Diagnostic Value of MRA and MRI for The Articular-Sided Partial-Thickness Rotator Cuff Tears: A Meta-Analysis

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Abstract

Background: This study aims to compare the diagnostic accuracy of magnetic resonance imaging (MRI) and MR arthrography (MRA) for the articular-sided partial-thickness rotator cuff tear (PTRCT).

Methods: Three electronic databases, PubMed/Medline, Embase and Cochrane Library, were utilized to retrieve articles comparing the diagnostic value of MRA and MRI for detecting articular-sided PTRCTs. The pooled statistical indexes included sensitivity, specificity, positive/negative predictive value, diagnostic odds ratio (DOR) and the area under receiver operating characteristic curve (AUC).

Results: Eleven studies involving 1703 patients and 1704 shoulders were included. The pooled sensitivity, specificity, DOR and AUC and their 95% CIs of MRA to diagnose articular-sided PTRCTs were 0.81 (95% CI, 0.65-0.90), 0.96 (95% CI, 0.91-0.98), 68.14 (95% CI, 33.20-139.84) and 0.96 (95% CI, 0.94-0.97), respectively. The pooled sensitivity, specificity, DOR and AUC and their 95% CIs of MRI were 0.78 (95% CI, 0.65-0.87) and 0.97 (95% CI, 0.84-0.99), 47.82 (95% CI, 8.29-275.89) and 0.89 (95% CI, 0.86-0.92), respectively.

Conclusions: This meta-analysis reveals that MRA has a better diagnostic value than that of MRI for the diagnosis of articular-sided partial-thickness rotator cuff tears, but only small improvement of sensitivity. Considering the price and invasion of MRA, MRI is recommended as an initial examination to detect patients suspected with articular-side partial-thickness rotator cuff tears.

Introduction

Partial-thickness rotator cuff tear (PTRCT) was first described by Codman [1] and later divided into bursal-sided, articular-sided, and intratendinous tears according to the depth and location of the tear [2]. Partial tears are shown to have a variable rate of progression with 28–40% eventually becoming full-thickness tears [3–5]. It should be noted that articular-sided PTRCT was 2–3 times more common than bursal-sided tears [6, 7].

Recent literature has reported inconsistencies in the correlation between rotator cuff (RC) lesions viewed with magnetic resonance imaging (MRI) and those found arthroscopically, especially regarding partial-thickness tears [8, 9]. The improvements of arthroscopic diagnosis and imaging modalities and the cognition status of partial-thickness RCTs created a dramatic increase in the number of patients diagnosed with partial-thickness RCTs. Technological advances in arthroscopic shoulder surgery have made surgical management of rotator cuff tears much less invasive and thereby more cost effective [10, 11]. Good outcomes can be achieved with arthroscopic debridement and selective acromioplasty among patients with articular- or bursal-sided PT tear of < 50% tendon thickness. Unfortunately, fewer studies have focused on articular-sided tears partial-thickness RCTs. Therefore, it is very important to distinguish articular-sided PTRCTs from all kinds of tears, especially from PTRCTs.

Shoulder plain film and various physical examination tests have been shown to be insufficient at effectively diagnosing rotator cuff tears [12, 13]. A retrospective study in a large homogeneous study group demonstrated that the arthroscopic transtendon repair of articular-sided partial-thickness RCTs is an effective and safe procedure that leads to significant improvement in pain and shoulder function, with high patients' satisfaction rate, while the complication rate is low [14].

Numerous diagnostic studies focused on the evaluation of performance of MRA, MRI or ultrasound (US) imaging for the diagnosis of full- or partial-thickness tears. A previous meta-analysis confirmed that 3-dimensional US is very effective and highly accurate to detect full-thickness RCTs, but may lack accuracy in the diagnosis of partial tears [15]. A recent network meta-analysis of diagnostic tests performed by our team reported that high-field MRA had the highest diagnostic value, then low-field MRA, followed by high-field MRI, high-frequency ultrasound, low-field MRI, and low-frequency ultrasound [16]. However, both of two meta-analyses were performed based on the full-, partial- or any tear. It is important to identify the subtype of partial-thickness tears [17, 18]. Furthermore, another meta-analysis also conducted by our team indicated that MRA and MRI have similar diagnostic value for the diagnosis of bursal-sided partial-thickness rotator cuff tears [19]. However, there is no study focused on the articular-sided PTRCTs.

To our knowledge, several studies have been performed to rigorously assess the diagnostic performance of MRA and MRI for the articular-sided PT-RCTs, but the results remains controversial. Therefore, the purpose of this meta-analysis was to assess the diagnostic accuracy of MRA and MRI for detecting articular-sided PTRCTs based on all available scientific published data.

Materials And Methods

This study was performed in accordance with the Preferred Reporting Items for a Systematic Review and Meta-analysis of Diagnostic Test Accuracy Studies (PRISMA-DTA) statement [20].

Data Sources and Search Strategy

Two independent reviewers searched PubMed, Embase and the Cochrance Library (including Epub Ahead of Print) for titles from data inception to January 1, 2019. The vocabulary and syntax were specifically adapted according to the database. The combination of keywords and mesh terms were “diagnostic”, “diagnosis”, “rotator cuff”, “supraspinatus”, “infraspinatus”, or “subscapularis” and “MRI”, “magnetic resonance imaging”, “MRA” or “magnetic resonance arthrography”. The purpose, research question, and eligibility criteria for the search were determined a priori. Additionally, the reference lists of relevant articles and included studies were searched by hand for supplementary eligible records. Any disagreement was settled through the discussion of researchers until a consensus was reached.

Study Screening and Selection

The included studies should confirm all criteria listed as follows: 1) study design, diagnostic accuracy study; 2) population, patients with suspected rotator cuff tear; 3) MRA/MRI test was performed; 4) the final diagnosis of articular-sided RCT was confirmed by predesigned gold standards; and 5) diagnostic data (number of false/true-positive [FP/TP] and false/true-negative [FN/TN] cases) could be extracted or calculated to construct a two-by-two contingency table.

Exclusion criteria were 1) animal studies or cadaver experiments; 2) studies in which articular-sided RCT could not be differentiated; or 3) commentary, letter, case-report, reviews or conference poster.

