

Original Research Paper

ROLE OF MAGNETIC RESONANCE IMAGING IN EVALUATION OF
INTERNAL DERANGEMENT OF SHOULDER JOINT IN INDIAN
POPULATION

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ABSTRACT

Background: The shoulder complex comprises three joints namely the sternoclavicular, acromioclavicular, and glenohumeral joints. Internal derangement of shoulder is evaluated with radiography, CT, MRI, arthrography and arthroscopy. MRI and MR arthrography are the imaging modality of choice due to excellent contrast resolution and multiple imaging planes provide the most detailed evaluation and diagnosis of abnormalities of the rotator cuff especially partial versus intact or full-thickness tears, the biceps tendon and also useful in the assessment of instability of shoulder joint. **Aim & Objective:** 1. To study the MRI characteristics of various non-neoplastic pathologies of shoulder joint. 2. To assess the role of MRI in evaluation of patients with painful shoulder, predominantly rotator cuff, impingement and labral pathologies. 3. To study the relationship between the clinical presentation and MRI findings. **Methods: Study design:** A Cross sectional study. **Study setting:** Department of Radiodiagnosis BJGMC & Sassoon General Hospital, Pune. **Study duration:** conducted from Dec 2018 to May 2019. **Study population:** All Patients referred to the department of Radiodiagnosis BJGMC & Sassoon General Hospital, Pune for MRI shoulder with shoulder pain or clinically suspected with internal derangement of shoulder joint were enrolled. **Sample size: 50 Results:** The male to female ratio is 2.1:1. Majority of the patients, 22 (44%) were in the age group of 21 to 40 years, followed by 18 in the age group of 41 to 60 years (36%). There were 8 patients (16%) in the age group of 61 to 80 years and 2 were less than 20 years of age (4%). The most common clinical presentation was pain in shoulder, seen in 43 patients (86%) followed by restricted movements in 34 patients (68%). Joint instability, trauma and joint stiffness was seen in 19 (38%), 22 (44%), 9 (18%) patients respectively. Also 7(14%) patients gave history of recurrent dislocations. rotator cuff pathologies were seen in 41 out of 50 cases (82%). The commonest rotator cuff pathology was found to be partial tear of the supraspinatus tendon seen in 19(38%) patients. Impingement syndrome was seen in 5(10%) patients. Significant association was seen between the rotator cuff pathologies and age ($p = 0.028$). Most common clinical presentation in patients with rotator cuff pathologies was pain, seen in total 37 out of 41 patients (90.24%) followed by restricted movements in 30 out of 41 patients (73.17%), trauma in 18 patients (43.90%) and joint instability in 14 patients (34.15%). Stiffness was seen in 7 cases (17.07%) and H/o Recurrent Dislocations was observed in 5 cases (12.20%). **Conclusions:** Magnetic resonance imaging of the shoulder is an excellent non invasive investigation for evaluation of shoulder pain and suspected cases with internal derangement due to multiplanar imaging and excellent delineation of the soft tissue structures.

Keywords: Shoulder joint, rotator cuff pathology, Internal derangement of shoulder, MRI and MR arthrography.

INTRODUCTION:

Shoulder joint is an elegant anatomic structure formed by the humerus, clavicle and the scapula. The shoulder complex comprises three joints namely the sternoclavicular, acromioclavicular, and glenohumeral joints. The sternoclavicular joint and the acromioclavicular joint link the two bones of the pectoral girdle to each other and to the trunk. The combined movements at these two joints enable the scapula to be positioned over the thoracic wall with a wide range of movement of the upper limb.¹ The shoulder joint is an incongruous ball and socket joint without any fixed axis of rotation and has a wide range of motion in multiple planes; hence stability is compromised for mobility. To compensate for the unstable bony anatomy the shoulder is protected anteriorly, posteriorly and superiorly by a capsule and the tendons that form the rotator cuff. Internal derangement is an internal disturbance in the normal resting position of the joint that results in pain and movement restriction.² It can occur in acute, sub-acute, or chronic conditions resulting in pain, instability or abnormal movements of the shoulder. Internal derangement of the shoulder is a blanket term used to cover a group of disorders involving destruction of the normal functioning mechanism of the complex assembly of muscles, tendons, ligaments, cartilage and bones comprising the shoulder joint. Most of the shoulder derangements fall into three major categories: soft tissue disorders which includes tendon tears and labroligamentous lesions, articular injury or instability, and arthritis. The incidence of shoulder pathologies increases with age due to progressive tendon tissue degeneration and weakening, although repeated microtrauma or overuse from professional or athletic activity can also cause shoulder problems in all age groups. Internal derangement of shoulder is evaluated with radiography, CT, MRI, arthrography and arthroscopy. Radiography is considered to form the basis of all imaging for evaluation of bony structures. However more advanced imaging methods are required for evaluating soft tissue structures. Ultrasonography is useful for initial screening in abnormalities of the rotator cuff and the biceps tendon. It is a cost-effective technique, yet it is highly user dependent and, therefore, has not yet gained widespread acceptance.³ Conventional radiography and CT give valuable information regarding the bones forming the joints like degenerative changes in the bones and joints, osteophytosis, spur formation. CT scan is also useful in the evaluation of fractures, especially complex fractures. CT arthrography is indicated in conditions resulting in instability of the glenohumeral joint.⁴ MRI and MR arthrography are the

