Annals of Orthopaedics, Trauma and Rehabilitation

Research Article

The Role of Ultrasound in Shoulder Impingement Syndrome and Rotator Cuff Tear

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ARTICLE INFO

Received Date: December 19, 2018
Accepted Date: January 25, 2019
Published Date: January 29, 2019

KEYWORDS

Ultrasound
Shoulder Impingement
Rotator Cuff Tear
Positive Predictive Value
Negative Predictive Value
Accuracy

Citation for this article: Iqra Manzoor, Raham Bacha, Syed Amir Gilani and MahjabeenLiaqat. The Role of Ultrasound in Shoulder Impingement Syndrome and Rotator Cuff Tear. Annals of Orthopaedics, Trauma and Rehabilitation. 2019; 2(1):126

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ABSTRACT

Objective: To evaluate the role of ultrasound in shoulder impingement syndrome and rotator cuff tear in patients of primary and secondary health care settings.

Methods: Google scholar, PubMed, Medline, Medscape, Wikipedia and NCBI were searched in June 2017 including all original researches and review articles to identify the relevant study. Two reviewers selected the articles independently for evaluation of the diagnostic accuracy of ultrasound for detecting rotator cuff tear and shoulder impingement syndrome from abstract retrieved by search of the literature. Selection criteria were ultrasound accuracy for both diseases as index text, arthrography, magnetic resonance imaging, surgery as reference text, rotator cuff tear and shoulder impingement syndrome as target conditions. The extraction of the data done by two reviewers on selected study characteristics and results made to construct the tables and figures.

Results: 14 studies were found for full-thickness tear and the pooled sensitivity of ultrasound in diagnosing full-thickness tear is 95% and specificity is 96%. 11 studies were found for partial thickness tear and the pooled sensitivity of ultrasound for diagnosing the partial-thickness tear is 72% and specificity is 93%. 3 studies were found for shoulder impingement syndrome and the pooled sensitivity of ultrasound in diagnosing impingement syndrome is 79% and specificity is 94%.

Conclusion: From the literature review it is concluded that musculoskeletal ultrasonography has high accuracy in detecting the full thickness rotator cuff tear and impingement syndrome and these results can help the clinicians for their diagnosis.

INTRODUCTION

Ultrasonography (US) has been used by radiologists from many years. With advances, wide accessibility in innovation and technology there is an emerging pattern among doctors in different strengths to use US into their routine clinical evaluation. More as of late rheumatologists have begun utilizing US for quantitative and subjective ongoing evaluation of musculoskeletal (MSK) diseases. US is progressively being utilized as an expansion to physical examination. Its application in rheumatology far beyond the recognition of joints inflammation. Developing proof has made it clear that early also, forceful treatment of provocative joint inflammation with a treat to target approach alter prognosis significantly. This requires the utilization of effortlessly accessible imaging modalities, for example, US in building up precise determination so that early restorative choices can be made. Aside from analysis, US assumes a noteworthy part in infection checking, evaluation of harm and

therapeutics. The first report on MSK was published in 1972 by McDonald and Leopold in which sonographic differentiation was described between Baker's cyst and thrombophlebitis. The uses of ultrasound to MSK conditions have kept on extending and it has turned into the essential methodology of imaging for a large portion of MSK conditions [1,2]. US is the quick and quick technique for getting scans of the MSK system. It can be performed promptly in the clinical setup, with evaluation of different joints at a similar arrangement, giving a 'one stop' reply to numerous MSK issues. This moderately economical innovation with the advantages of transportability and constant dynamic examination has made it conceivable to give a diagnostic benefit in the group or even on the games field. There are a several uses of dynamic US examination in the MSK framework. US can indicate instability of the tendons for example, anterior dislocation of the extensor carpi ulnaris (ECU) [3]. It assumes an imperative part in the finding of impingement of the shoulder by indicating which structure is being encroached and uncovers potential characteristic and outward causes [4]. Many methods can be used for the diagnosis of shoulder impingement syndrome and rotator cuff tear but here we want to do a systematic review on the role of ultrasound and its accuracy in diagnosing both these disorders with the help of previous researches.

METHODS

Search strategy: Two reviewers (I.M and R.B) searched the data bases Google scholar, PubMed, NCBI, Medline and Medscape from 2000 up to 2015 with the key terms: diagnostic accuracy, ultrasound, ultrasonography, sensitivity, specificity, rotator cuff tear, and shoulder impingement syndrome.

