ROLE OF MRI AND ULTRASOUND IN THE ASSESSMENT OF RHEUMATOID ARTHRITIS IN THE HAND AND WRIST JOINTS

Essay
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ABSTRACT

MRI and sonography can be useful tools in evaluating patients with early rheumatoid arthritis. Both imaging techniques can detect preerosive synovitis. They can also identify early bone damage before it becomes apparent on radiography. Furthermore, MRI can be used to predict future bone damage.

Rheumatoid arthritis is characterized by proliferative, hypervascularized synovitis, resulting in bone erosion, cartilage damage, joint destruction, and long-term disability. Diagnosis is based on clinical, laboratory, and radiographic findings.

KEYWORDS

Rheumatoid arthritis; ultrasound; MRI; hand; wrist.

CONTENTS

LIST OF ABBREVIATIONS

AIUM	American institute of ultrasound in medicine
BME	Bone marrow edema
CCP	Cyclic citrullinated peptide
CEUS	Contrast enhanced ultrasound
CMCJ	Carpometacarpal joint
DCE-MRI	Dynamic contrast enhanced magnetic resonance
DIP	Distal interphalangeal joint
DMARDs	Disease modifying anti-rheumatic drugs
DRUJ	Distal radioulnar joint
ECU	Extensor carpiulnaris
EULAR	European league against rheumatism
FCR	Flexor carpiradialis
FOV	Field of view
IL	Interleukin
MCP	Metacarpophalangeal joint
MHz	Megahertz
MRI	Magnetic resonance imaging
MTP	Metatarsophalangeal joint
OMERACT	Outcome measures in rheumatoid arthritis clinical trials
PDUS	Power Doppler ultrasound
PIP	Proximal interphalangeal joint
RA	Rheumatoid arthritis
RAMRIS	Rheumatoid arthritis magnetic resonance imaging score
RF	Rheumatoid factor
RUL	Radioulnar ligament
SH	Synovial hypertrophy
STIR	Short-TI Inversion Recovery
TFCC	Triangular fibrocartilage complex
TNF	Tumor necrosis factor
TUI	Targeted Ultrasound Initiative
UCL	Ulnocarpal ligament
US	Ultrasound

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INTRODUCTION

Recent advances in imaging technology are dramatically changing the approach to patients with inflammatory arthritis. Conventional radiography is still the major imaging modality used to evaluate patients with rheumatoid arthritis (RA) in daily clinical practice, but an ever-growing number of rheumatologists are integrating the radiographic findings with those obtainable using ultrasound (US) and MRI **(Colebatch et al, 2013).**

In daily clinical practice, four main imaging techniques are used to explore bone and joint involvement in RA: conventional radiography, computed tomography (CT), US and MRI. Other techniques such as nuclear medicine imaging, peripheral quantitative computed tomography (pQCT), digital X-ray radiogrammetry and dual X-ray absorptiometry have limited indications and are less frequently used to image RA patients. Conventional radiography and CT offer information mainly on the bone damage, while US and MRI provide a detailed evaluation of soft tissues, as well **(Grassi et al, 2016).**

Early diagnosis and personalized treatment is the cornerstone of an effective strategy aimed at inducing clinical

remission and preventing irreversible anatomical damage. Imaging is crucial for fulfilling these tasks. Both US and MRI allow for a careful confirmation of the clinical suspicion of RA by revealing even minimal pathologic changes indicative of soft tissue inflammatory involvement and/or joint damage **(Schmidt et al, 2013).**

Ultrasound has been demonstrated to be superior to clinical examination in detecting synovitis because of its capability to identify otherwise undetectable fine, soft tissue changes. The main advantages of US, with respect to other imaging techniques, include absence of radiation, good visualization of the joint cavity, low running costs, multiplanar imaging capability, quantifications of soft-tissue abnormalities and real-time imaging. Moreover, it is rapidly performed and readily accepted by patients and may be used to assist needle positioning within the selected target area and facilitate joint aspiration, biopsy and local injections. In RA patients, US can detect a core set of basic findings which indicate either the disease activity or its severity, these include: joint cavity, tendon sheath and bursal enlargement (due to an abnormal amount of synovial fluid and/or synovial hypertrophy), Doppler signal, cartilage damage, tendon tear and bone erosion. A variable combination of these basic findings may be

detected, giving reason for the wide range of pathological changes detectable even in a single RA patient. Each of these findings can be graded using different scoring systems and data obtained in different anatomic sites can be added together to gather information at patient level **(Grassi et al, 2012) and (Hammer et al, 2010).**

MRI plays an important role in RA, providing diagnostic and prognostic information. MRI can visualize both the inflammation and the structural damage in RA patients. MRI findings include synovitis, tenosynovitis, bone edema/osteitis, enthesitis, bone erosion and cartilage damage. One of the major advantages of MRI compared to other techniques is the ability to assess bone edema/osteitis, which is visualized only by MRI **(Grassi et al, 2016).**

This review will summarize the options, uses and optimization of these imaging modalities with a special focus on US which is currently the most promising tool to change the paradigms in both early diagnosis and therapy monitoring of RA.

