REVIEW ARTICLE

# A systematic review and pooled analysis of the prevalence of rotator cuff disease with increasing age

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**Hypothesis and background:** Abnormalities of the rotator cuff are more common with age, but the exact prevalence of abnormalities and the extent to which the presence of an abnormality is associated with symptoms are topics of debate. Our aim was to review the published literature to establish the prevalence of abnormalities of the rotator cuff and to determine if the prevalence of abnormalities increases with older age in 10-year intervals. In addition, we assessed prevalence in 4 separate groups: (1) asymptomatic patients, (2) general population, (3) symptomatic patients, and (4) patients after shoulder dislocation.
**Methods:** We searched PubMed, EMBASE, and the Cochrane Library up to February 24, 2014, and included studies reporting rotator cuff abnormalities by age. Thirty studies including 6112 shoulders met our criteria. We pooled the individual patient data and calculated proportions of patients with and without abnormalities per decade (range, younger than 20 years to 80 years and older).
**Results:** Overall prevalence of abnormalities increased with age, from 9.7% (29 of 299) in patients aged 20 years and younger to 62% (166 of 268) in patients aged 80 years and older ($P < .001$) (odds ratio, 15; 95% confidence interval, 9.6-24; $P < .001$). There was a similar increasing prevalence of abnormalities regardless of symptoms or shoulder dislocation.
**Discussion and conclusion:** The prevalence of rotator cuff abnormalities in asymptomatic people is high enough for degeneration of the rotator cuff to be considered a common aspect of normal human aging and to make it difficult to determine when an abnormality is new (e.g., after a dislocation) or is the cause of symptoms.
**Level of evidence:** Level III, Systematic Review.
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**Keywords:** Rotator cuff; abnormalities; prevalence; age

For many years, rotator cuff abnormalities were ascribed to subacromial abrasion/impingement caused by overhead activities.[20,25] In 1995, Milgrom et al proposed natural aging as the primary reason for cuff changes, as most people participate in limited overhead activity.[21] Additional studies have found rotator cuff abnormalities to be prevalent in both symptomatic and asymptomatic patients.[49] In addition, bilateral cuff abnormalities are commonly found in patients
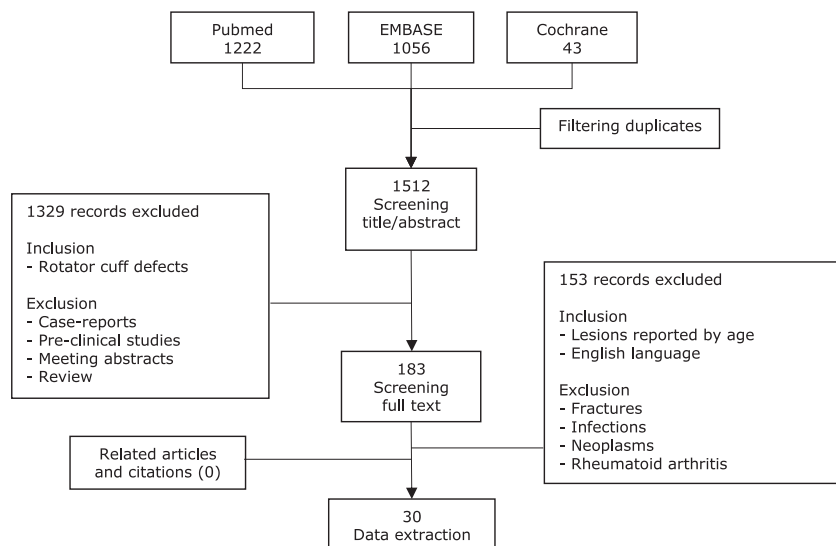
**Figure 1**  Flow chart of study selection.

with unilateral symptoms.[48] Atraumatic rotator cuff defects are commonly referred to as tears, but if rotator cuff thinning is part of the normal aging process, the word *tear*—which implies damage in need of repair—may be inappropriate. Given that pain—the cognitive and emotional responses to nociception—makes humans feel protective and prepare for the worst, accurate descriptions of the pathophysiologic processes that do not exacerbate maladaptive responses are important.

We aimed to perform a systematic review to establish the prevalence of rotator cuff abnormalities and to determine if the prevalence of abnormalities increases with older age. In addition, we assessed prevalence in (1) asymptomatic patients, (2) the general population, (3) symptomatic patients, and (4) patients after a shoulder dislocation.

## Materials and methods

### Selection criteria

We performed a systematic review adhering to the published guidelines by the Cochrane Collaboration and Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.[9,22] Our review is registered with PROS-PERO,[30] registration number CRD42014008670 (Appendix 1).[40] We included studies that established rotator cuff abnormalities by the individual patient's age or per decade in the English language. Case reports, meeting abstracts, reviews, and preclinical studies were excluded. We also omitted studies addressing rotator cuff tears with associated fractures, infections, neoplasms, or rheumatoid arthritis.

### Search strategy

We searched PubMed, EMBASE, and the Cochrane Library up to February 24, 2014, using the search string for title and abstract

(rotator cuff [mesh/emtree&regular]) AND (degeneration* OR tear* OR disruption* OR perforation* OR injury* OR ''pathologic change*'' OR ''degenerative change*'' OR defect* OR lesion* OR lesion* OR abnormality*) AND (age OR ages OR aged OR aging [mesh/emtree&regular]). See Appendix 2 for each specific search.

This yielded 1222 results from PubMed, 1056 from EMBASE, and 43 from the Cochrane Library. Title and abstract for each result from the databases were independently examined by 2 reviewers (T.T. and B.L.), who subsequently screened the full texts of eligible articles. Both reviewers also scanned the reference lists for additional studies that met the inclusion criteria (Fig. 1). The final list of included studies was agreed to by consensus.

We found 2 overlapping patient cohorts[24,26,32,34] (same authors and patient population) and included only the largest and most detailed studies.[24,26]

### Risk of bias assessment

The relevant criteria from the Newcastle-Ottawa Scale for assessing quality of nonrandomized cohort studies were used to assess methodologic quality of the included studies.[37] This scale provides a maximum of 3 stars for method of selection (1) and outcome assessment (2) (Appendix 3).

### Data extraction

Two reviewers (T.T. and B.T.R.) independently extracted study data using standardized sheets. Discordance was resolved by both reviewers rechecking their extracted data until data sheets corresponded. For each study, we extracted author, year, institute, retrospective/prospective design, specimen type, rotator cuff visualization, definition of abnormality, number of patients and shoulders, rotator cuff abnormality, and individual age or per decade. We included only tears of the supraspinatus tendon as this was most consistently reported throughout the included studies.

We contacted 70 corresponding authors of studies published after 2006 that did not report individual age but described eligible