Rotator Cuff Tears: Consideration Factors for ACC Cover

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This information has been developed by ACC Clinical Services with the support of the New Zealand Shoulder and Elbow Society (on behalf of the New Zealand Orthopaedic Association). It is based on a review of published research evidence and expert opinion. The document sets up the factors ACC's Clinical Advisors consider when providing their clinical advice to case owners who assess whether ACC can provide cover for a rotator cuff tear.

When to use this document

This document is recommended as a reference guide for ACC Clinical Advisors who are considering a causal link between an accident event and rotator cuff tear(s) confirmed on soft tissue imaging.[1]

For assessing whether a shoulder surgery request can be fast-tracked please refer to:

- Consideration factors for the fast track assessment of shoulder surgery requests (updated October 2012).[2]

This document provides:

- *Key points* on rotator cuff pathology, demographic characteristics and the initial presentation of rotator cuff tears
- *Rotator Cuff Tears – Clinical advice support tool* – criteria that are more supportive and less supportive of a possible causal link between an accident event and a rotator cuff tear
- *References* to key research papers.

1. Teres minor is one of the rotator cuff muscles however in the context of this document rotator cuff refers to supraspinatus, infraspinatus, subscapularis and the long head of biceps tendons.
2. This document is available on the ACC website on *http://acc.co.nz*

How to apply the consideration factors

The document is intended to provide a number of factors to be considered in combination when providing advice on causation of rotator cuff tears. It is not intended to be used as a point scoring tool e.g. with numeric comparison of the factors that are more supportive and less supportive of traumatic causation. The factors are not to be considered in isolation; rather the overall balance of factors that are more supportive and less supportive of a causal link should be considered.

The assessment of causation requires a good understanding of the identified pathology and careful consideration of the mechanism of injury, history, clinical and imaging findings. The timeframe between the accident event and imaging findings should also be considered. Imaging findings should be interpreted in the context of the patient's age, history of injury and history of symptoms when considering the aetiology of a rotator cuff tear (17).

Key points

Rotator cuff tendon pathology

Rotator cuff tears may be caused by a single episode of trauma, but more commonly represent a non-accident related gradual process. A preceding traumatic event is noted in approximately 40% of all cuff tears (18–20).

The natural history of degenerative rotator cuff tendon pathology includes the histological changes associated with tendinosis through to tendon tearing. This gradual tear development may occur without notable symptoms. The literature reports that 36% – 51% of all asymptomatic rotator cuff tears become symptomatic in 2.8 – 3.0 years without the need for an accident event (7, 22, 23).

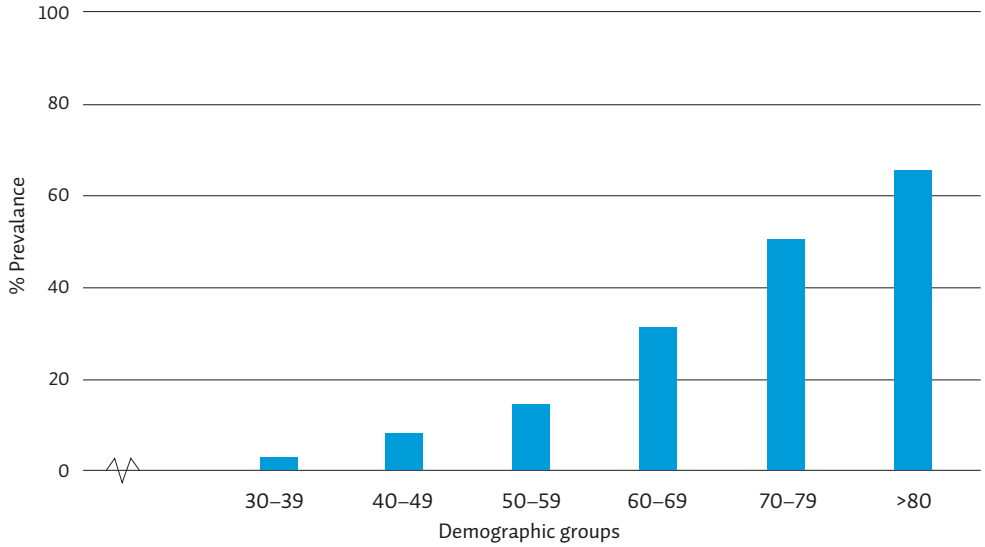
It is possible to cause an acute injury of a pathological tendon, e.g. an accident event could extend a gradual process tendon tear. This is associated with a sudden increase in symptoms and imaging evidence of acute tear enlargement. The assessment of suspected "acute on chronic" pathology should include consideration of the natural history. The natural history of gradual process rotator cuff tendon tears is that they may increase in size, often without trauma e.g. progression from partial thickness to full thickness through to complete (full thickness and full width) tendon tears. Just under half of all asymptomatic rotator cuff tendon tears enlarge within a few years (7, 22). Factors such as the size of the initial tear may influence the likelihood of tear enlargement (22).