Two investigators performed blindly a systematic screening in duplicate. We first removed redundant and unrelated records by screening titles and abstracts. Then the full texts of remainders were downloaded to confirm their eligibility based on above criteria. The final decision regarding inclusion was according to the full article using inclusion and exclusion criteria.

Data Extraction

Following information were collected from all included articles into a pre-designed Microsoft Excel spreadsheet (Version 2010, Microsoft, Redmond, WA, USA) by two investigators blindly and repeatedly: the first author's surname, publication time of original study, sources of origin, participant characteristics (number, age and gender), design of study, gold standard, time from diagnostic test to gold standard, blinding, no. of readers, the experience of readers, clinical findings of patients, technical parameters of MRA/MRI including the administration of contrast agent (indirect or direct), vendor, model, magnetic field strength, various sequences, slice thickness, analyzed image plane. Data extraction from all included studies was completed in tandem by two independent reviewers. The spreadsheets were combined and each reviewer checked a random selection of the other's entries for quality control. Any discrepancies were resolved by consensus decision.

Quality Assessment

Two investigators performed blindly the methodological quality of the included studies in duplicate using the Quality Assessment of Diagnostic Accuracy Studies-2 (QUADAS-2) tool [21].

Statistical Analysis

Inter-reviewer agreement was calculated at each stage of searching, screening, and the quality assessment of the included studies with a Kappa (κ) statistic. Agreement was categorized a priori as follows: 0.20 or less; poor agreement, 0.21 to 0.40; fair agreement, 0.41 to 0.60; moderate agreement, 0.61 to 0.80; substantial agreement, and 0.81 to 0.99; almost perfect agreement. Quantitative analyses in this study were conducted with the forest plots using STATA 12.0 Version (V. 12.0, StataCorp, College Station, TX). The whole process of searching, filtering, data extraction and quality assessment was implemented by two researchers (LFX & DJL) independently and repeatedly. For any discrepancy, a consensus was reached by discussion with an arbitrator (LLX). The pooled estimates indexes to assess the accuracy of MRA/MRI included sensitivity, specificity, positive likelihood ratio (PLR), negative likelihood ratio (NLR), diagnostic odds ratio (DOR) and area under receiver operating characteristic curve (AUC). The threshold effect was tested by calculating the logarithm of sensitivity and logarithm of 1-specificity. Heterogeneity among the included studies was assessed using the I^2 statistic. The meta-regression and subgroup analyses were conducted to explore the available source of heterogeneity. Publication bias was performed using Deeks' Funnel Plot Asymmetry Test. Additionally, for the non-threshold effect, we performed meta-regression analysis and the patient sample size (≥ 100 or < 100), publication year (before or after 2014), magnetic field strength (3.0-T or not), number of readers (≥ 2 or 1), Blinding (Yes or No) and QUADAS-2 score (≥ 10 or < 10), design of study (prospective or retrospective) as well as muscle tendon were used as covariates.

Results

Studies retrieved and Characteristics

In total, 2192 articles were identified by searching three databases and removing duplicates. The screening of the reference lists of these and other relevant articles yielded 4 additional studies. After screening remaining titles and abstracts, and identifying related full-text, finally, 11 studies [18, 22-31] published during the period from 2007 to 2018 remained for quantitative analysis. The selection processes for the eligible studies are summarized in **Figure 1**.

The sample size of the included studies ranged from 10 to 333 with a total of 1703 patients with articular-sided partial-thickness rotator cuff tears. Main characteristics and technical parameters of MRI and MRA in the included studies are presented in **Table 1**. According to the QUADAS-2 score, 4 [23, 27, 30, 31] (36.4%), 2 [18, 29] (18.2%), 3 [24-26] (27.3%), 1 [22] (9.1%) and 1 (9.1%) [28] study scored 11, 10, 9, 8 and 7, respectively. **Table 2** shows the accuracy of MRA and MRI for the detection of articular-sided partial-thickness RCTs.

Diagnostic Value of MRA

In total, 8 studies [18, 23-29] evaluated the performance of MRA to diagnose articular-sided partial-thickness RCTs. The pooled sensitivity and specificity were 0.81 (95% CI, 0.65-0.90) and 0.96 (95% CI, 0.91-0.98), respectively (**Fig. 2**). The pooled PLR, NLR, DOR and AUC were 13.94 (95% CI, 7.25-26.80), 0.23 (95% CI, 0.12-0.44) (**Appendix figs. 1 and 2**), 68.14 (95% CI, 33.20-139.84) and 0.96 (95% CI, 0.94-0.97), respectively (**Figs. 3 and 4A**). The I^2 statistics for sensitivity and specificity values were 77.19% (95% CI, 61.56%-92.81%) and 88.15% (95% CI, 81.33%-94.97%), respectively (**Fig. 2**), indicating substantial heterogeneity among the included studies. Estimation of the Spearman's correlation coefficient (*p*-value = 0.779) indicated the absence of the threshold effect. The results of meta-regression analysis revealed that patient sample size, publication year, magnetic field strength, the number of readers, design of study, blinding, the results of QUADAS-2 score and muscle tendon did not accounted for the heterogeneity of sensitivity and specificity (**Appendix fig. 3**) and the Deeks' Funnel Plot Asymmetry Test revealed no publication bias (*p*-value = 0.61) (**Fig. 5A**).

Diagnostic Value of MRI

In total, 5 studies [22, 23, 27, 30, 31] assessed the performance of MRI to diagnose articular-sided PTRCTs. The pooled sensitivity and specificity were 0.78 (95% CI, 0.65-0.87) and 0.97 (95% CI, 0.84-0.99), respectively (**Fig. 6**). The pooled PLR, NLR, DOR and AUC were 11.85 (95% CI, 1.71-82.19), 0.34 (95% CI, 0.17-0.67) (**Appendix figs. 4 and 5**), 47.82 (95% CI, 8.29-275.89) and 0.89 (95% CI, 0.86-0.92), respectively (**Figs. 7 and 4B**). The I^2 statistics for sensitivity and specificity values were 71.57% (95% CI, 45.21%-97.93%) and 95.17% (95% CI, 92.36%-97.97%), respectively (**Fig. 6**), indicating substantial heterogeneity among the included studies. Estimation of the Spearman's correlation coefficient (*p*-value = 0.873) indicated the absence of the threshold effect. The Deeks' Funnel Plot Asymmetry Test revealed no publication bias (*p*-value = 0.18) (**Fig. 5B**).