AIM OF THE WORK

The aim of this work is to discuss and compare the role of ultrasound and MRI of the hand and wrist joints in early diagnosis, follow-up and detection of response to treatment in rheumatoid arthritis.

CHAPTER 1 ANATOMY OF THE HAND AND WRIST

(I) GROSS ANATOMY

The anatomic linkage between the distal forearm and the hand is composed of 15 bones: 8 carpal bones, the distal radius and ulnar, and the bases of the 5 metacarpals **(Phillips, 2013).**

BONES

The carpal bones are divided into two rows: proximal and distal. The proximal carpal row is composed of the scaphoid, lunate, triquetrum, and pisiform. The distal carpal row is comprised of the trapezium, trapezoid, capitate, and hamate **(Boggess, 2014).**

All carpal bones participate in wrist function except for the pisiform, which is a sesamoid bone through which the flexor carpi ulnaris tendon passes. The scaphoid serves as link between each row; Therefore, it is vulnerable to fractures. The distal row of carpal bones is strongly attached to the base of the second and third metacarpals, forming a fixed unit. All other structures (mobile units) move in relation to this stable

unit. The flexor retinaculum, which attaches to the pisiform and hook of hamate ulnarly and to the scaphoid and trapezium radially, forms the roof of the carpal tunnel **(Wilhelmi, 2013).**

The hand contains 5 metacarpal bones. Each metacarpal is characterized as having a base, a shaft, a neck, and a head. The first metacarpal bone (thumb) is the shortest and most mobile. It articulates proximally with the trapezium. The other 4 metacarpals articulate with the trapezoid, capitate, and hamate at the base. Each metacarpal head articulates distally with the proximal phalanges of each digit **(Wilhelmi, 2013).**

There are 14 phalanges, three in each finger and two in the thumb. Each has a head, shaft and proximal base. The shaft tapers distally, its dorsal surface transversely convex. The palmar surface is transversely flat but gently concave anteriorly in its long axis **(Standring, 2015).**

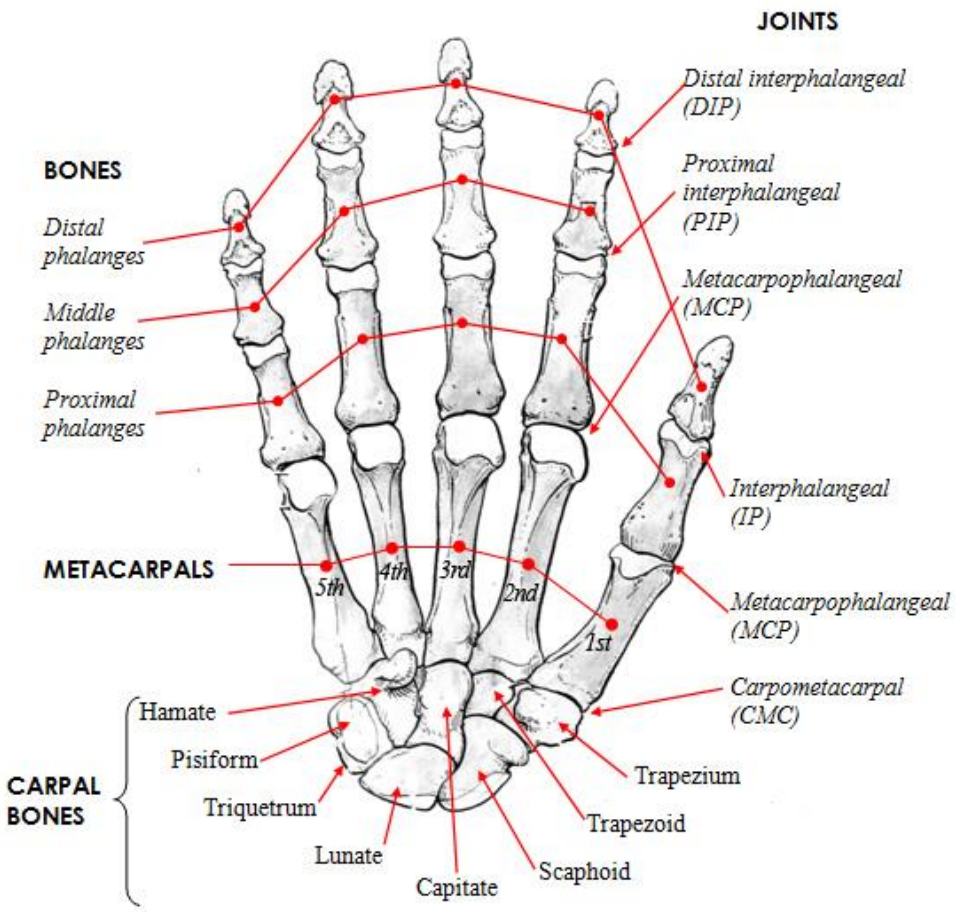

Figure 1.1: Bones and joints of the hand.

Source: www.davidlnelson.md

JOINTS

The anatomy of wrist, thumb and hand is complex because of the presence of many different functional joints: the distal radioulnar joint, the wrist joint (containing the radiocarpal and the intercarpal joints, the carpometacarpal