imaging modality of choice due to excellent contrast resolution and multiple imaging planes provide the most detailed evaluation and diagnosis of abnormalities of the rotator cuff especially partial versus intact or full-thickness tears, the biceps tendon and also useful in the assessment of instability of shoulder joint.⁴ MRI plays an important role as a triage tool in evaluation of rotator cuff pathologies due to its ability to non-invasively display high resolution anatomy images with excellent soft tissue contrast. Many radiological-arthroscopy correlation studies have shown that MRI plays an important role as a non-invasive test to determine if a patient requires surgical intervention or may be managed conservatively. Hence, MRI is demonstrated as a cost effective tool by reducing unnecessary surgical and arthroscopic interventions.⁵⁻⁷ MRI provides multiplanar imaging in different anatomic planes without contrast and absence of radiation hazards and provides excellent soft tissue contrast. Some structures, such as the contour of humeral head, rotator cuff, and glenoid shape, are very well appreciated and evaluated.⁸ The strength of MRI lies in its ability to assess sonographically inaccessible areas such as labrum, deep parts of various ligaments, capsule, and areas obscured by bone.⁹ MRI in addition to detailed information regarding cuff pathologies, also provides information about adjacent structures such as, muscle atrophy, size of muscle cross-sectional area, and fatty degeneration which have significance for the physiologic and mechanical status of the rotator cuff.¹⁰ Thus, MRI accurately depicts associated muscle abnormalities thereby helping in recognizing surgically amenable pathologies. MRI also provides excellent information in assessment of non-rotator cuff abnormalities such as shoulder instability, synovial joint diseases and labroligamentous pathologies. Because of these numerous advantages MRI has become the modality of choice for imaging of shoulder pathology. Shoulder pain is a common symptom frequently consulted for in primary care and has a prevalence rate ranging from 6.7 to 46.7% per year in the general population.^{11,12} It leads to disability and prevents the patient's normal activity including the ability to work, posing as a substantial socioeconomic burden. The etiology of shoulder pain is diverse and many disorders present with similar symptoms and signs.¹³⁻¹⁵

AIM AND OBJECTIVE

OBJECTIVES:

To study the MRI characteristics of various non-neoplastic pathologies of shoulder joint. To assess the role of MRI in evaluation of patients with painful shoulder, predominantly rotator cuff, impingement and

labral pathologies. To study the relationship between the clinical presentation and MRI findings.

MATERIAL AND METHODS

Study design: A Cross sectional study.

Study setting: Department of Radiodiagnosis BJGMC & Sassoon General Hospital, Pune.

Study duration: Conducted from Dec 2018 to May 2019

Study population: All Patients referred to the department of Radiodiagnosis BJGMC & Sassoon General Hospital, Pune for MRI shoulder with shoulder pain or clinically suspected with internal derangement of shoulder joint were enrolled.

Sample size: 50

Inclusion criteria: All patients of different age groups presenting with history of painful shoulder and clinically suspected with internal derangement of shoulder joint, referred for magnetic resonance imaging of the shoulder.

Exclusion criteria:

All patients with infections and neoplasms of shoulder joint or previous surgery of shoulder joint. Patients with ferromagnetic implants, cardiac pacemakers, cochlear implants and aneurysm clips. Patients with claustrophobia.