Discussion

This meta-analysis involving 8 studies [18, 23–29] for MRA and 5 studies [22, 23, 27, 30, 31] for MRI, reveals that MRA have a better diagnostic value than that of MRI for the diagnosis of articular-sided partial-thickness rotator cuff tears, but only small improvement of sensitivity (a sensitivity of 0.81 *vs.* 0.78).

It has become a popular topic whether contrast agent is used in the application of MRI to diagnosis RCTs. A network meta-analysis of 144 diagnostic studies involving 14059 patients (14212 shoulders) demonstrated that for the detection of full-thickness tears, partial-thickness tears, or any tear, MRA had the highest sensitivity, specificity, and superiority index in three common-used imaging modalities (MRA, MRI and US), which revealed that high-field MRA had the highest diagnostic value for detecting any tear, followed by low-field MRA, high-field MRI, high-frequency US, low-field MRI, and low-frequency US [16]. In addition, another meta-analysis included 14 studies involving 1216 patients with labral lesions, revealed that MRA had the highest sensitivity and specificity compared with those of MRI and CTA, which indicated that MRA was suggested for use in patients with chronic shoulder symptoms or a pathologic abnormality [32]. MRA has a good diagnostic performance mainly depending on the objective evidence of the leakage of contrast agent, accompanied by a good anatomic resolution and subtle defects depicted by contrast agents [33, 34]. Nonetheless, MRA, as an invasive diagnosis modality, has many disadvantages and limitations, including a longer examination time, increased risk of infection and adverse complication [35, 36].

MRI, as a noninvasive and reproducible diagnosis image, was recommended for the diagnosis of patient with suspected rotator cuff injuries [37]. Our lab's own research [16] confirmed that the diagnostic value rank (from high to low) of commonly-used modalities was 3.0-T MRA, 1.5-T MRA, 3.0-T MRI, 7.5-MHz US, 1.5-T MRI, and < 7.5-MHz US in the diagnosis of full-thickness tears; however, in the diagnosis of partial-thickness tears, the diagnostic value rank (from high to low) was 3.0-T MRA, 3.0-T MRI, 1.5-T MRA, 7.5-MHz US, 1.5-T MRI, and < 7.5-MHz US. Moreover, other research performed in our lab's confirmed that MRI had a similar sensitivity and specificity to MRA in the detection of bursal-sided PTRCTs [19]. In addition, another meta-analysis revealed that MRI is by far the first choice recommendation for imaging modality for the detection of acute labral lesions [32]. Recently, one study in 2020 using hierarchical summary receiver operating characteristic curves (HSROC) demonstrated that MRI was recommended to be a first-choice imaging modality for the detection of rotator cuff tears [38]. Although MRA have a higher sensitivity and specificity, it cannot replace MRI after the comprehensive consideration of accuracy and practicality.

In this study, MRA has a sensitivity of 0.81 and specificity of 0.96 for detecting articular-sided PTRCTs; however, MRI shows a sensitivity of 0.78 and specificity of 0.97 in detection of the articular-sided PTRCTs. The differences in specificity and sensitivity between MRA and MRI are quite small, and that may be a good reason to avoid the potential risk/cost of MRA, this result is in accordance with a prospective study that the sensitivity and specificity of MRA were improved only by 3–4% when compared with MRI [36].

Several limitations in this research should merit consideration. At first, the number of patients in the included studies is very small and most of the included studies are retrospective type. Evidence of heterogeneity in the pooled data existed cross the included studies. We used the meta-regression analysis to explore many factors that may bring the heterogeneity, including the patient sample size, publication year, magnetic field strength, number of readers, blinding and QUADAS-2 score, design of study (prospective or retrospective) as well as muscle tendon were used as covariates. Even though we found the source of heterogeneity, the insufficient data cannot support us to conduct relevant subgroup analyses, which will reduce statistical efficacy power. Moreover, this meta-analysis included 11 studies, mainly involved in patients suspected of full- and partial-thickness RCTs and not specifically articular-sided PTRCTs. Furthermore, the field density is very important for the diagnostic value of MRI or MRA in the detection of articular-sided PTRCTs, however, the insufficient data about the field density of MRA/MRI cannot support us to analysis this important influence. We assessed only the diagnostic value of the imaging modalities alone (MRA or MRI) without physical tests. Finally, the safety and cost-effectiveness of MRA/MRI in clinical practice should be assessed systematically.

Conclusion

This meta-analysis reveals that MRA has a better diagnostic value than that of MRI for the diagnosis of articular-sided partial-thickness rotator cuff tears, but only small improvement of sensitivity. Considering the price and invasion of MRA, MRI is recommended as an initial examination to detect patients suspected with articular-side partial-thickness rotator cuff tears.

Abbreviations

AUC: area under receiver operating characteristic curve; CIs: confidence intervals; DOR: diagnostic odds ratio; FN: false negative; FP: false positive; HSROC: hierarchical summary receiver operating characteristic curves; MRI: magnetic resonance imaging; MRA: MR arthrography; NLR: negative likelihood ratio; PTRCT: partial-thickness rotator cuff tear; PLR: positive likelihood ratio; PRISMA-DTA: Preferred Reporting Items for Systematic Review and Meta-analysis of Diagnostic Test Accuracy Studies; QUADAS: quality assessment of diagnostic accuracy studies; RCTs: rotator cuff tears; SROC: summary receiver operating characteristic curve; TN: true negative; TP: true positive.

Declarations

Acknowledgements

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Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Authors' contributions

LFX, DJL and LLX conceived and designed the study. LFX, DJL and LLX performed the search, extraction of data, and methodological assessment. All authors analysed the data and wrote the paper. All authors read and approved the final manuscript.

Ethics approval and consent to participate

Not applicable.