Selection Criteria: Two reviewers (I.M and R.B) independently screened the titles and abstracts of the relevant articles and full articles for inclusion and extraction of the data. The disagreement of the reviewers was resolved with the help of consensus. Studies were eligible if they include the information about rotator cuff tear either partial thickness tear or full thickness tear or both, shoulder impingement syndrome and diagnostic accuracy of US in both these diseases. US was used as a index test, reference test (MRI, arthroscopy), target condition (rotator cuff tear and shoulder impingement syndrome.), as proposed by the STARD-guidelines for reporting diagnostic accuracy studies.

Data Synthesis: The eligible studies were first categorized and the analysis of the data was performed according to the target condition. We retrieve the sensitivity and specificity of the diseases for each individual study and make the forest plot. Table is also made for predefined subgroups of type of article, country, sample size, sensitivity, specificity, positive predictive value, negative predictive value, and accuracy. Data analysis was performed with the help of Microsoft excel 2017.

RESULTS

Study selection and Characteristics: Total 45 studies were found after the search and from them 4 were excluded due to duplication, 13 studies did not have sufficient data regarding to our research, and 12 records were rejected on the basis of title and abstracts. Flow chart summarizes the flow records through review in figure 1. 16 studies were included in the analysis of review [5-19] (Figure 1). And from them 11 were original articles, 5 were review and meta-analysis, 14 articles were of rotator cuff tear, 4 articles were of shoulder impingement syndrome, 2 articles were of both diseases, 5 articles were of full-thickness tear, sample size was 1098 in the original articles and 252 articles were in the review and meta-analysis. 13 authors were contacted to provide the complete data but insufficient data was given by them. All the researches were done in the clinical and radiology departments of hospitals. In the included studies 4 studies were prospective, 3 were comparative, 2 were cross-sectional, 1 was retrospective, and 6 were reviews.

Data Analysis: (Figure 2,3&4) represents the forest plot for the full-thickness tear, partial thickness tear and shoulder impingement syndrome. Characteristics of included studies for full-thickness tear, partial thickness tear and shoulder impingement syndrome were described in (Table 1). Pooled results of rotator cuff tear and shoulder impingement syndrome were described in (Table 2). The 14 studies addressing the full-thickness tear and overall pooled sensitivity of US in diagnosing full-thickness tear is 95% and specificity is also 96%. The 11 studies addressing the partial-thickness tear and the overall pooled sensitivity of the US in diagnosing the partial-thickness tear is 72% and specificity is 93%. The 3

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studies addressing the shoulder impingement syndrome and the pooled sensitivity of ultrasound in diagnosing impingement syndrome is 79% and specificity is 94%. None of the analysis found significant heterogeneity between the studies.