Ethical Clearance: The study protocol was approved by the Institutional Ethics Committee before the commencement of the study.

Informed Consent: Patients fulfilling the selection criteria were informed about the nature and purpose of the study and were enrolled after obtaining a written

informed consent.. The consent was recorded in patient's own language.

Data Collection: After fulfilling the inclusion and exclusion criteria for this study, complete history of patients was taken and demographic characteristics were noted.

Positioning and coil selection:

The patient was placed in supine position with the shoulder in close relation to the shoulder coil with the shoulder and arm placed alongside and parallel to the body, positioned in neutral to mild external rotation and stabilized using small sandbag to reduce motion artifacts. The patients were briefed about the procedure, about the noise of the gradient coils and the need to control the body movements for successful image acquisition.

Imaging protocol:

All patients underwent MRI of the shoulder joint using a dedicated shoulder coil on a 1.5 Tesla GE Signa HDxt MRI machine. After obtaining localizer in all three orthogonal planes, following sequences are obtained with slice thickness: 3- to 4-mm, imaging matrix : 256 to 512 (frequency) ×256 (phase), field of view (FOV) : 12- to 14 cm :

PDFATSAT Coronal, Sagittal and Axial;

- Axial T2 FSE
- Sagittal T2 FSE
- Coronal T1
- Sagittal T1
- Coronal STIR
- 3D FGRE Axial



Figure 1: 1.5 Tesla GE Signa HDxt MRI machine

RESULTS AND OBSERVATIONS

The present study was conducted at the department of radiodiagnosis BJGMC & Sassoon General Hospital, Pune. A total of 50 patients referred for MRI scan were enrolled after qualifying the selection criteria.

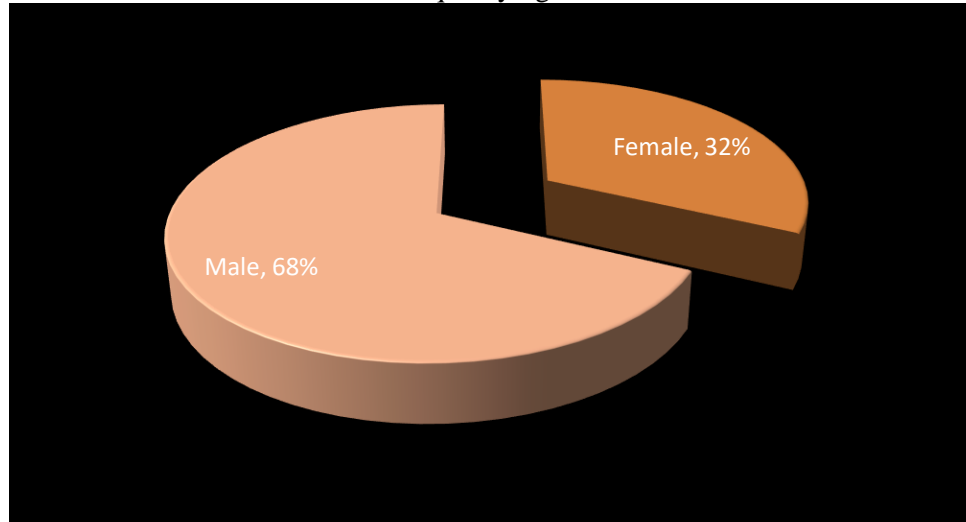


Figure no: 1 Sex distribution of the study population

Of the 50 patients studied, 34(68%) were males and 16(34%) were females. The male to female ratio is 2.1:1.

Table no.1: Distribution of study subjects according to age

Age in years	Frequency	Percentage
< 20	2	4
21 to 40	22	44
41 to 60	18	36
61 to 80	8	16
Total	50	100

Mean age = 44.08 Standard deviation =16.53

The mean age of the study participants was 44.08 ± 16.53 years. Majority of the patients, 22 (44%) were in the age group of 21 to 40 years, followed by 18 in the age group of 41 to 60 years (36%). There were 8 patients (16%) in the age group of 61 to 80 years and 2 were less than 20 years of age (4%).