Consent for publication

All authors read the final manuscript and approved for publication.

Competing interests

The authors declare that they have no competing interests.

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Tables

TABLE 1. Main characteristics and technical parameters of the included studies.

Study, year	Country	Patients (Male, %)	Mean age (years)	Shoulders	Test	Sequence	Analyzed image plane	No. of readers	Reader experience (years)	Study design	Inclusion interval	Muscle tendon	QUAD 2 sco
Fritz, 2007	USA	230 (65.2)	43	238	1.5-T MRI	FS, T1WI, GE	transverse, cor obl, sag obl	2	NA	R	04.2000-07.2004	SSP or ISP	8
Magee, 2009	USA	150 (69.0)	31	150	3.0-T MRA	T1WI FSE, FS T2WI FSE	Ax, cor obl, sag	2	10/10	R	01.2007-07.2007	SSP	11
					3.0-T MRI	T1WI FSE, FS T2WI FSE, FS T2WI FSE							
Oh, 2009	Korea	36 (44.4)	53.9	36	3.0-T MRA	FS T1WI FSE, T2WI FSE, 3D fast FS GRE	Ax, cor obl, sag obl	2	NA	P	03.2006-06.2006	SSP or ISP	9
Chun, 2010	Korea	202 (54.5)	51	202	1.5-T MRA	FS T1WI SE,T2WI FSE	transverse, sag obl, cor obl	2	> 10	R	NA	All	10
Choo, 2012	Korea	49 (44.9)	55.6	49	3.0-T MRA	FS T1WI FSE, T2WI FSE, 3D FS T1WI FSE	Ax, cor obl, sag obl	2	Yes	R	08.2010-04.2011	All	9
Modi, 2013	UK	103 (73.8)	30	103	3.0-T MRA	FS T1WI SE, STIR, fs T2WI FSE, fs T1WI SE	Ax, cor obl, sag obl	3	Yes	NA	11.2006-07.2011	All	9
Lee, 2014	Korea	205 (47.8)	56.5	206	3.0-T MRA	FS T1WI FSE, 3D FS T1WI FSE	Ax, cor obl, sag obl	1	8	R	03.2011-07.2012	SSP or ISP	11
Choo, 2015	Korea	231 (42.0)	59	231	3.0-T MRA	T2WI FSE, FS T1WI FSE	cor obl, sag obl	1	8	R	01.2011-12.2013	SSP or ISP	7
Lee, 2015	Korea	333 (48.0)	56.9	333	3.0-T MRA	FS T1WI, T2WI FSE	Ax, cor obl, sag obl	2	10/7	R	03.2011-09.2013	SSP or ISP	10
					3.0-T MRI	GE, FS FSE PDW, T2WI FSE							
Lo, 2016	China	146 (65.1)	48.3	146	1.5-T MRI	T1WI, FS T2WI, SE DWI	cor obl	2	20/5	R	01.2012-07.2013	All	11
Perez, 2018	USA	10 (100)	16.7	10	1.5-T MRI	FS T2, PD, T1WI	Ax, cor obl, sag obl	NA	NA	R	01.2010-10.2016	All	11

P prospective, R retrospective, PD proton-density, PDW proton-density-weighted, FSE fast spin-echo, STIR short Tau-inversion recovery, GE gradient echo, TSE turbo spin-echo, FS fat suppreesed, SE spin-echo, GRE gradient-recalled echo, SPIR spectral presaturation inversion recovery, sag obl sagittal oblique, cor obl coronal oblique, cor coronal, sag sagittal, Ax Axial, fs fat-saturated, DE dual-echo, NA not available.

Table 2. The accuracy of MRA and MRI for detection of articular-sided partial-thickness rotator cuff tears.

Study	Test	Sensitivity (95% CI)	Specificity (95% CI)	PLR (95% CI)	NLR (95% CI)	DOR (95% CI)	AUC (95% CI)
Choo, 2012	3.0-T MRA	0.92 (0.62, 1.00)	0.92 (0.79, 0.98)	11.61 (3.87, 34.86)	0.09 (0.01, 0.59)	128.33 (12.09, 1362.4)	
Choo, 2015	3.0-T MRA	0.90 (0.73, 0.98)	0.83 (0.74, 0.90)	5.17 (3.30, 8.10)	0.13 (0.04, 0.37)	41.29 (11.20, 152.20)	
Chun, 2010	1.5-T MRA	0.85 (0.73, 0.93)	0.90 (0.84, 0.94)	8.41 (5.14, 13.75)	0.17 (0.09, 0.31)	50.98 (20.29, 128.09)	
Lee, 2014	3.0-T MRA	0.56 (0.31, 0.79)	0.98 (0.95, 1.00)	34.82 (10.53, 115.15)	0.45 (0.27, 0.76)	77.08 (17.70, 335.79)	
Lee, 2015	3.0-T MRA	0.75 (0.51, 0.91)	0.98 (0.95, 0.99)	32.55 (13.2, 80.27)	0.26 (0.12, 0.55)	127.20 (33.12, 488.54)	
Magee, 2009	3.0-T MRA	0.97 (0.84, 1.00)	1.00 (0.97, 1.00)	227.18 (14.28, 3614.60)	0.05 (0.01, 0.22)	4977.0 (1.9E+2, 1.3E+5)	
Modi, 2013	3.0-T MRA	0.40 (0.12, 0.74)	0.98 (0.92, 1.00)	18.60 (3.88, 89.14)	0.61 (0.37, 1.02)	30.33 (4.59, 200.33)	
Oh, 2009	3.0-T MRA	0.67 (0.22, 0.96)	0.90 (0.74, 0.98)	6.67 (1.98, 22.44)	0.37 (0.12, 1.16)	18.00 (2.26, 143.30)	
Pooled estimate		**0.81 (0.75, 0.87)**	**0.95 (0.93, 0.96)**	**13.94 (7.25, 26.80)**	**0.23 (0.12, 0.44)**	**68.14 (33.20, 139.84)**	**0.96 (0.94, 0.97)**
Fritz, 2007	1.5-T MRI	0.82 (0.65, 0.93)	0.98 (0.95, 1.00)	41.93 (15.68, 112.13)	0.19 (0.09, 0.38)	226.13 (59.96, 852.77)	
Lee, 2015	3.0-T MRI	0.50 (0.12, 0.88)	0.98 (0.92, 1.00)	23 (4.7, 112.47)	0.51 (0.23, 1.14)	45.00 (5.36, 377.56)	
Lo, 2016	1.5-T MRI	0.93 (0.77, 0.99)	0.65 (0.51, 0.78)	2.69 (1.83, 3.96)	0.11 (0.03, 0.41)	25.50 (5.44, 119.64)	
Magee, 2009	3.0-T MRI	0.69 (0.5, 0.84)	1 (0.97, 1.00)	162.27 (10.11, 2604.7)	0.32 (0.19, 0.53)	507.86 (28.72, 8980.6)	
Perez, 2018	1.5-T MRI	0.25 (0.01, 0.81)	0.67 (0.09, 0.99)	0.75 (0.07, 7.73)	1.13 (0.42, 3.00)	0.67 (0.03, 18.06)	
Pooled estimate		**0.77 (0.68, 0.85)**	**0.95 (0.92, 0.97)**	**11.85 (1.71, 82.19)**	**0.34 (0.17, 0.67)**	**47.82 (8.29, 275.89)**	**0.89 (0.86, 0.92)**

