ORIGINAL ARTICLE

EFFECTIVENESS OF PLAIN SHOULDER RADIOGRAPH IN DETECTING DEGENERATE ROTATOR CUFF TEARS

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Background: Studies have demonstrated radiographic findings of sclerosis and cortical irregularity at the greater tuberosity can suggest a rotator cuff tear. Plain radiographs are the most easily attainable first-line investigations in evaluating shoulder injuries. This study determines the effectiveness in predicting degenerate rotator cuff tears by detecting radiographic changes on shoulder x-rays. **Methods**: Retrospective cross-sectional study with a consecutive series of patients conducted in Hinchingbrooke Hospital, Huntingdon, United Kingdom from January 2015 to June 2017. Anteroposterior shoulder radiographs of 150 symptomatic patients who underwent shoulder arthroscopy were independently analysed by surgeons who were blinded from the arthroscopic results. Patients aged fewer than 30 and over 70 years were excluded. Patients with advanced osteoarthritis and cuff tear arthropathy evident on x-rays were also excluded. Sixty-five patients included in the study had rotator cuff tears on arthroscopy. Radiographic changes were correlated with arthroscopic findings to determine this test's ability to predict degenerate rotator cuff tears. **Results:** When both cortical irregularity and sclerosis were present on the plain radiograph, these signs had a sensitivity of 78.8% [95% CI 65.7, 87.8%] and specificity 77.4% [95% CI 67.2, 85.0%] with a positive predictive value of 68.3%, using contingency table analysis. The presence of cortical irregularity was found to be a better predictor of a tear as compared to sclerosis. **Conclusions:** This study concludes that plain radiograph are good modality for initial evaluation of rotator cuff tears and detecting when both cortical irregularity and sclerosis. Consideration of these radiographic findings serves as a useful adjunct in diagnostic workup and can guide subsequent investigations and treatment when evaluating rotator cuff tears of the shoulder

Keywords: Effectiveness; Plain Radiograph; Shoulder; Degenerate; Rotator Cuff Tears

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INTRODUCTION

The shoulder rotator cuff consists of four muscle tendons; the function of these tendon units is to support and bracing the head of humerus in the shoulder joint and gives assistance in movement of upper limb.[1] The partial/incomplete or complete discontinuation of any of these tendons because of injury due to trauma or degeneration is described as a rotator cuff tear. The occurrence of rotator cuff tears is higher with increasing age. Pain, restriction of movement and weakness are the symptoms of rotator cuff tears.[1] Long term causes like recurrent microtraumas, impingement in subacromial space, degeneration of tendons, and decrease vascular supply are found to be accountable for rotator cuff tears and behind its age-related prevalence. Rotator cuff tear due to intense macrotrauma is less frequent observed.[2,3]

Rotator cuff disease increases with age with 4% of patients below 40 years of age having asymptomatic rotator cuff tears. This increases with age with 54% of patients above 60 years of age having partial or full thickness tears on imaging[4]. More than half of asymptomatic tears progress to become symptomatic in 3 years.[5]

It is important to detect rotator cuff tears early as untreated tears can cause increasing pain and enlarge in size. This may lead to irreversible atrophy of rotator cuff muscles along with fatty degeneration.[6,7] Clinical examination has a specificity of 54% and sensitivity of 90% in identifying symptomatic full thickness tears[8]. Supraspinatus weakness, weakness of external rotation and impingement are the most useful signs.[9]

Imaging studies like ultrasound and MRI (magnetic resonance imaging) are most commonly used in diagnosis of pathology of shoulder joint, predominantly in diseases of rotator cuff, but standard radiographs of the shoulder joint are still considered as the first used diagnostic tools in shoulder pathology. X-ray findings of chronic rotator cuff tear arthropathy include superior migration of humeral head narrowing of glenohumeral joint space periarticular soft tissue calcifications.[10] Greater tuberosity (GT) sclerosis, osteophyte formation at GT along with cyst formation, humeral osteophyte, and acromioclavicular joint arthrosis seen on Radiographs are also proven to help identifying presence of rotator cuff disease.[11] GT sclerosis on sonography has sensitivity of 90% and a

negative predictive value of 96% in detecting rotator cuff tear.[12] The true anteroposterior view of glenohumeral joint (Grashey view with the thorax externally rotated to 35–45 degrees) has been shown to be better in detecting the above mentioned radiographic findings when compared to a plain shoulder AP radiograph.[13]