Table no: 2 Distribution of patients according to the clinical presentation

Clinical Presentation	Frequency	Percentage
Pain	43	86
Restricted Movements	34	68
Trauma	22	44
Joint Instability	19	38
Stiffness	9	18
H/o Recurrent Dislocations	7	14

The most common clinical presentation was pain in shoulder, seen in 43 patients (86%) followed by restricted movements in 34 patients (68%). Joint instability, trauma and joint stiffness was seen in 19 (38%), 22 (44%), 9 (18%) patients respectively. Also 7(14%) patients gave history of recurrent dislocations.

Table no:3 Distribution of patients according to MRI diagnosis-Rotator cuff pathologies

Site	Findings	Number	Percentage
Supraspinatus	Tendinosis	13	26.0
	Partial Intra substance tear	1	2.0
	Partial Tear Bursal surface	6	12.0
	Partial tear Articular surface	12	24.0
	Full Thickness tear	6	12.0
	Complete Tear	1	2.0
	Normal	11	22.0
Subscapularis	Tendinosis	12	24.0
	Partial Tear	9	18.0
	Full Thickness tear	1	2.0
	Normal	28	56.0
Infraspinatus	Tendinosis	4	8.0
	Partial tear	3	6.0
	Complete Tear	1	2.0
	Normal	42	84.0
Teres Minor	Normal	50	100.0%
Impingement syndrome		5	10.0

In this study, rotator cuff pathologies were seen in 41 out of 50 cases (82%). The pathologies of the rotator cuff tendons comprised of tendinosis and tendon tears – partial, full thickness, complete tears and impingement syndrome. The commonest rotator cuff pathology was found to be partial tear of the supraspinatus tendon seen in 19(38%) patients. Impingement syndrome was seen in 5(10%) patients.

Table no: 4 Distribution of patients according to MRI diagnosis- Non Rotator Cuff Pathologies

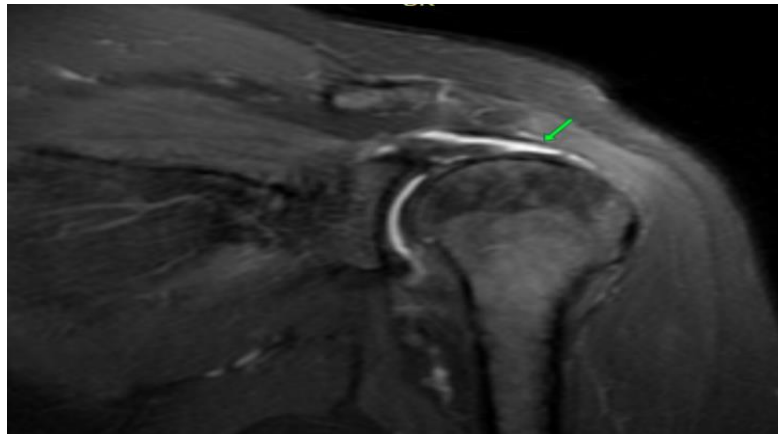
Site	Finding	No	%
Biceps	Tear	1	2.0
	Tendinosis	4	8.0
	Dislocation	2	4.0
	Acromioclavicular	17	34.0
Arthritis	Glenohumeral	3	6.0
	Clavicle	1	2.0
Fractures	HH, GT	1	2.0
	GT	5	10.0
Dislocation/subluxation	Glenohumeral	3	6.0
AC Joint Injury		1	2.0
Hill Sachs		9	18.0
	SLAP tear	3	6.0
	Bony Bankart	2	4.0
Labrum	Soft tissue Bankart lesion	7	14.0
	Tear	6	62.0
Adhesive capsulitis		5	10.0
Denervation muscle atrophy		2	4.0

Among the non rotator cuff pathologies, acromioclavicular joint arthritis was found to be the commonest finding, seen in 17(34%) patients, followed by Hill Sachs lesions seen in 9(18%) cases.