MRA magnetic resonance angiography, MRI magnetic resonance imaging, T tesla, PLR positive likelihood ratio, NLR negative likelihood ratio, DOR diagnostic odd ratio, AUC area under curve, CI confidence interval.

Figures

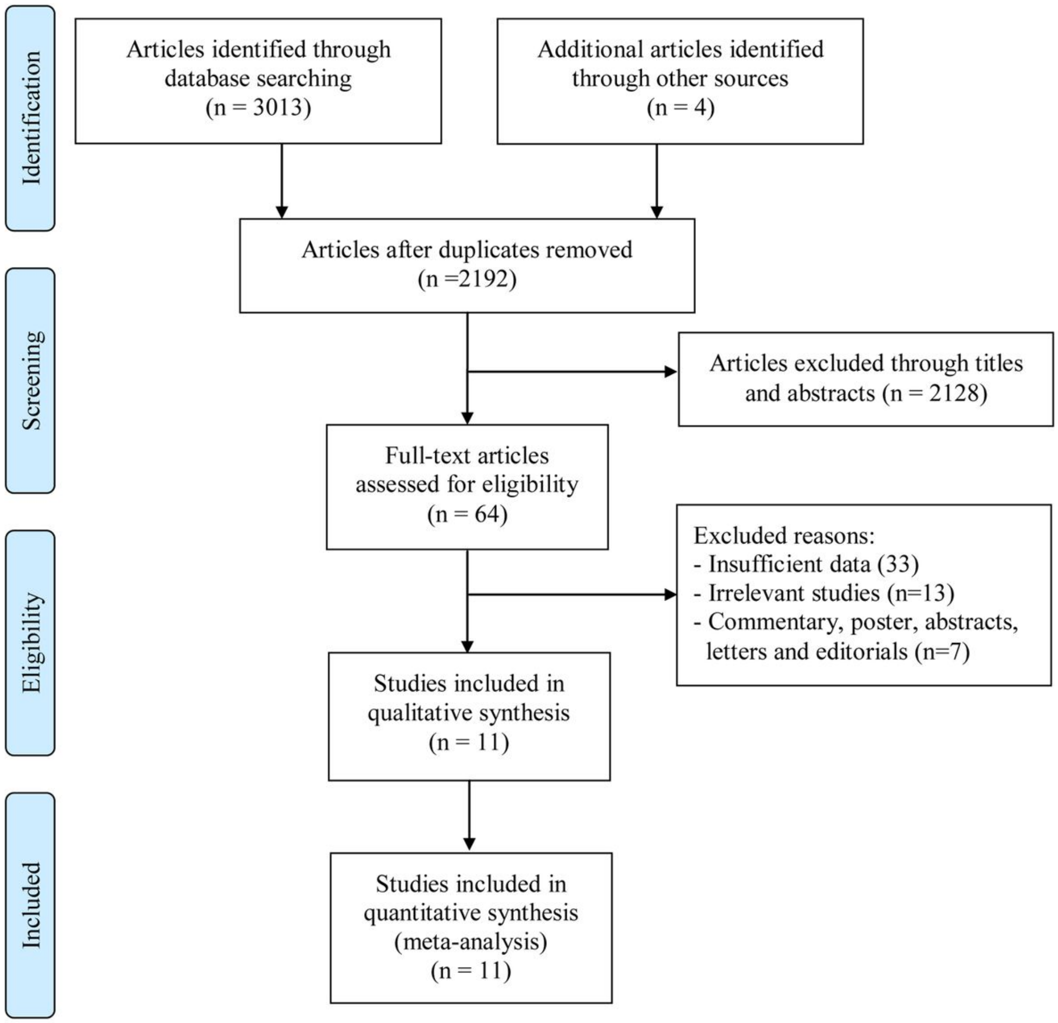

Figure 1

Selection process of the included studies.

