tenosynovitis.	73
43	Tenosynovitis	73
44	Rheumatoid nodule	74
45	Carpal tunnel syndrome	77
46	Pie chart illustrating the gender distribution among our study group	83
47	Column graph illustrating the percentage of presenting symptoms of patients	85
48	Column graph illustrating the findings of clinical examination of both wrist and hand joints	85
49	Column graph illustrate the laboratory findings of RA	86
50	Column graph illustrating percentage of patients with disease activity by PD	87
51	Illustrates the semi-quantitative score for	88

<b>Fig.</b>	<b>Title</b>	<b>Page</b>
	disease activity	
52	Column graph illustrating the percentage of different sonographic findings of RA among males and females in the study group	89
53	Clustered column graph illustrating the sensitivity, specificity, positive, negative predictive values and diagnostic efficacy of US & PD	90
54	Illustrative case.	91
55	Illustrative case.	91
56	Illustrative case.	92
57	Illustrative case.	92
58	Illustrative case.	93
59	Illustrative case.	93
60	Illustrative case.	94
61	Illustrative case.	94
62	Illustrative case.	95
63	Illustrative case.	95
64	Illustrative case.	96
65	Illustrative case.	96
66	Illustrative case.	97
67	Illustrative case.	97

## List of Tables

Table	Title	Page
1	Illustrates the percentage of RA among the included male & female	84

## Introduction

Rheumatoid arthritis (RA) is an autoimmune disease that causes chronic inflammation of the joints. It is a destructive joint disease that is caused by inflammation in the tissue that normally produces lubrication fluid for joints. When this tissue remains inflamed, it leads to deformity by loosening joint ligaments and to joint destruction by eroding away cartilage and bone (*Firestein et al., 2012*).

Autoimmune diseases are illnesses that occur when the body's tissues are mistakenly attacked by their own immune system. The immune system contains a complex organization of cells and antibodies designed normally to "seek and destroy" invaders of the body, particularly infections. Patients with autoimmune diseases have antibodies and immune cells in their blood that target their own body tissues, where they can be associated with inflammation. While inflammation of the tissue around the joints and inflammatory arthritis are characteristic features of rheumatoid arthritis, the disease can also cause inflammation and injury in other organs in the body. Because it can affect multiple other organs of the body, rheumatoid arthritis is referred to as a systemic illness and

is sometimes called rheumatoid disease. Rheumatoid arthritis is a classic rheumatic disease. Rheumatoid arthritis that begins in people under 16 years of age is referred to as juvenile idiopathic arthritis or JIA (*McInnes and Georg, 2011*).

Rheumatoid arthritis is a common rheumatic disease, affecting approximately 1.3 million people in the United States, according to current data. The disease is three times more common in women as in men. It afflicts people of all races equally. The disease can begin at any age and even affects children (juvenile idiopathic arthritis), but it most often starts after 40 years of age and before 60 years of age. Though uncommon, in some families, multiple members can be affected, suggesting a genetic basis for the disorder (*Koopman et al., 2017*).

The presence of auto antibodies such as Rheumatoid Factor (RF) and anti-citrullinated protein antibody (ACPA) (Tested as anti-cyclic citrullinated peptide (anti-CCP) can precede the clinical manifestation by many years (*Nielen et al., 2004*).

The wrist joint is one of the joints that are affected early in the course of the rheumatoid arthritis. It shows the rheumatic changes such as bone erosions, joint effusion and

tendinopathy. So, the wrist joint changes with rheumatoid arthritis could be used for diagnosis of the disease activity (*Goldring et al., 2013*).

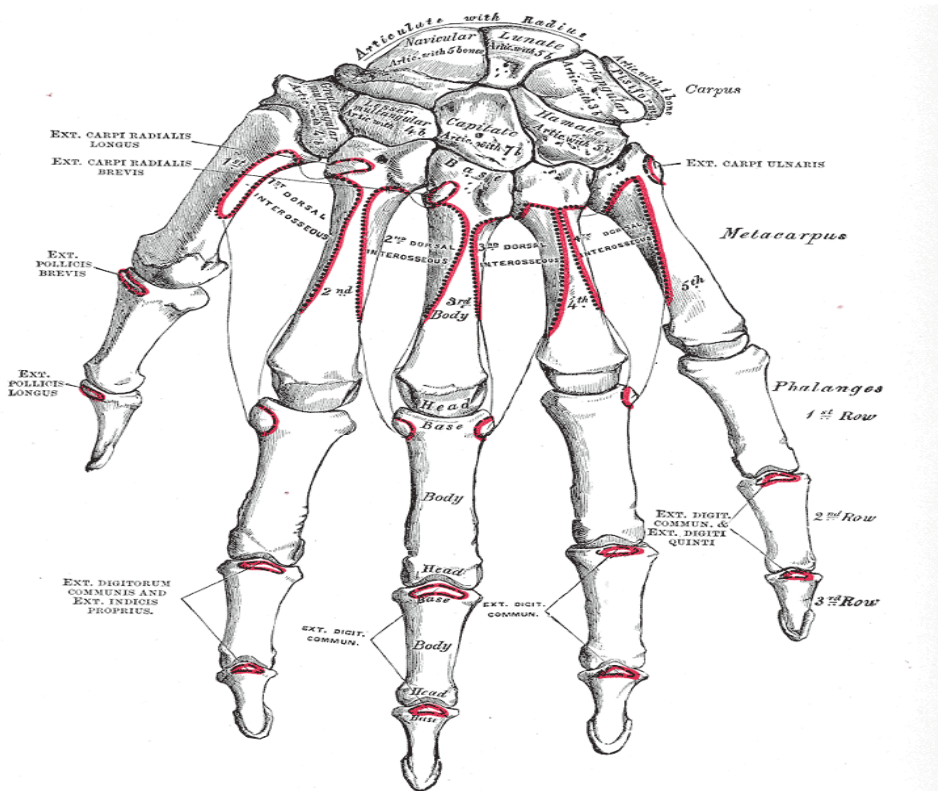
Within the last decade, musculoskeletal sonography and Power Doppler ultrasonography (PD-US) have been become an established imaging technique for the diagnosis and follow-up of patients with rheumatic diseases. This has been made possible through technological improvements resulting in faster computers and higher frequency transducers (*Hau, 2011*).

