



بسم الله الرحمن الرحيم

∞∞∞∞

تم رفع هذه الرسالة بواسطة / حسام الدين محمد مغربي

بقسم التوثيق الإلكتروني بمركز الشبكات وتكنولوجيا المعلومات دون أدنى

مسئولية عن محتوى هذه الرسالة.

ملاحظات : لا يوجد





# **The Role of MRI in assessment of acromial morphology in association with rotator cuff tear**

*Thesis*

*Submitted for Partial Fulfillment of the Master Degree  
in Radiodiagnosis*

*By*

**Aya Khalil Gawish**

*M.B.B.Ch Faculty of Medicine Cairo University*

*Under supervision of*

**Prof. Dr. Mohamed Amin Nassef**

*Professor of Radiodiagnosis*

*Faculty of Medicine, Ain Shams University*

**Dr. Nermeen Nasry Keriakos**

*Assistant Professor of Radiodiagnosis*

*Faculty of Medicine, Ain Shams University*

*Faculty of Medicine  
Ain Shams University*

*2022*

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

# قَالَ

سَبَّحَانَكَ لَا إِلَهَ إِلَّا مَا عَلَّمْتَنَا إِنَّكَ أَنْتَ  
الْعَلِيمُ الْعَظِيمُ

صدق الله العظيم

سورة البقرة الآية: ٣٢

# Acknowledgment

*First and foremost, I feel always indebted to **ALLAH**,  
the Most Kind and Most Merciful.*

*I'd like to express my respectful thanks and profound  
gratitude to **Prof. Dr. Mohamed Amin Nassef**,  
Professor of Radiodiagnosis, Faculty of Medicine, Ain Shams  
University for his keen guidance, kind supervision, valuable  
advice and continuous encouragement, which made possible the  
completion of this work.*

*I am also delighted to express my deepest gratitude and  
thanks to **Dr. Herveen Masry Keriakos**, Assistant  
Professor of Radiodiagnosis, Faculty of Medicine, Ain Shams  
University, for her kind care, continuous supervision, valuable  
instructions, constant help and great assistance throughout this  
work.*

*Aya Khalil*

# *List of Contents*

Title	Page No.
List of Abbreviations.....	i
List of Tables .....	ii
List of Figures .....	iv
Introduction .....	1
Aim of the Work.....	3
Review of Literature	
Anatomy.....	4
MRI Technique.....	30
Pathology.....	36
Patients and Methods.....	54
Results .....	59
Case Presentation .....	81
Discussion .....	102
Summary and Conclusion.....	110
References .....	113
Arabic Summary .....	—

# *List of Abbreviations*

Abb.	Full term
Ac.....	Acromion
AHD.....	Acromio-humeral distance
Cl .....	Clavicle
Co.....	Coracoid process
FSE.....	Fast spin-echo
GHL.....	Glenohumeral ligament
GRE .....	Gradient echo
IGHL.....	Inferior glenohumeral ligament
IS .....	Infraspinatus
LAA.....	Lateral acromial angle
MGHL.....	Middle glenohumeral ligament
MRI.....	Magnetic resonance imaging
OA.....	Os Acromiale
PASTA.....	Partial-thickness articular-surface tendon avulsion
RCT.....	Rotator cuff tear
SS.....	Supraspinatus
SSc .....	Subscapularis
SST .....	Supraspinatus tendon
T1W .....	T1-weighted
T2W .....	T2-weighted
T2WI.....	T2-weighted imaging
TM .....	Teres minor