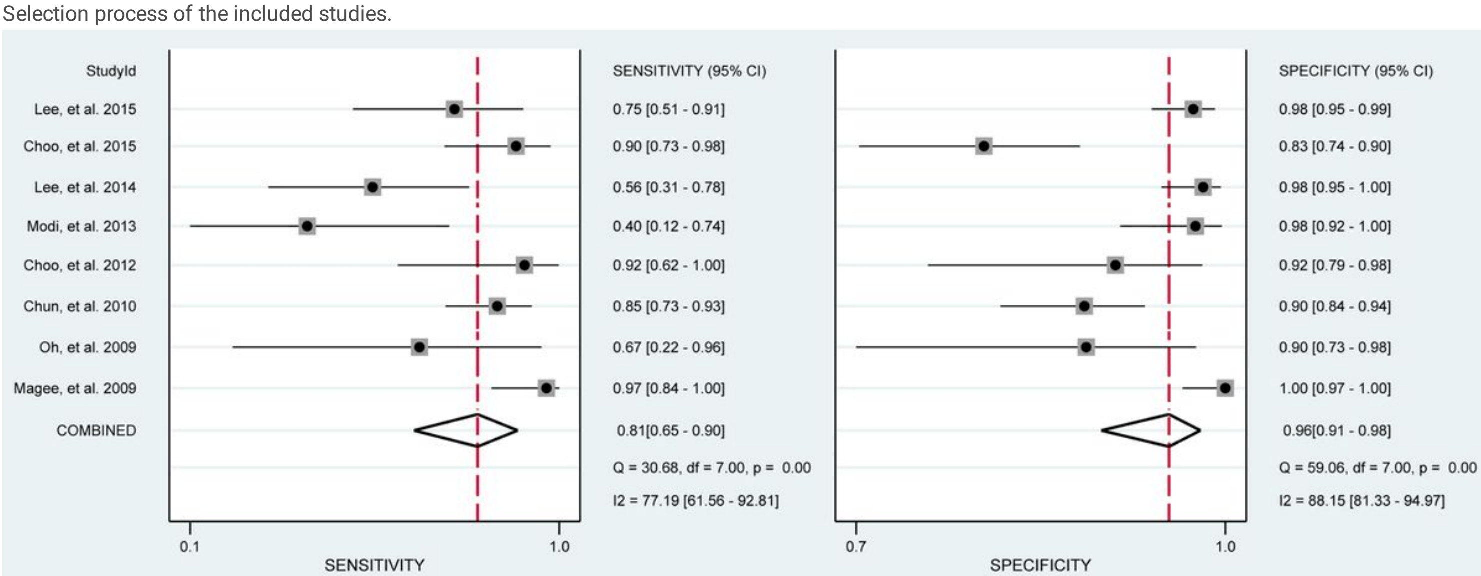

Figure 2

Forest plots of the pooled sensitivity and specificity of MRA to diagnose articular-sided partial-thickness rotator cuff tears with the corresponding 95% confidence region.

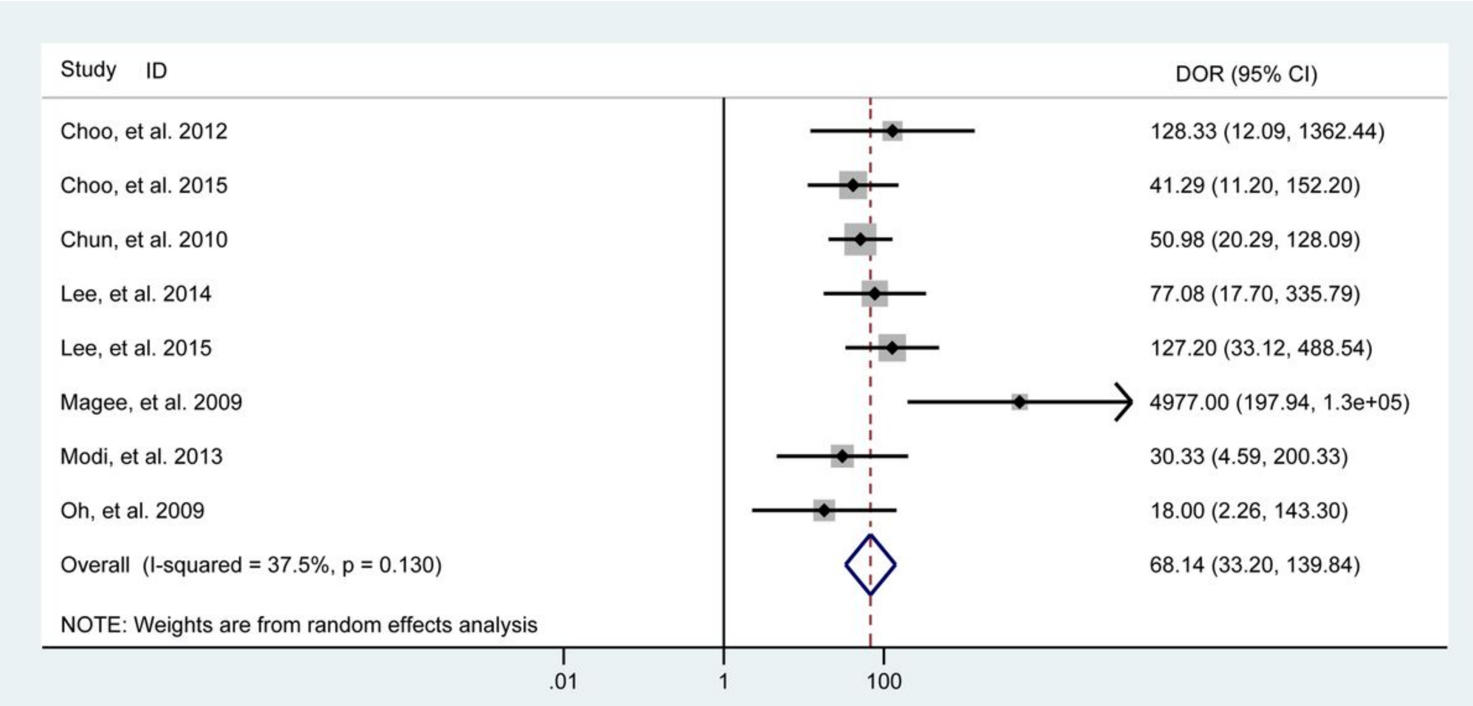

Figure 3

Forest plots of the pooled diagnostic odds ratio (DOR) of MRA to diagnose articular-sided partial-thickness rotator cuff tears with the corresponding 95% confidence region.

