

ROLE OF MRI IN ASSESSMENT OF ACROMIAL MORPHOLOGY IN ASSOCIATION WITH ROTATOR CUFF TEAR

Thesis

Submitted for partial fulfillment of M.Sc. degree in Radiodiagnosis

By

TAG ELASFYA ELKHAIR ABDELWAHAB ABDALLA

M.B.B.S

Faculty of medicine

University of science and technology

Supervised by

Prof. Dr. SALWA MOHAMMED FATHY

professor of Radiodiagnosis

Faculty of Medicine

Cairo Universality

Dr .MARIAN FAYEK FARED

Lecturer of Radiodiagnosis

Faculty of Medicine

Cairo University

2015

Abstract

This study included 30 patients; 16 males and 14 females, 20-60 years age with mean range of 40. Cases were referred from the orthopaedic and outpatient department to the radiology department in Kasr Al-Aini for MRI shoulder. Patient selection according to recent or chronic shoulder pain and Positive clinical tests. Specifically, patients presenting with non traumatic shoulder pain may benefit from early physical therapy and intervention if findings on MRI suggest impingement. Early intervention may prevent ultimate tears of the rotator cuff and could possibly reduce morbidity with aging .

Keywords: MRI- Acromion shapes- RCT-

ACKNOWLEDGMENT

*Firstly, I thank **ALLAH** for granting me the power to accomplish this work.*

*I would like to express my deep thanks and profound gratitude and sincere to **Prof. SALWA MOHAMED FATHY**, Professor of Radiodiagnosis, Faculty of Medicine, Cairo University, who gave me the chance to continue my post graduate studies and Special thank to **DR. MARIAN FAYK FAREED**, Lecturer of Radiodiagnosis, Faculty of Medicine, Cairo University, for her kind supervision, illuminating discussion and adding valuable suggestions and remarks.*

Finally, special thank to my family and my closed friends for their helpful efforts and encouragement during the research period.

TAG ELASYA ELKHAIR ABDELWAHAB

(2015)



DEDICATION

***I WOULD LIKE TO DEDICATE THIS STUDY TO
MY FAMILY FOR THEIR GREAT HELP;
CONTINUOUS SUPPORT AND
ENCOURAGEMENT WHICH WERE ESSENTIAL
FOR THE COMPLETENESS OF THIS WORK.***

CONTENTS

	Page
▪ Introduction & aim of work	1
▪ Anatomy of the shoulder joint....	4
▪ MRI anatomy of the shoulder joint	25
▪ MRI technique of the shoulder joint.....	34
▪ Rotator cuff function & mechanism of injury	43
▪ Acromion shapes and orientations.....	45
▪ Rotator cuff tear.....	55
▪ Patients and method.....	78
▪ Results.....	81
▪ Case presentation.....	88
▪ Discussions.....	104
▪ summary and conclusions.....	112
▪ References.....	114
▪ Arabic summary...	

LIST OF TABLES

No.	Title	Page
1	Distribution of acrmial types in patients relation to sex	82
2	Distribution of armorial types in patients relation to age group.	82
3	Association of different acromial types with partial thickness rotator cuff tear in the studied patients .	83
4	Association of different acromial types with full thickness rotator cuff tear in the studied patients.	83
5	Tendenopathy associated with different acromial types.	84
6	Osteoarthritis associated with different acromial types.	85
7	Bursitis associated with different acromial types.	85
8	Joint effusion associated with different acromial type.	85
9	Joint dislocation associated with different acromial type.	86
10	OS acromial associated with different acromial types.	86
11	Comparison between different acromial shapes in patients with RCT and acromial measurements including; acromial thickness, AHD, AI and LAA.	87

LIST OF CHARTS

No.	Title	Page
1	Distribution of acromial types in patients with relation to sex.	82
2	Association of different acromial types with rotator cuff tear in the studied patients.	85
3	associated findings with different acromial types.	87

ABBREVIATIONS

AHD	Acromiohumeral distance.
AI	Acromion index
AT	Acromion thickness.
LAA	Lateral acromial angle.
MRI	Magnetic resonance imaging
RCT	Rotator cuff tear
PD	Proton density.