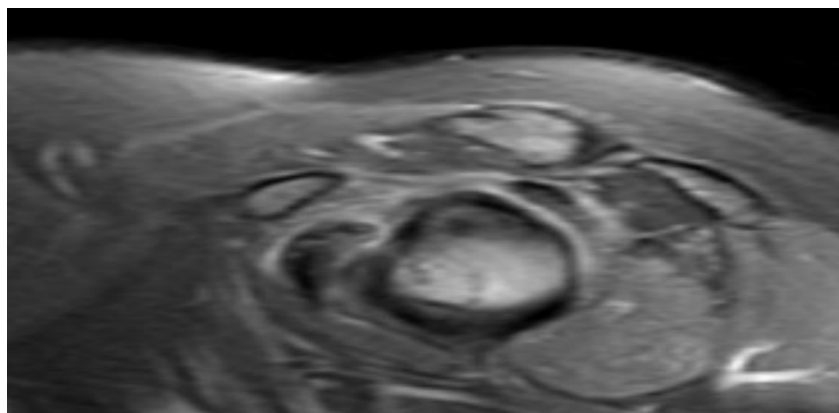
Table no: 5 Rotator cuff pathologies and Age group

		Rotator cuff		Total
		Normal	Abnormal	
Age group	< 50 years	8	20	28
	> 50 years	1	21	22
Total		9	41	50
X² = 4.82, p = 0.028, Significant				

Significant association was seen between the rotator cuff pathologies and age (p = 0.028). Normal rotator cuff was seen in 8 patients of age less than 50 years as compared to only 1 in patients more than 50 years. Also among patients more than 50 years, more number of patients (21 out of 22 – 95.4%) had an abnormal rotator cuff as compared to 20 out of 28(71.4%) in less than 50 years age group.



1A Coronal and 1B Sagittal PDFS images showing full thickness tear of supraspinatus tendon.



1D Sagittal PDFS image showing abnormal hyperintensity in rotator interval.

DISCUSSION

Shoulder pain is a common complaint affecting all age groups. Causes of internal derangement of shoulder joint range from traumatic, inflammatory and degenerative and in turn responsible for shoulder pain and instability. MRI is a non invasive and commonly used modality of imaging shoulder joint for diagnosing internal derangement and majority of shoulder pathologies involving the tendons, muscles, ligaments, labrum, capsule and osseous structures. MRI is the modality of choice as it provides multiplanar planes and no radiation hazards. This study included a total of 50 patients with shoulder pain or clinically suspected with internal derangement of shoulder joint referred for MRI shoulder. Imaging was done using a dedicated shoulder coil on a GE Healthcare 1.5 Tesla MRI scanner at the Department of Radiodiagnosis, BJGMC and Sassoon Hospital, Pune.

Age wise distribution of study population

In the current study the age of the patients ranged from 13 to 76 years with the mean of 44.08 ± 16.53 years. The commonest age group was between 21 to 40 years which comprised 44% of the patients. The mean age and age distribution pattern observed in the present study was comparable to the study of Chaudhary H. et al¹⁶ in India and Arafat MR. et al. from Jordan.¹⁷

Sex distribution of study population

In the present study males outnumbered females as 68% of the patients were males and 32% were females with male to female ratio of 2.1:1. Similar sex distribution pattern was reported in a study by Chaudhary H. et al¹⁶ in India where authors noted 54 men and 27 women out of the 81 patients studied. Recently Arafat MR. et al.¹⁷ in their retrospective analysis of 114 patients reported 77 males and 37 females with a male to female ratio of 2:1.

Clinical complaints and shoulder derangement

Majority (86%) of the patients presented with pain, followed by restriction of movements (68%), joint instability/weakness (38%), stiffness (18%). 44% patients among the study population gave history of trauma. Recurrent dislocation of shoulder joint was seen in 14% patients. In the present study MRI scan revealed abnormal findings in 98% of the patients while normal findings were seen in 2% of the patients. In this study there was a wide variation in the MRI diagnosis and patients presented with various conditions and were categorised into rotator and non-rotator cuff pathologies.

Rotator cuff pathologies

Rotator cuff tendinosis was seen in a total of 25 patients, most commonly seen in the age group of 21 to 30 years (8 out of 25 – 32%). Rotator cuff tears were seen in 28 patients, most commonly seen in the age group of 51 to 60 years (11 out of 28 cases – 39.29%). In

patients more than 50 years, 95.4% had rotator cuff disease. Various literatures have pointed out that the incidence of rotator cuff tendon degeneration and injury increases with the age. Our study also shows a significant association between increasing age and rotator cuff disease, specially tears. Etiology of rotator cuff disease is multi factorial both extrinsic and intrinsic factors have been implicated. Intrinsic factors like poor vascularity, alteration in the material composition & properties with aging have been studied¹⁸. In a study conducted by Needell et al¹⁹ in 100 asymptomatic shoulders, a higher incidence of tendinosis was found among younger population against more tears in the older age group in the fifth and sixth decade of life. The extrinsic factors like impingement secondary to spurs, osteophytosis, downsloping acromion, type II & III of acromion also increases with age¹⁹.