US & PD are commonly used to assess soft tissue pathology, detect fluid collection and measure synovial vascularity due its capability to provide data that can be used to evaluate the level of joint inflammation and assess rheumatoid arthritis. It can also be used to visualize cartilage and bone surfaces. The real-time capability of ultrasonography allows dynamic assessment of joint and tendon movements to visualize the structural abnormalities. US is helpful in the guidance of aspiration, biopsy, and injection therapy. It is very patient friendly because of its non-invasive nature, lack of ionizing radiation and in addition it is not time consuming. Because it is relatively inexpensive, US can be repeated as often as necessary to monitor therapy (*Hau, 2011*).

## **Aim of the Work**

Our goal in this study is to demonstrate the role of Ultra-Sonography and Power Doppler in diagnosis of activity in rheumatoid arthritis in the hands and wrist joints among different aged population and correlate it with the laboratory investigation.

# Anatomy of the Wrist and Hand Joints



Fig

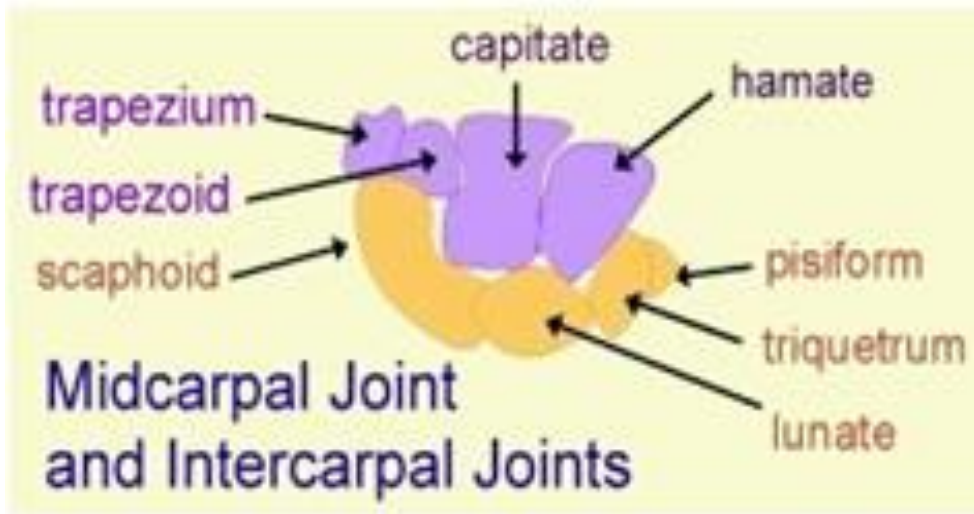
. (1): Bones of the left hand from the dorsal aspect. (Standring, 2010).

**Bones of the wrist (Carpus):** The carpus contains eight bones in proximal and distal rows of four. Proximally, in lateral to medial order, are the scaphoid, lunate, triquetrum and pisiform; in the distal row is the trapezium, trapezoid, capitate and hamate. The pisiform articulates with palmar surface of the triquetrum, thus separated from the other carpal bones, all of which articulate with their neighbors. The

other three proximal bones form an arch proximally convex, articulating with the radius and articular disc of the inferior radioulnar joint. The arch's concavity is a distal recess embracing, proximally, the projecting aspects of the capitate and hamate; the two rows are thus mutually and firmly adapted (*Roger, 2015*).



**Fig. (2):** 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 (3): Carpal bones, mid carpal, and inter carpal joints (Neumann, 2002).*

**Carpal arcs (Gilula arcs or lines) are three smooth arcs (fig.4):**

1. **Arc I** outlines the proximal surface of the scaphoid, lunate, and triquetrum.
2. **Arc II** represents the smooth arc that defines the distal surface of these same three carpal bones.
3. **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