LIST OF FIGURES

Figure NO	Title	Page NO
Figure 1	Osteology of bones forming shoulder joint	Page 6
Figure 2	schematic drawing showing the ligaments and the synovial envelope of the joint capsule	Page 11
Figure 3	schematic drawing showing subacromial bursa,&subscabular bursa	Page 13
Figure 4	T1 sagittal oblique image of the shoulder. Showing Coracoacromial arch	Page 15
Figure 5	graphic image of lateral view of the rotator cuff muscle	Page 19
Figure 6	graphic image of a posterior view of the muscles of the back of the shoulder	Page 20
Figure 7	graphic image of a superior view of the supraspinatus muscle	Page 20
Figure 8	graphic image of a coronal section view of the rotator cuff muscle	Page 21
Figure9	graphic image of a lateral section through the shoulder showing the glenohumeral ligaments	Page22
Figure10	Projectional images of rotator cuff muscles and tendons as seen in an anterior,ateral and posterior view of the shoulder.	Page 23
Figure 11	axial MR anatomy superior images	Page 27
Figure12	coronal oblique conventional MRI anatomy	Page 30
Figure 13	sagittal conventional MRI anatomy (mid-sagittal ,lateral and medial images	Page 33
Figure14	MRI T2 WIS axial planner image showing planning of oblique coronal images	Page 35
Figure15	MRI T2 WIS axial planner image showing planning of oblique sagittal images	Page 35
Figure16	Mathematical determination of acromial morphology sagittal MRI	Page 41
Figure17	Methods of measuring acromio-humeral distance , acromial index and the lateral acromial angle	Page 42
Figure18	T1 coronal oblique mri image of the shoulder showing Normal acromiohumeral interval.	Page 45
Figure19	T1 coronal oblique mri image of the shoulder showing Subacromial/subdeltoid bursal fat low-lying acromion	Page 46
Figure20	Coronal oblique T1-weighted mri image shows low lying acromion	Page 48
Figure 21	T1 sagittal oblique mri image of the shoulder showing anterior-sloping acromion	Page 50
Figure 22	T1 coronal oblique mri image of the shoulder showing acromial slope: inferolateral tilt.	Page 50
Figure 23	SE T2 oblique coronal images showing the relationship of the acromion to the distal clavicle in three different shoulders.	Page 51
Figure 24	Sagittal mri showing types of acromial shape.	Page 52

Figure 25	T2* axial image of the shoulder showing a cut through the level of the acromioclavicular joint shows a separate os acromiale	Page 54
Figure 26	Coronal graphic shows a partial undersurface tear of the articular surface of the supraspinatus tendon.	Page 55
Figure 27	<i>graphic shows a bursal surface partial tear with reactive bursal changes</i>	Page 56
Figure 28	Coronal graphic shows an interstitial delaminating partial tear	Page 57
Figure 29	Coronal graphic shows a full thickness tear through the mid substance of the supraspinatus tendon	Page 58
Figure 30	full-thickness supraspinatus tendon tears. Coronal oblique (a) and sagittal (b) fat-saturated T2-weighted MR images	Page 59
Figure 31	Coronal oblique fat-saturated T1-weighted MR image shows an articular-surface partial-thickness tear	Page 61
Figure 32	T2-weighted MR image shows thinning of the supraspinatus tendon	Page 62
Figure 33	Drawings illustrate a U-shaped tear before (a) and after (b) repair, a crescentic tear before (c) and after (d) repair, and an L-shaped tear before (e) and after (f) repair	Page 64
Figure 34	Tendon tears. Axial fat-saturated T2-weighted MR image shows a tear of the distal supraspinatus tendon	Page 65
Figure 35	Coronal oblique and axial (fat-saturated T2-weighted MR images show medial retraction	Page 67
Figure 36	axial fat-saturated T2-weighted MR image, intact infraspinatus muscle and tendon fibers	Page 67
Figure 37	Sagittal extent of rotator cuff tears as. Chart superimposed on a sagittal fat-saturated T2-weighted MR image shows the division of the rotator cuff into four segments.	Page 68
Figure 38	(a) Coronal oblique fat-saturated T2-weighted MR image shows an anterior tear (arrow) of the supraspinatus tendon (SST). (b) Coronal oblique fat-saturated T2-weighted MR image shows that the tear involves the ligamentous pulley of the long head of the biceps brachii tendon.	Page 70
Figure 39	Axial fat-saturated T2-weighted MR image shows anterior subluxation of the humeral head.	Page 72
Figure 40-42	(40) Drawing illustrates use of the sagittal plane relative to the coracoid base and acromial spine for estimating volume loss in the supraspinatus muscle. (41) Sagittal fat-saturated T2-weighted MR image shows a representing the ratio between the cross-sectional area of the belly of the supraspinatus muscle and that of the scapular fossa (42). Sagittal fat-saturated T2-weighted MR image shows volume loss in the supraspinatus muscle	Page 72
Figure 43	Tangent sign. (a) Sagittal fat-saturated T2-weighted MR image shows the belly (green) of a normal supraspinatus muscle	Page 75
Figure 44	Coronal oblique fat-saturated T2-weighted MR image shows a Muscle fatty degeneration and volume loss in a rotator cuff muscle	Page 77