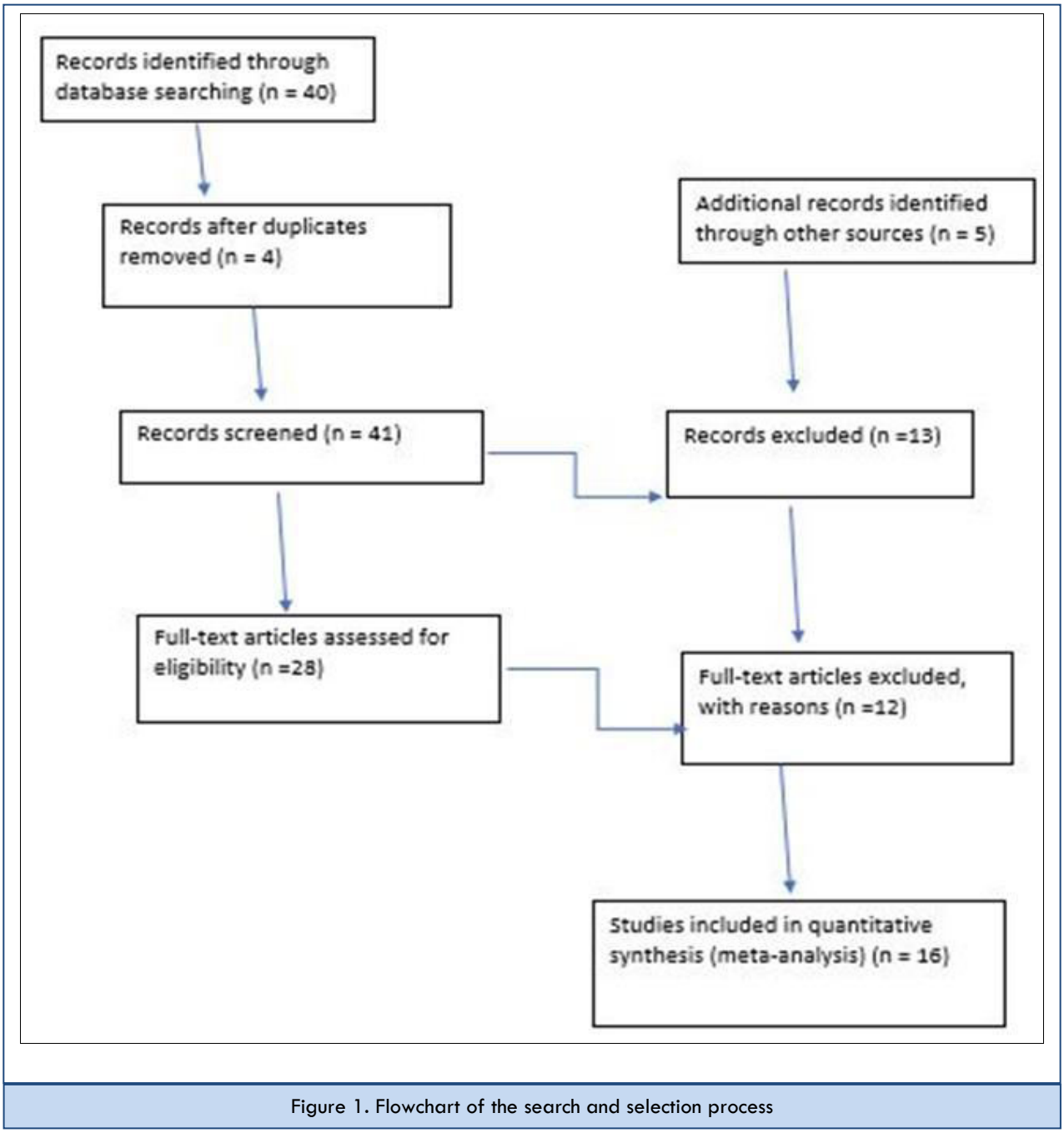

Figure 1. Flowchart of the search and selection process

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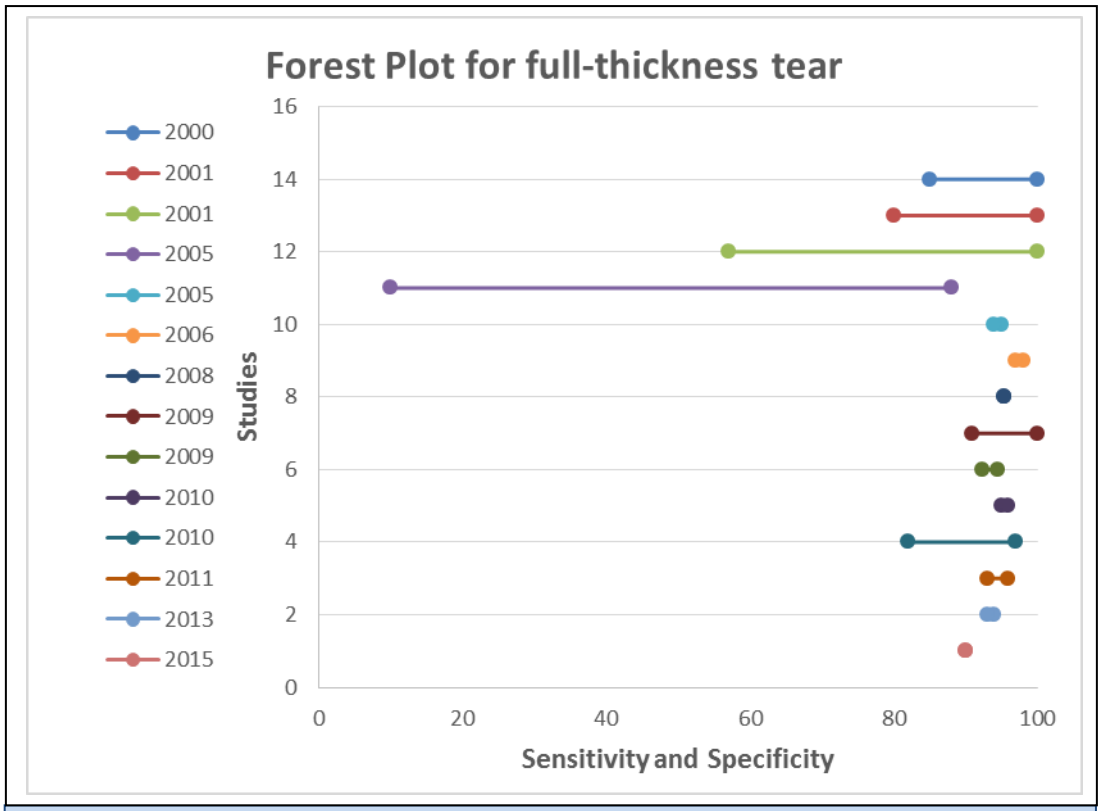