In a recent meta-analyses MR arthrography (sensitivity 91.7% and specificity 96.5% for all tears) was considered the most sensitive radiographic test for rotator cuff tears with MRI (sensitivity 85.5 and specificity 90.4% for all tears) and Ultrasound (sensitivity 85.1% and specificity 92.0% for all tears) having no statistically significant difference in sensitivity or specificity.[14]

The objective of this study is to determine the specificity and sensitivity of greater tuberosity sclerosis and cortical irregularity seen on x-rays in diagnosing rotator cuff tears. We aim to show that plain x-rays are a good modality for initial evaluation of rotator cuff tears.

MATERIAL AND METHODS

Retrospective cross-sectional study with a consecutive series of patients conducted in Hinchingbrooke Hospital, Huntingdon, United Kingdom from January 2015 to June 2017. Patients included in this study were 30–70 years of age and were symptomatic with shoulder pain. All patients underwent a pre-operative shoulder x-ray followed by an arthroscopic procedure. All study radiographs were captured at same institution/hospital. Standard Anterio Posterior shoulder radiograph were achieved by making patient position in erect and cassette parallel to body in coronal plane. The radiation beam administered in Anterio Posterior direction respective to patient's body with the shoulder in neutral rotation.

Exclusion criterion includes patients with advanced osteoarthritis, previous proximal humeral fractures and obvious radiographic cuff tear arthropathy (as defined by superior migration of the humeral head and concave acromial erosions).

A total of 150 anteroposterior radiographs were reviewed individually by surgeons, who were blinded from the arthroscopic result. Two radiographic signs were sought for: greater tuberosity sclerosis and cortical irregularity. On arthroscopy, sixty-five patients had rotator cuff tears.

Statistical analysis was undertaken by a surgeon who was not involved in any of the patients' care. If either greater tuberosity sclerosis or cortical irregularities were present, the test was considered positive. The XLSTAT extension software (v. 18.06) to Microsoft Excel was used to undertake contingency table analysis and to compare the surgeons' concurrence. A value of $p<0.05$ was considered significant.

RESULTS

Total numbers of patient were 150, anteroposterior shoulder radiograph was taken and arthroscopy was performed. Female were 85 (56.66%) and male were 65 (43.33%) and mean age was 50±13.69. Using contingency table analysis, the test had a specificity of 77.6% [95% CI 67.6, 85.2%] and sensitivity of 75.4% [95% CI 63.6, 84.3%] with a positive predictive value of 72.1% [95% CI 61.4, 82.7] in detecting rotator cuff tears (Table-1). When excluded patients with history of trauma, the test had a sensitivity of 78.8% [95% CI 65.7, 87.8%] and specificity 77.4% [95% CI 67.2, 85.0%] and a positive predictive value of 68.3.

Using logistic regression, the coefficient for cortical irregularity was 0.600 and that of greater tuberosity sclerosis was 0.456, suggesting cortical irregularity is a better predictor of a tear (Figure-1,2,3). The surgeons agreed on the presence of cortical irregularity in 145 out of 150 radiographs and on greater tuberosity sclerosis in 140 out of 150.