# *List of Tables*

Table No.	Title	Page No.
<b>Table (1):</b>	Age distribution of the patients participating in the study.....	59
<b>Table (2):</b>	Gender distribution of the patients participating in the study. ....	59
<b>Table (3):</b>	Distribution of different acromion types found in this study.....	60
<b>Table (4):</b>	Types of injury and different associations found in this study.....	62
<b>Table (5):</b>	Distribution of age groups in correlation with different acromion types. ....	63
<b>Table (6):</b>	Distribution of different acromion types in correlation with gender.....	65
<b>Table (7):</b>	Full thickness tear among different acromion types.....	66
<b>Table (8):</b>	Partial thickness tear in association with acromion types.....	67
<b>Table (9):</b>	Tendinopathy in association with different acromion types.....	68
<b>Table (10):</b>	Distribution of low lying acromion among different acromion types.....	69
<b>Table (11):</b>	Joint effusion in association with different acromion types.....	70
<b>Table (12):</b>	Bursitis in association with different acromion types.....	71
<b>Table (13):</b>	Osteoarthritis in association with different acromion types.....	72
<b>Table (14):</b>	Os acromial in association with different acromion types.....	73

## *List of Tables Cont...*

Table No.	Title	Page No.
<b>Table (15):</b>	Acromion parameters among different acromion types in patient and control groups. ....	74
<b>Table (16):</b>	Different acromial parameters compared in type I acromion in both patients and control groups. ....	77
<b>Table (17):</b>	Different acromial parameters compared in type II acromion in both patients and control groups. ....	78
<b>Table (18):</b>	Different acromial parameters compared in type III acromion in both patients and control groups. ....	79
<b>Table (19):</b>	Different acromial parameters compared in type IV acromion in both patients and control groups. ....	80



# *List of Figures*

Fig. No.	Title	Page No.
<b>Figure (1):</b>	Osteology of bones forming shoulder joint .....	6
<b>Figure (2):</b>	T1 fat suppressed axial image (MR arthrogram) glenoid labra .....	8
<b>Figure (3):</b>	Schematic illustration of the anterior ligaments of the shoulder .....	10
<b>Figure (4):</b>	Diagram of the coracoacromial arch in the sagittal plane .....	11
<b>Figure (5):</b>	T1 sagittal oblique image of the shoulder .....	14
<b>Figure (6):</b>	Low-lying acromion .....	16
<b>Figure (7):</b>	FSE T2 oblique coronal images showing the relationship of the acromion to the distal clavicle in three different shoulders .....	17
<b>Figure (8):</b>	Types of acromial shape .....	18
<b>Figure (9):</b>	T1 axial image (MR arthrogram) OS acromial .....	19
<b>Figure (10):</b>	Axial MR anatomy superior images .....	22
<b>Figure (11):</b>	Coronal oblique conventional MRI anatomy .....	25
<b>Figure (12):</b>	Coracohumeral ligament and rotator interval.....	27
<b>Figure (13):</b>	Sagittal conventional MRI anatomy .....	29
<b>Figure (14):</b>	Shoulder imaging technique .....	32
<b>Figure (15):</b>	Mathematical determination of the acromial morphology.....	33
<b>Figure (16):</b>	Type I acromial shape with focal full thickness RCT .....	35
<b>Figure (17):</b>	Coronal graphic shows a partial undersurface tear of the articular surface of the supraspinatus tendon involving the critical zone .....	39

## *List of Figures Cont...*

Fig. No.	Title	Page No.
<b>Figure (18):</b>	Coronal graphic shows a bursal surface partial tear with reactive bursal changes .....	39
<b>Figure (19):</b>	Coronal graphic shows an interstitial delaminating partial tear .....	40
<b>Figure (20):</b>	Rim-rent or partial-thickness articular-surface tendon avulsion (PASTA) tear .....	40
<b>Figure (21):</b>	Coronal graphic shows a full thickness tear through the mid substance of the supraspinatus tendon .....	41
<b>Figure (22):</b>	Focal full-thickness supraspinatus tendon tears .....	42
<b>Figure (23):</b>	Partial supraspinatus tear .....	43
<b>Figure (24):</b>	Tendon tears before and after repair .....	45
<b>Figure (25):</b>	Tendon tears .....	46
<b>Figure (26):</b>	Full thickness care with retraction .....	47
<b>Figure (27):</b>	Sagittal extent of rotator cuff tears as described .....	48
<b>Figure (28):</b>	Involvement of the rotator interval. ....	49
<b>Figure (29):</b>	Tangent sign .....	51
<b>Figure (30):</b>	Sagittal oblique T1-weighted (T1W) image demonstrates normal rotator cuff musculature .....	53
<b>Figure (31):</b>	Age distribution of participants. ....	60
<b>Figure (32):</b>	Distribution of different acromion types in this study. ....	61
<b>Figure (33):</b>	Mean age for each type of acromion. ....	64