Demographic characteristics

Rotator cuff tendon tears are relatively rare in younger people. The prevalence of asymptomatic partial and full thickness rotator cuff tears increases with age (23, 29–31), with tearing increasingly prevalent after the age of 50 years (29). A systematic review and pooled analysis of the prevalence of rotator cuff disease suggests that the overall prevalence of rotator cuff pathologies increases from less than 20% in patients under 60 years of age to more than 60% in patients aged 80 years and older (33).

The prevalence of rotator cuff abnormalities by age group is demonstrated in Figure 1.

FIGURE 1: PREVALENCE OF ROTATOR CUFF ABNORMALITIES IN THE GENERAL POPULATION. DATA FROM TEUNIS ET AL (33)



Initial presentation

The clinical presentation following a traumatic rotator cuff tendon tear is typically associated with a clear history of an accident event (with an appropriate mechanism of injury) and a sudden onset of significant symptoms e.g. severe pain, immediate loss of strength and the presence of functional impairment of the shoulder. It has been suggested that patients with acute traumatic cuff tears are expected to present soon after the accident event e.g. within 72 hours (8). In New Zealand the consensus expert opinion is that presentation would typically occur within a few weeks.

The absence of these features tends to point away from a single episode of trauma as being causative of any subsequently identified rotator cuff tear.

It is noted however that acute rotator cuff tears may be missed on initial clinical examination in the absence of early soft tissue imaging (34). It is also noted that a variety of injury mechanisms may be associated with the subsequent identification of a rotator cuff tear on soft tissue imaging (34).

The initial clinical examination findings need to be considered in the context of the time taken to that first assessment. A functional improvement, including measurable ROM and strength, may occur over time – especially with smaller tears.

Tear location

Rotator cuff tendon tear location is not considered in itself to be a reliable indicator of aetiology.

The supraspinatus tendon is often reported to be the rotator cuff tendon most commonly affected by tearing, either in isolation or in association with other tendon tears i.e. adjacent infraspinatus and/or subscapularis tendon tearing (32). Degenerative cuff tears were commonly thought to begin in the anterior part of the supraspinatus tendon and propagate posteriorly, but recent literature suggests that most degenerative cuff tears may actually initiate from a more posterior point, nearer to the junction of the supraspinatus and infraspinatus tendons (35). It is not clear whether the location of traumatic cuff tears is similar or differing to that of degenerative cuff tears.

Tearing of the subscapularis tendon most commonly occurs in association with other rotator cuff pathology. Isolated subscapularis tendon tears (pathology affecting only the subscapularis tendon of the rotator cuff) are relatively uncommon, present in less than 7% of all patients who undergo surgical rotator cuff repair (20, 36). Isolated tearing of the subscapularis tendon can be caused by trauma or gradual process/degeneration. The literature suggests that the majority (over 60%) of surgically treated isolated subscapularis tears are thought to be traumatic in origin (16, 24,

25, 36). Although isolated subscapularis tears frequently reflect single episode trauma this pattern of pathology should not be assumed to be traumatic without consideration of other factors. To accept a traumatic cause of an isolated subscapularis tendon tear the history should include an appropriate mechanism of injury e.g. a significant loaded external rotation and/or hyperextension injury of the shoulder, in combination with a supportive clinical history/presentation. Early imaging following a traumatic subscapularis tear may identify a full thickness tear of the superior half of the subscapularis with fresh haematoma at the tendon edge.

Subscapularis tearing, regardless of cause, is frequently associated with subluxation/dislocation of the long head of biceps tendon.