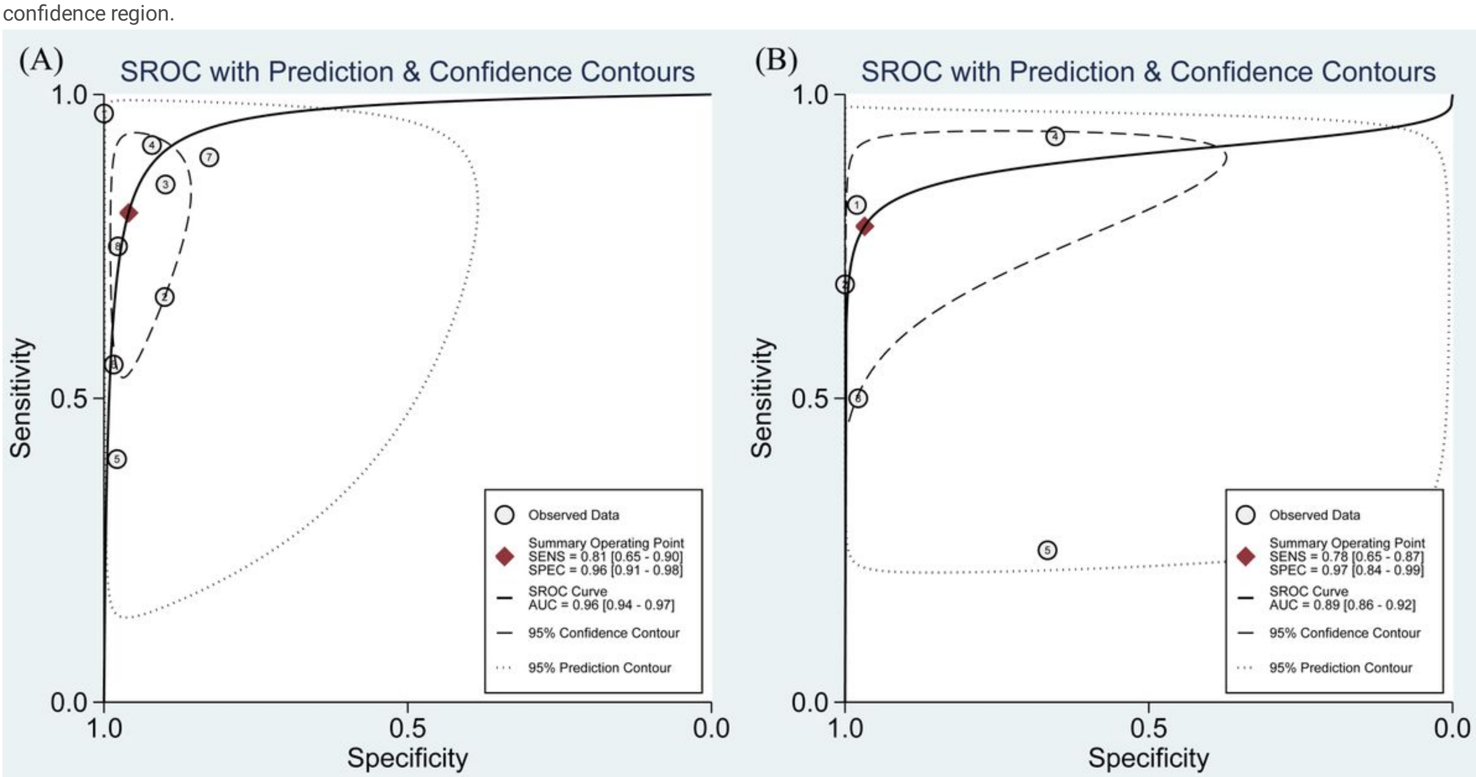

Figure 4

Summarized receiver operating characteristic curve (SROC) of MRA (A) and MRI (B) to diagnose articular-sided partial-thickness rotator cuff tears with the corresponding 95% confidence region

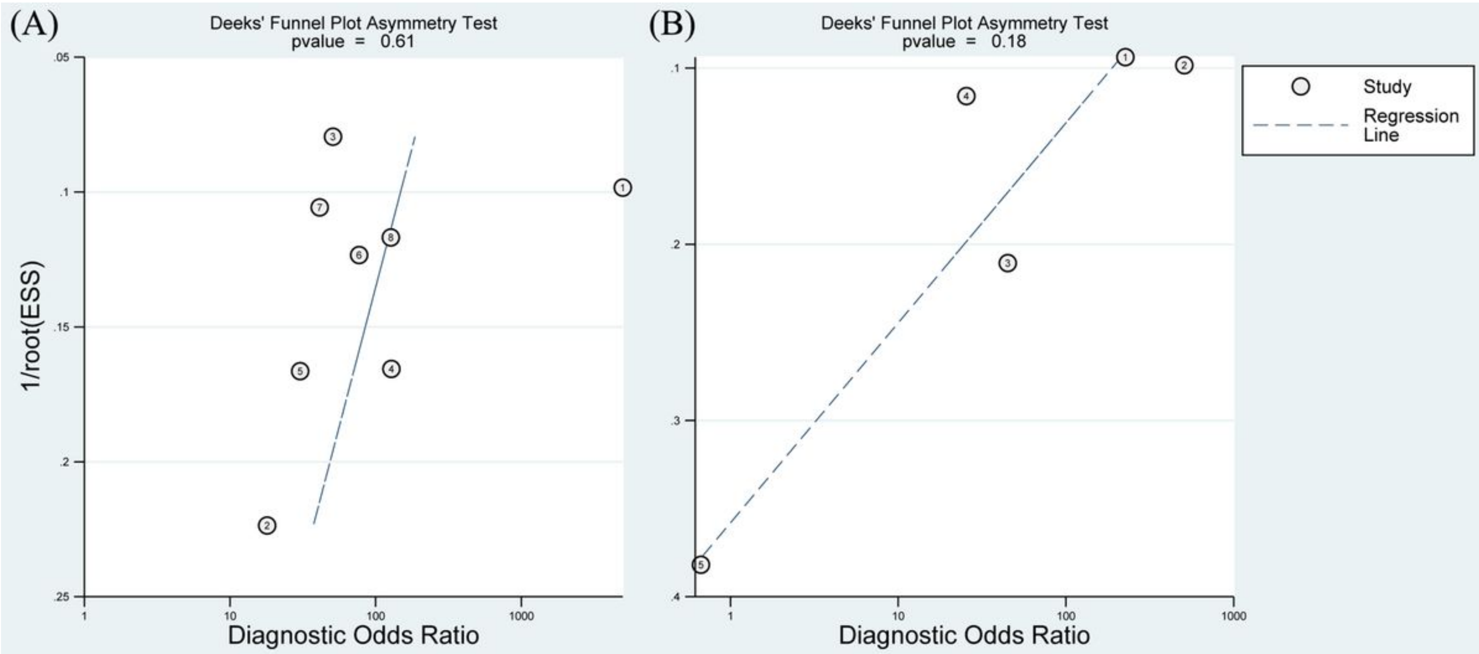

Figure 5

Graphical display of the results of Deek's test for publication bias of MRA (A) and MRI (B)