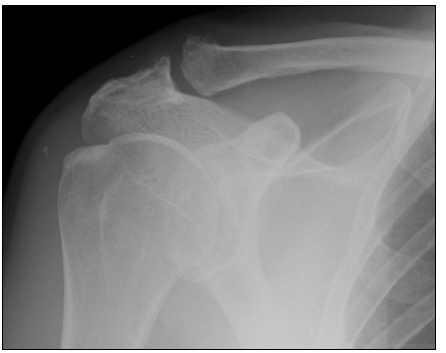

Figure-1: Greater tuberosity sclerosis

Figure-2: Greater tuberosity roughness

Figure-3: Greater tuberosity roughness and sclerosis

Table-1: Assessing performance at differentiating all tears from non-tears

Statistic	Value	Lower bound (95%)	Upper bound (95%)
Correct classification	0.772	0.704	0.839
Misclassification	0.228	0.161	0.296
Sensitivity	0.766	0.647	0.853
Specificity	0.776	0.676	0.852
False positive rate	0.224	0.137	0.310
False negative rate	0.234	0.134	0.335
Prevalence	0.430	0.350	0.509
PPV (Positive Predictive Value)	0.721	0.614	0.827
NPV (Negative Predictive Value)	0.815	0.730	0.899
LR+ (Positive likelihood ratio)	3.425	2.253	5.207
LR- (Negative likelihood ratio)	0.302	0.191	0.477
Relative risk	3.891	2.429	6.235
Odds ratio	11.347	5.298	24.305

DISCUSSION

Rotator cuff injuries are a common cause of shoulder pain. Plain Radiographs are the most widely available and easiest investigations to obtain when evaluating shoulder pain. We have highlighted two radiographic findings of greater tuberosity sclerosis and cortical irregularity which are commonly found along with rotator cuff tears and have evaluated their specificity and sensitivity in isolation by excluding patients with X-ray evidence of advanced osteoarthritis and cuff tear arthropathy.

The results show that combined greater tuberosity cortical irregularity and sclerosis are good predictors for rotator cuff tear which is more specific if patients with history of trauma are excluded. Greater tuberosity irregularity on ultrasound has been shown to correlate with rotator cuff tears in previous studies.[9] These findings show that this can be demonstrated on X-rays with good inter-observer correlation. Various clinical examination tests are described for detecting rotator cuff tears. Although not reliable individually these tests when used in combination can help to diagnose rotator cuff tears.[15–17] Combining this with our study findings can potentially further increase diagnostic ability of the practitioner although this point has not been explored in this study. It is known that early detection and treatment of rotator cuff injuries can improve outcomes.

Several studies revealed that wealth of any nation and health expenditure can influence the rate of dissemination of costly medical technologies, especially in radiology[18]. Plain radiograph is a quick, readily available, cheap and a dependable investigation compared to an expensive, often delayed from limited availability, MRI or Ultrasound scan. Careful use of these two signs along with clinical findings can reduce the demand, use and pressure on more expensive investigations saving precious health-care resources. It will also facilitate faster decision making and treatment reducing waiting times. In a resource poor setting it can give some confidence to a surgeon to proceed with surgical intervention in symptomatic patients. Rotator cuff tears are often present with bicep tendon pathologies as well as sub acromial impingement.[19,20] These conditions can sometimes cause overlapping clinical examination findings. Additional arthroscopic procedures done in same episode to address conditions improves shoulder function.[21]

We would propose a further study by combining the x-ray findings with clinical examination and assessing the sensitivity and specificity of combined clinical examination and greater tuberosity sclerosis and cortical irregularity this would provide further evidence on the accuracy of using these methods to diagnose rotator cuff tears.

CONCLUSION

This study concludes that plain radiograph is good modality for initial evaluation of rotator cuff tears and detecting when both cortical irregularity and sclerosis. Consideration of these radiographic findings serves as a useful adjunct in diagnostic workup and can guide subsequent investigations and treatment when evaluating rotator cuff tears of the shoulder.

AUTHORS' CONTRIBUTION

AH AJD: Study conception and design, collection and review of data and results, writing and editing of manuscript. MM FB EMV: Writing and editing of

manuscript. EMV: Statistical analysis. AJD: Guidance and supervision of other authors

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