Rotator cuff re-tear

When a rotator cuff tear is surgically repaired there is the potential for structural failure (”re-tear”) of the repair. The failure of a repaired rotator cuff tendon could be associated with an accident event but can also occur in the absence of trauma. This finding could also represent tears that did not fully heal (37). Post-operative structural failure may occur without recurrence of symptoms (38). Several factors, including the size of the original tear, the amount of fatty infiltration of the tendon and the time taken before a repair is performed may influence the likelihood of post-operative structural failure.

Shoulder (glenohumeral joint) dislocation and rotator cuff tears

An accident event that is forceful enough to result in a traumatic glenohumeral dislocation of a stable shoulder has the potential to cause a rotator cuff tear (8). There is an increased risk of a rotator cuff tear that may involve multiple tendons, when people aged in their 40s and above sustain shoulder dislocation. However, a traumatic dislocation does not always result in an associated rotator cuff tear. Approximately one third of patients who sustain a traumatic anterior dislocation have either a rotator cuff tear or a greater tuberosity fracture (39). The overall frequency of rotator cuff tear after an anterior dislocation ranges between 7% and 32% and rises with advancing age (40). It should be considered that the prevalence of rotator cuff abnormalities increases with age, making the determination of aetiology more difficult particularly in older people in which the prevalence of rotator cuff abnormalities increases (33). Patients in their 70s or 80s will usually sustain a fracture in association with a shoulder dislocation rather than a rotator cuff tear.

Rotator Cuff Tears – Clinical advice support tool

IMPORTANT:

The factors in these tables are not to be considered in isolation; rather the overall balance of factors that are more supportive and less supportive of a causal link should be considered.

Factors that are MORE SUPPORTIVE of a possible causal link between an accident and an identified rotator cuff tendon tear.

Demographic	Younger demographic groups. Refer to Figure 1.
Cover	There is an ACC covered shoulder injury or evidence of a shoulder injury documented in the contemporaneous clinical notes.
Past history	No previous history of shoulder symptoms and no evidence suggestive of pre-existing rotator cuff pathology.

Factors that are LESS SUPPORTIVE of a possible causal link between an accident and an identified rotator cuff tendon tear.

Demographic	Older demographic groups. Refer to Figure 1.
Cover	ACC cover has not been given for a shoulder injury or there is no evidence of a shoulder injury documented in the contemporaneous clinical notes.
Past history	A history of shoulder problems in the injured shoulder, or intermittent pre-injury pain in the injured shoulder. Note that a history of prior shoulder problems does not exclude a new accident causing a new rotator cuff tear. A history of shoulder problems in the contralateral shoulder is directly relevant only if there is a history suggestive of a degenerative or atraumatic rotator cuff tear in that shoulder.
	A documented history of rotator cuff disease, including a past history of long head of biceps (LHB) pathology – particularly tears (*15*).
	Previous claims for the same shoulder, particularly if associated with low energy accident events. Note that if there are previous claims for the same shoulder then any contribution from these accidents to the current rotator cuff pathology should be considered, including consideration of the natural history of the condition.

Continued …

Factors that are MORE SUPPORTIVE of a possible causal link between an accident and an identified rotator cuff tendon tear.	
Initial presentation	Short time interval between the date of injury and the initial presentation, most commonly within a few days/weeks following a traumatic rotator cuff tear.
	The acute presentation includes immediate pain, loss of strength and reduced shoulder movement after the accident (*8*, *11*).
Mechanism of accident	The mechanism of injury involves an unexpected and high energy torsional force (*8*). For example: • Falling off a ladder/scaffolding/stairs and holding on to the railing/rung • Falling backwards from a height with the arm stretched out behind (posteriorly extended)
	The mechanism of injury correlates with the specific pathology identified e.g. a traumatic isolated subscapularis tendon tear is typically associated with a forceful hyperextension or external rotation of the adducted arm (*16*).

Factors that are LESS SUPPORTIVE of a possible causal link between an accident and an identified rotator cuff tendon tear.	
Initial presentation	The time interval between the date of injury and the initial presentation for treatment is greater than one month without explanation for this delay (*8*).
Mechanism of accident	The absence of a clear and consistent description of how the accident occurred. Preference should be given to the contemporaneous clinical notes, unless there is a good reason for doing otherwise.
	The mechanism of accident would not be consistent with causing a rotator cuff tear. There should be consideration of the likely pre-injury state of the tendon. Typical examples of mechanisms of accident that are unlikely to cause a traumatic rotator cuff tear include: • active muscular efforts in the case of controlled lifting or holding of loads (*8*) i.e. controlled activities– particularly within normal physiological limits for load • controlled and anticipated movements of the shoulder such as reaching to lift an item.