CONCLUSION

Magnetic resonance imaging of the shoulder is an excellent non invasive investigation for evaluation of shoulder pain and suspected cases with internal derangement due to multiplanar imaging and excellent delineation of the soft tissue structures. MRI is unique in its ability to evaluate the tendon pathologies, capsular and labroligamentous structures as well as osseous abnormalities.

BIBLIOGRAPHY

1. Susan Standring ,editor.Gray's Anatomy :The anatomical Basis of Clinical Practice.39th ed.,Spain:Elsevier,2008: 625-635.
2. McKenzie RA, May S. The lumbar spine: mechanical diagnosis and therapy. 2nd ed., Waikanae: Spinal Publications Ltd; 2003
3. Burbank KM, Stevenson JH, Czarnecki GR, Dorfman J. Chronic shoulder pain: Part I. Evaluation and diagnosis. Am Fam Physician 2008; 77:453-60
4. Hodler J. Imaging methods. Ther Umsch 1998;55(3):169-74.
5. Gail DG, et al. Role of MRI in musculoskeletal practice: A clinical perspective. J Manual and Manipulative Therapy. 2011;19(3):152-61.

6. Zlatkin, M.B., Hoffman, C. and Shellock, F.G. Assessment of the rotator cuff and the glenoid labrum using an extreme MR system; MR results compared to surgical findings from a multi center study. *J Magnetic Resonance* 2004;19:623-31.
7. Funk, L. and Auplish, S. Single or double row rotator cuff repair? : Oslo, Norway: 2nd Nordic Advanced Arthroscopy meeting; April 17 -18, 2008.
8. Chaipat L, Palmer WE. Shoulder magnetic resonance imaging. *Clin Sports Med* 2006;25(3):371-86, v.
9. Adler RS, Finzel KC. The complementary roles of MR imaging and ultrasound of tendons. *Radiol Clin North Am* 2005; 43:771-807.
10. Morag Y, Jacobson JA, Miller B, De Maeseneer M. MR Imaging of Rotator Cuff Injury: What the Clinician Needs to Know: *RadioGraphics* 2006;26(4):1046-7.
11. Feleus A, Bierma-Zeinstra SM, Miedema HS, Bernsent RM, Verhaar JA, Koes BW. Incidence of non-traumatic complaints of arm, neck and shoulder in general practice. *Man Ther* 2008;13(5):426-33.
12. Luime JJ, Koes BW, Hendriksen IJ, Burdorf A, Verhagen AP, Miedema HS, et al. Prevalence and incidence of shoulder pain in the general population; a systematic review. *Scand J Rheumatol* 2004;33(2):73-81.
13. Farber JM, Buckwalter KA. Sports-related injuries of the shoulder: instability. *Radiologic clinics of North America*. 2002; 40(5):235-249.
14. Brox JI. Regional musculoskeletal conditions: shoulder pain. *Best Pract Res Clin Rheumatol*. 2003; 17(1):33-56.
15. Murphy RJ, Carr AJ. Shoulder pain. *BMJ Clin Evid*. 2010; 1107.
16. Chaudhary H, Aneja S. MRI Evaluation of Shoulder Joint: Normal Anatomy & Pathological Finding A Pictorial Essay And Review. *IOSR Journal of Dental and Medical Sciences (JDMS) Volume 2, Issue 2 (Nov.- Dec. 2012), PP 01-09*
17. Arafat MR, Abdelhadi JM, Zayadeen AR, Tamimi AA, Jaouni MT. Evaluation of Shoulder Pathologies using MRI - Our experience at King Hussein Medical Centre. *Middle East J Age and Aging* 2013;10(5):35-41.
18. Iaononi, J.P. Full thickness rotator cuff tears: factors affecting surgical outcome. *J. Am. Acad. Orthop. Surgeons* 2:87-95, 1994
19. Steven DN, Michael BZ, Jerry S, Brian J, John W. MR Imaging of the Rotator cuff: Peritendinous and Bone Abnormalities in Asymptomatic Population. *AJR* 1996;166:869-867.