Figure 2

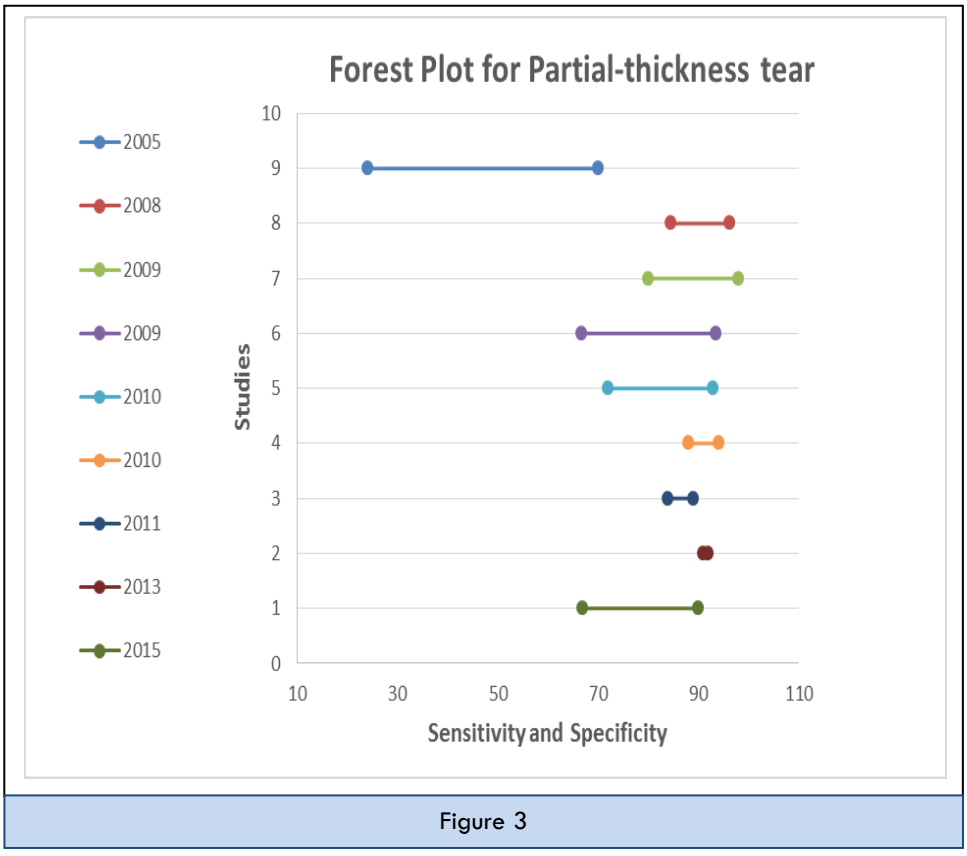

Figure 3

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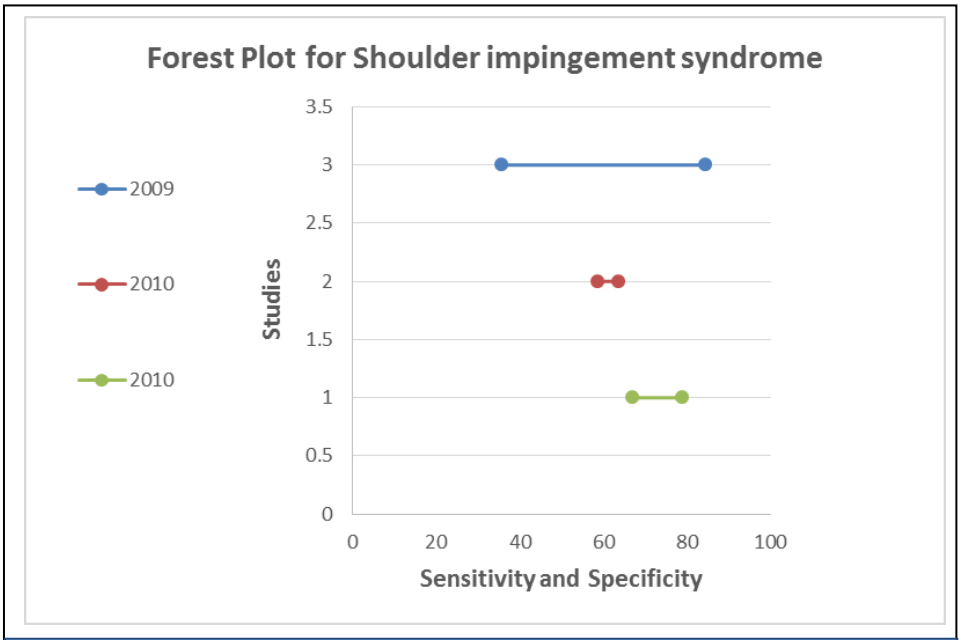