Continued …

Factors that are MORE SUPPORTIVE of a possible causal link between an accident and an identified rotator cuff tendon tear.	
Examination	Acute supraspinatus tendon tears may be associated with an inability to initiate abduction. A sudden inability to abduct the arm above 90° may also be relevant for supraspinatus tears (*21*). Patients with acute full thickness tearing often cannot elevate their arm for days or weeks after the injury (*11*).
	Drop arm sign [supraspinatus] and loss of strength with external rotation [infraspinatus] or internal rotation [subscapularis] are common clinical findings with tendon-specific rotator cuff dysfunction (*8*). These tendon specific findings are typical with an acute tendon injury though may also be present in the non-accident related pathology.
General imaging features (may be identified on one or more imaging modalities/ intraoperative observation)	The presence of blood, haematoma, debris or a large effusion (*2*,*3*).
	A mid-substance tear (*3*).
	Contralateral side is unremarkable (*8*, *9*).
	Haemarthrosis and haemorrhagic bursal effusion within a period of two weeks (*8*).
	Early surgical observation may demonstrate a fresh haematoma at the tendon margin (*8*).

Factors that are LESS SUPPORTIVE of a possible causal link between an accident and an identified rotator cuff tendon tear.	
Examination	A good range of motion (ROM) at the time of initial presentation. The timing between the accident event and this clinical examination needs to be considered.
	Wasting i.e. muscular atrophy of supraspinatus/infraspinatus/ deltoid within a short timeframe of accident (*8*).
General imaging features (may be identified on one or more imaging modalities/ intraoperative observation)	Tendinopathy affecting multiple (more than one) rotator cuff tendons.
	'Partial tears' may not equate to 'tendinopathy' or 'degenerative change'.
	As compared with previous imaging there is no new physical injury. Note that tear enlargement is not necessarily indicative of trauma. Tear progression may be part of the natural history of cuff tears (*7*).
	Non-visualised cuff due to massive tear (*3*, *10*) unless in conjunction with clear imaging and clinical evidence of major trauma with severe symptoms.
	Absence of a significant effusion within a short timeframe following injury.

Continued …

Factors that are MORE SUPPORTIVE of a possible causal link between an accident and an identified rotator cuff tendon tear.	
General imaging features (may be identified on one or more imaging modalities/ intraoperative observation) continued ...	Isolated tearing of the subscapularis tendon (in the absence of other rotator cuff pathology) appears to be more commonly traumatic (2, 17) though this pattern of pathology could also be caused by gradual process (24, 25). Current NZ expert opinion specifically refers to trauma as a likely cause of isolated full thickness tearing of the superior half to two thirds of subscapularis.
Ultrasound	The presence of significant joint or bursal fluid may represent acuity of tearing (17) and may be present for up to six months after a rotator cuff tear (3). It should be considered that full-thickness tears of any duration and regardless of aetiology, may be associated with increased bursal fluid as full-thickness tears may allow communication of fluid from the glenohumeral joint (more so in the presence of glenohumeral joint changes).

Factors that are LESS SUPPORTIVE of a possible causal link between an accident and an identified rotator cuff tendon tear.	
General imaging features (may be identified on one or more imaging modalities/ intraoperative observation) continued ...	A prominent inferior acromioclavicular joint (ACJ) osteophyte shown to be impinging on the cuff tendon on soft tissue imaging.
	Contralateral atraumatic cuff pathology, ie pathology in the other shoulder (9).
	Rotator cuff tear arthropathy (8). This finding is usually associated with massive cuff tears although is an uncommon sequelae. Cuff tear arthropathy is thought to take many years to develop (17). An acromio-humeral interval (AHI) <7 mm is strongly suggestive of a chronic rotator cuff tear (13, 17, 26).
X-ray	The presence on X-ray of cortical irregularity over the anterior greater tuberosity of the humerus when confirmed on Ultrasound/ MRI; particularly the presence of anterior cysts of the greater tuberosity (4–16) is suggestive of more chronic supraspinatus/ infraspinatus pathology.
	An acromio-humeral interval (AHI) <7 mm is strongly suggestive of a chronic rotator cuff tear (13).
	An acromial spur >5mm (14).
Ultrasound	Absence of joint or bursal fluid within a short timeframe of the accident event (). Note that a small amount of fluid in the bursa is physiological.