Figure 45	Conventional MRI coronal and sagittal oblique (T1WI,T2WI,STAIR images) showing type IV acromion .& partial tear of supraspinatous tendon .	Page 89
Figure 46	Conventional MRI coronal oblique (T1WI,T2WI,STAIR images)showing; type III acromion &The supraspinatous tendon showing partial tear at inferior surface near its insertion.	Page 91
Figure 47	Conventional MRI coronal oblique (PDWI,T2WI,STAIR images)showing; showing type III acromion with subsequent intrasubstance supraspinatus partial thickness tear	Page 93
Figure 48	Conventional MRI coronal& sagittal oblique (T1WI,T2WI,STAIR images)showing; type I acromion is seen encroaching upon the subacromial fat planes.with subsequent supraspinatus partial thickness tear at (articular surface)	Page 95
Figure 49	Conventional MRI coronal& sagittal oblique (PDWI,T2WI,STAIR images)showing type III acromion.& supraspinatus full thickness	Page 97
Figure 50	Conventional MRI coronal& sagittal oblique (T1WI,T2WI,STAIR images)showing type I acromion with full thickness supraspinatous	Page 99
Figure 51	Conventional MRI coronal& sagittal oblique (T1WI,T2WI,STAIR images)showing; with anterior hooking configuration type III acromion. Subsequent with full thickness supraspinatous .	Page 101
Figure 52	Conventional MRI coronal& sagittal oblique (T1WI,T2WI,STAIR images)showing; anterior hooking configuration type III acromion. Subsequent encroachment upon the subacromial tunnel and supraspinatous tendon that is seen thickened with abnormal signal within yet with no evidence of disruption of its fibers.	Page 103

INTRODUCTION

The acromion is a posterior shoulder landmark, formed as a posterolateral extension of the scapular spine, superior to the glenoid. It articulates with the clavicle and is the origin of the deltoid and trapezius muscles. Variation in the shape of the acromion can endorse variety of pathologies such as impingement syndrome and rotator cuff tear (RCT). (*Mansur et al., 2013*).

Rotator cuff disorder is one of the most common disorders of the shoulder. It is a common cause of chronic shoulder pain in adults. The specific etiology of a RCT has not been fully elucidated, but it has been considered to result from a combination of intrinsic and extrinsic factors. Intrinsic factors include degenerative changes, hypovascularity, and microstructural collagen fiber abnormalities. Recognized extrinsic factors include subacromial impingement, tensile overload and repetitive use. (*Oh et al., 2010*). .

The pathogenesis of RCT seems to be related to the morphology of the acromion which is usually assessed through the five commonly used parameters on standard plain radiographs including the acromial type, acromial slope, acromial tilt, lateral acromial angle and acromial index. (*Balke et al., 2013*).

However, with only a plain radiograph of the acromion in the supraspinatus outlet view, it is notoriously difficult to image the acromion and distinguish the hooked from the non-hooked acromion with anterior spurs. (*Nho et al., 2008*)

The magnetic resonance imaging (MRI) makes it possible to depict the shape of acromion in its longitudinal axis with better evaluation of the acromial morphological factors including the acromial shape, acromial thickness, acromio-humeral distance, and lateral acromial angle and acromial index. These factors are suggested to influence the status of the rotator cuff. (*Hirano et al., 2002*).

The acromial shape can be classified into four types: type I (flat), type II (curved), type III (hooked) (*Balk et al .,2013*) and type IV(convex) (*morag et al .,2006*).

AIM OF WORK

This study aimed to evaluate morphological characteristics of different acromial shapes in association with rotator cuff tears.

ANATOMY OF THE SHOULDER JOINT

The shoulder joint is a ball-and-socket synovial joint in which an elegant freedom of movement is allowed at some expense to its strength and stability.

The bones entering in its formation are the hemispherical head of the humerus (ball) linking to the shallow glenoid cavity of the scapula (socket). Some protection of the joint against displacement is afforded by its ligaments and by the tendons and muscles that surround it. The ligamentous protection supplied by the muscles and tendons effectively limits the degree of movement allowed by the joint. Additional protection superiorly supplied by the arch formed by the coracoid process, acromion, and coracoacromial ligament (*Prescher, 2000*).

The clavicle connects the axial and appendicular skeletons of the upper extremity. Its sternal end is expanded and fits into the notch on the manubrium at the sternoclavicular joint. The lateral one-third is flat, and its sternal (lateral) end is expanded as it curves back to meet the scapula at the acromioclavicular joint. (*Goldstein, 2004*)

The scapula consists of the scapular body, the scapular spine, the scapular neck, the acromion, the glenoid fossa, and the coracoid process. It has costal (anterior) and posterior surfaces with its anterior surface in contact with the thoracic cage (the scapulo-thoracic interface). From the upper part of the posterior surface, the spine of the scapula projects laterally, terminating into the acromion, which forms the lateral most tip of the shoulder. (*Goldstein, 2004*).

The lateral angle of the scapula is thick and strong, with an expanded large, shallow glenoid fossa, facing slightly forward and upwards, ready to receive the head of the humerus. Just medial to the glenoid fossa is the coracoid process as it projects upwards from the neck of the scapula. The coracoid process serves as an attachment site for several important ligaments and muscles (*Goldstein, 2004*).

The proximal humerus consists of the head, anatomic neck, and the greater and lesser tuberosities. The intertubercular or bicipital groove is located between the greater and lesser tuberosities along the anterior surface of the humerus (*Stoller, et al, 1997*).

The head of the humerus is approximately one third of a sphere and it is about four times larger than the socket on the scapula. In anatomic position, it faces superiorly, medially, and posteriorly with the lesser tuberosity in front and the greater tuberosity pointing laterally (*Goldstein, 2004*) (*figure 1, a-c*).