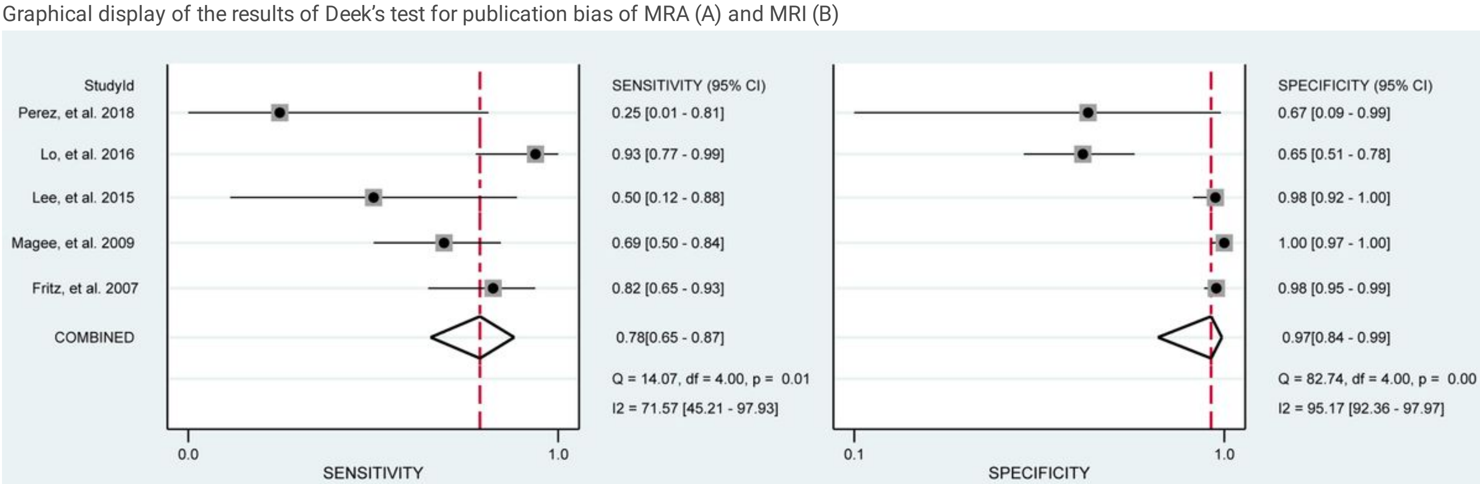

Figure 6

Forest plots of the pooled sensitivity and specificity of MRI to diagnose articular-sided partial-thickness rotator cuff tears with the corresponding 95% confidence region.

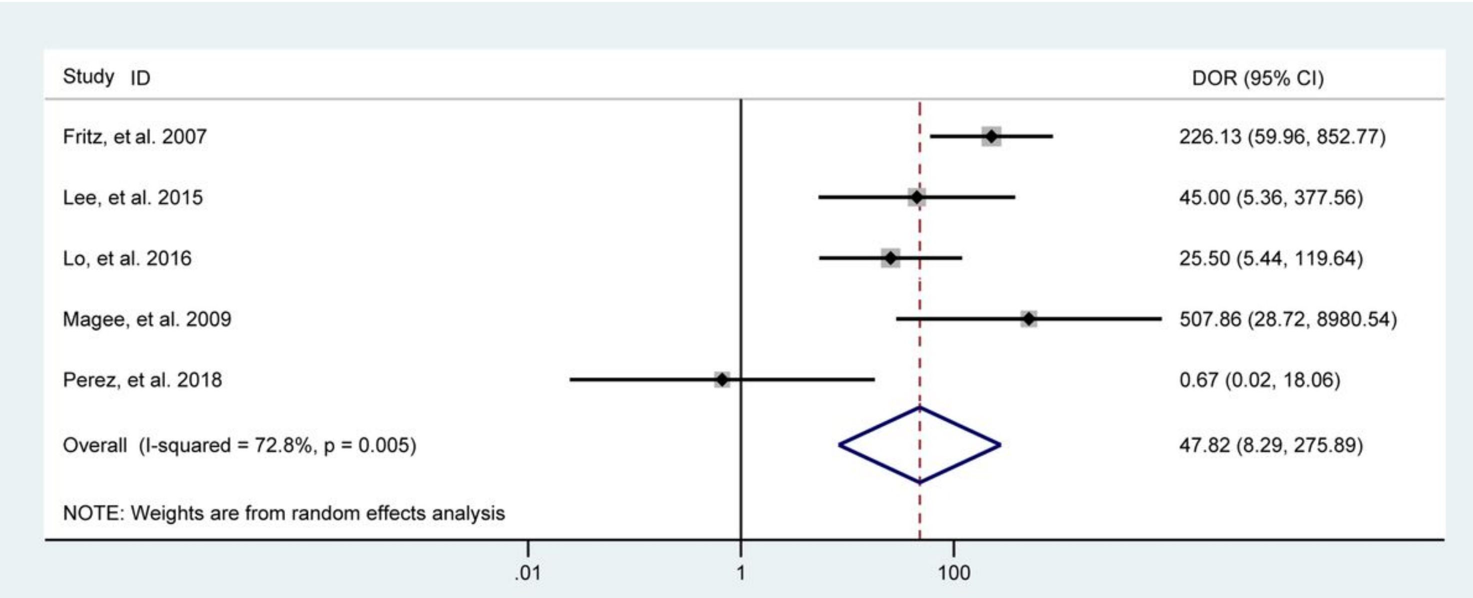

Figure 7

Forest plots of the pooled diagnostic odds ratio (DOR) of MRI to diagnose articular-sided partial-thickness rotator cuff tears with the corresponding 95% confidence region.

Supplementary Files

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