Figure 4

Table 1. Characteristics of the studies included for Full-thickness tear, Partial-thickness tear, Shoulder impingement syndrome.

Disease	Study year	Country	Type of article	Sensitivity	Specificity	PPV*	NPV**	Accuracy	Sample size
Full-Thickness tear	2000[5]	United States	Original	100	85	NR***	NR	NR	98
	2001[6]	United States of America	Original	80	100	100	88	NR	24
	2001[7]	Spain	Original	57	100	100	76.1	100	61
	2005[19]	United States	Original	10	88	NR	NR	NR	98
	2005[8]	Sweden	Original	100	91	91	100	95	190
	2006[9]	Taiwan	Original	98	97	NR	NR	NR	58
	2008[10]	United Kingdom	Original	95.4	95.4	96.2	95.4	95.8	143
	2009[8]	Sweden	Original	100	92	91	100	95	190
	2009[13]	United States	Review	92.3	94.4	NR	NR	NR	NR
	2010[15]	United Kingdom	Review	95	96	NR	NR	NR	NR
	2010[17]	Finland	Original	97	82	97	82	95	77
	2011[16]	United Kingdom	Review	96	93	NR	NR	NR	NR
	2013[18]	Brazil	Review	94	93	NR	NR	NR	NR
	2015[7]	Canada	Review	90	90	NR	NR	NR	NR
Partial-Thickness tear	2001[7]	Spain	Original	12.5	67.9	5.6	83.7	NR	61
	2005[19]	United States	Original	70	24	NR	NR	NR	98
	2005[8]	Sweden	Original	80	98	86	96	95	190
	2008[10]	United Kingdom	Original	96.2	84.6	79.5	95.7	95.8	143
	2009[8]	Sweden	Original	80	98	86	96	95	190

	2009[13]	United States	Review	66.7	93.5	NR	NR	NR	NR
	2010[15]	United Kingdom	Review	72	93	NR	NR	NR	NR
	2010[17]	Finland	Original	88	94	98	71	89	77
	2011[16]	United Kingdom	Review	84	89	NR	NR	NR	NR
	2013[18]	Brazil	Review	92	91	NR	NR	NR	NR
	2015[11]	Canada	Review	67	90	NR	NR	NR	NR
Shoulder impingement syndrome	2009[14]	Romania	Original	35.7	84.4	14.7	94.5	NR	100
	2010[15]	United Kingdom	Review	63.6	58.8	NR	NR	NR	NR
	2010[17]	Finland	Original	79	67	NR	NR	NR	77

*Positive predictive value(PPV), **Negative predictive value(NPV), ***Not recorded(NR)

Table 2. Pooled results for Rotator cuff tear and Shoulder impingement syndrome.

Outcomes	No. of studies	Sensitivity	No. of studies	Specificity
Full-thickness tear	3	100	2	100
	8	90-98	9	90-97
	1	80	3	82-88
	1	57	NR	NR
	1	10	NR	NR
Partial-thickness tear	2	92-96.2	7	90-98
	4	80-88	2	84.6-89
	2	70-72	1	67.9
	2	66.7-67	1	24
	1	12.5	NR	NR
Shoulder impingement syndrome	1	79	1	84.4
	1	63.6	1	67
	1	35.7	1	58.8