## *List of Figures Cont...*

Fig. No.	Title	Page No.
<b>Figure (34):</b>	Age groups in correlation with acromion types.....	64
<b>Figure (35):</b>	Distribution of acromion types amongst different genders.....	65
<b>Figure (36):</b>	Full thickness tear in correlation with different acromion shapes. ....	66
<b>Figure (37):</b>	Distribution of partial thickness tear injury with acromion types.....	67
<b>Figure (38):</b>	Tendinopathy in correlation with different acromion types. ....	68
<b>Figure (39):</b>	Low lying acromion in association with different acromion types. ....	69
<b>Figure (40):</b>	Joint effusion in association with different acromion types ....	70
<b>Figure (41):</b>	Bursitis in association with different acromion types. ....	71
<b>Figure (42):</b>	Osteoarthritis in association with different acromion types. ....	72
<b>Figure (43):</b>	Acromial thickness in patients and control groups.....	74
<b>Figure (44):</b>	AHD in patients and control groups. ....	75
<b>Figure (45):</b>	AI in patients and control groups.. ....	75
<b>Figure (46):</b>	LAA in patients and control group. ....	76
<b>Figure (47):</b>	Case (1).....	82
<b>Figure (48):</b>	Case (2).....	84
<b>Figure (49):</b>	Case (3).....	86
<b>Figure (50):</b>	Case (4).....	88
<b>Figure (51):</b>	Case (5).....	90
<b>Figure (52):</b>	Case (6).....	93
<b>Figure (53):</b>	Case (7).....	95

## *List of Figures Cont...*

Fig. No.	Title	Page No.
<b>Figure (54):</b>	Case (8).....	97
<b>Figure (55):</b>	Case (9).....	99
<b>Figure (56):</b>	Case (10) .....	101

## ABSTRACT

**Background:** The pathogenesis of rotator cuff tear (RCT) remains controversial. The acromion portion of the scapula and its morphology may be attributable for a variety of shoulder disorders such as RCT.

**Aim of the work:** The purpose of this article is to throw light on the role of MRI in the assessment of morphological characteristics of different acromial shapes in association with RCTs.

**Patients and Methods:** This study was carried out at Ain Shams Teaching Hospital Radiodiagnosis Department. We used MRI prospectively to image the shoulders of patients who presented to the radiology department with suspected RCT. Their ages ranged between 24 and 73 years with a mean age 48 years. Data were tabulated and manipulated using SPSS (vi 16), and the level of significance was less than 0.05.

**Results:** Significant correlation between partial thickness tear and type I acromion was found (p value 0.02). Type-III acromion was the most commonly encountered acromial shape in patients with full thickness tear, yet no significant correlation was found ( $P > 0.05$ ). The acromial thickness, AHD, AI and LAA were significantly different in patients with RCT compared to control group ( $P < 0.001$ ).

**Conclusion:** Thicker acromion, shorter AHD, smaller LAA and larger AI are associated with rotator cuff tear. The types of acromion showed no significant correlation with full thickness tear.

**Keywords:** Magnetic resonance imaging, acromial morphology, rotator cuff tear.

# 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 (*Hassan et al., 2018*).

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*).

X-rays are useful to assess lateral extension of the acromion on the anteroposterior view whereas lateral view allows to analyze the anterior coverage. Ultrasound is the only dynamic technique but MRI is the best tool to depict rotator cuff disease (*Pesquer et al., 2018*).

MRI of the shoulder provides detailed images of structures within the shoulder joint, including bones, tendons, muscles, and vessels. MRI is a noninvasive medical test that helps diagnose and treat medical conditions. MRI uses a powerful magnetic field, radio-frequency pulses, and a computer to produce detailed pictures of organs, soft tissues, bone, and virtually all other internal body structures (*Hassan et al., 2018*).

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