DISCUSSION

Rotor cuff, which is also known as rotator cuff is a gathering of muscles and their tendons that demonstrate to balance out the shoulder. The four muscles of the rotator cuff are over half of the seven scapulohumeral muscles. The four muscles are the supraspinatus, the infraspinatus, teres minor, and the subscapularis. The rotator cuff muscles play a fundamental role in different movements of the shoulder joint and its stability [20]. These muscles emerge from the scapula and inserts within the head of the humerus, shaping a cuff at the shoulder joint. They hold the head of the humerus in the little and shallow glenoid fossa of the scapula. The glenohumeral joint has been comparably depicted as a golf ball sitting on a golf tee [21]. The tendons which are at the end of the rotator cuff muscles can end up plainly torn, prompting torment and limited movement of the arm. A torn rotor cuff can happen following an injury to the shoulder or it can happen through the "wear and tear" on tendons, most ordinarily the supraspinatus tendon found under the acromion. The injuries of the rotator cuff are regularly connected with movements that require rehashed overhead movements or compelling pulling movements. A clinical disorder which happens when the tendons of the rotator cuff muscles wind up noticeably irritated and kindled as they go through the subacromial space, the entry underneath the

acromion is known as shoulder impingement syndrome which is also known as subacromial impingement. This can bring about shortcoming and loss of movement at the shoulder [22]. At the point when the arm is raised, the subacromial space (hole between the foremost edge of the acromion and the head of the humerus) limits, through which the supraspinatus muscle tendon passes. Anything that brings on additional narrowing tends to encroach the tendon and cause a provocative reaction, bringing about impingement disorder. This can be caused by bony structures, for example, spurs of subacromial (hard projections from the acromion), osteoarthritic spurs on the acromioclavicular joint, and varieties in the state of the acromion. Thickening or calcification of the coracoacromial tendon can likewise cause impingement. Loss of capacity of the rotator cuff muscles, because of damage or loss of quality, may make the humerus move superiorly, bringing about impingement. Aggravation and resulting thickening of the subacromial bursa may likewise cause impingement.

A research done by Fukuda et al. in which he said that shoulder impingement and rotator cuff tear are the main cause of the disability of the shoulder and difficult movement of the arm. They can be misdiagnosed easily and if not diagnosed properly then they can be lead to mismanagement and aggravation of the disease [23]. A prospective study was published in 2004 in which 124 patients with shoulder pain were included to compare the US and magnetic resonance imaging in diagnosing the measurement of the tears in rotator cuff and findings of arthroscopy were used as a standard. In 71 patients arthroscopy was done and they were included and rest of the patients were excluded. 46 patients were diagnosed with full-thickness tear, 19 with partial-thickness tear and no tear was diagnosed in 6 patients arthroscopically. And the full-thickness tear was correctly diagnosed in all 46 patients with the help of US and MRI and 13 patients out of 19 diagnosed with partial-thickness tear with US and 12 out of 19 with MRI. And the overall accuracy of the US and MRI in diagnosing rotator cuff tear was 87% [24]. A meta-analysis was done in 2009 for the comparison between MR arthroscopy, US and MRI and for this purpose 65 articles were included in the meta-analysis and according to the results MR arthroscopy has the highest sensitivity and specificity($p<0.05$) for the diagnosis of rotator cuff tear as compared with US and MRI($p>0.05$) [13]. Shoulder US is dependable in the determination of full-thickness tears however less dependable in the location of partial thickness tears. The unwavering quality of shoulder US in the determination of Shoulder impingement syndrome has not been obviously settled [8,25,26]. And from a huge literature review we concluded that US has high accuracy in diagnosing the full-thickness tear of the rotator cuff then partial-thickness tear and then shoulder impingement syndrome.

CONCLUSION

It is concluded from our research that to achieve the accurate method of decision for the patient of rotator cuff tear and impingement syndrome we strongly recommend US as a diagnostic method to rule out full and partial thickness tear and to a lesser extent impingement syndrome because US gives a safe, cost effective and fast methods for surveying MSK variations from the norm. This survey has underlined the part of US examination as the essential imaging examination in starting assessment of MSK diseases. In many parts of evaluation of MSK diseases US is similar to or surprisingly better than the costly imaging strategies, for example, MRI. The combination of high-frequency transducers and enhanced power Doppler innovation gives an incredible chance to examine scanning parts of inflammatory conditions, for example, tenosynovitis and enthesitis that were generally viewed as hard to scan. Recent advances in innovation, for example, three-dimensional US and contrast agents can possibly assume a noteworthy part in early identification and observing of fiery joint inflammation later on. The long expectation to learn and adapt remains a critical constraining component to across the board utilization of US in routine clinical practice.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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