Continued ...

Factors that are MORE SUPPORTIVE of a possible causal link between an accident and an identified rotator cuff tendon tear.	
MRI	The presence of bone marrow oedema of the greater tuberosity with a supraspinatus tear may represent acuity (1). Oedema involving the whole muscle (12) It should be considered that whole muscle oedema is occasionally present without a history of trauma.

Factors that are LESS SUPPORTIVE of a possible causal link between an accident and an identified rotator cuff tendon tear.	
MRI	Tendon retraction beyond glenoid rim or > 35mm (2).
	Significant atrophy of the muscle belly e.g. significant supraspinatus atrophy detected by a tangent sign* (27, 28).
	No significant effusion/fluid signal in the tear (32)
	The presence of fatty infiltration of the supraspinatus and infraspinatus muscles is indicative of chronic tearing (20).The timing between the accident event and imaging needs to be considered. The terms 'atrophy' and 'fatty infiltration' are easy to confuse. Any reported findings of fatty infiltration that do not include the Goutallier grading should be interpreted with caution.

* The tangent sign is a technique for evaluating the amount of muscular atrophy of the supraspinatus tendon. It's seen on MRI as the failure of the supraspinatus to cross a line from the superior border of the coracoid process to the superior border of the scapular spine. It has strong correlation with other measures of atrophy or fatty infiltration, such as Goutallier sign.

References

1. McCauley TR, Disler DG, Tam MK. Bone marrow edema in the greater tuberosity of the humerus at MR imaging: association with rotator cuff tears and traumatic injury. *Magn Reson Imaging*. 2000;18(8):979–84.
2. Braune C, Gramlich H, Habermeyer P. [The macroscopic aspect of rotator cuff tears in traumatic and nontraumatic rupture cases]. *Unfallchirurg*. 2000;103(6):462–7. Der makroskopische Aspekt der Rotatorenmanschettenruptur bei traumatischen und atraumatischen Rupturformen.
3. Teefey SA, Middleton WD, Bauer GS, Hildebolt CF, Yamaguchi K. Sonographic differences in the appearance of acute and chronic full-thickness rotator cuff tears. *J Ultrasound Med*. 2000;19(6):377–8; quiz 83.
4. Fritz LB, Ouellette HA, O'Hanley TA, Kassarjian A, Palmer WE. Cystic changes at supraspinatus and infraspinatus tendon insertion sites: association with age and rotator cuff disorders in 238 patients. *Radiology*. 2007;244(1):239–48.
5. Suluova F, Kanatli U, Ozturk B, Esen E, Bolukbasi S. Humeral head cysts: association with rotator cuff tears and age. *European Journal of Orthopaedic Surgery and Traumatology*. 2014;24(5):733–39.
6. Jacobson J, Lancaster S, Prasad A, van Holsbeeck M, Craig J, Kolowich P. Full-thickness and partial-thickness supraspinatus tendon tears: value of US signs in diagnosis. *Radiology*. 2004;230(1):234–42.
7. Yamaguchi K, Tetro AM, Blam O, Evanoff BA, Teefey SA, Middleton WD. Natural history of asymptomatic rotator cuff tears: a longitudinal analysis of asymptomatic tears detected sonographically. *J Shoulder Elbow Surg*. 2001;10(3):199–203.
8. Lehner B, Loew M. Rotator cuff tears. Aetiology of rotator cuff tears and consequences for legal assessment. (Translated from German by Dr Ralf-Achim Thone, 2012). *Zentralblatt fur Chirurgie*. 2002;127:187–93.
9. Liem D, Buschmann V, Schmidt C, Gosheger G, Vogler T, Schulte T, et al. The prevalence of rotator cuff tears: is the contralateral shoulder at risk? *American Journal of Sports Medicine*. 2014;42(4):826–30.
10. Pill S, Phillips J, Kissenberth M, Hawkins R. *Decision making in massive rotator cuff tears. Instructional Course Lectures*. 2012;61:97–111.
11. Kuhn J. Current concepts: rotator cuff pathology in athletes – a source of pain or adaptive pathology? *Current Sports Medicine Reports*. 2013;12(5):311–5.
12. McMonagle J, Vinson E. MRI of the shoulder: rotator cuff. *Applied Radiology*. 2012;41(4):20–7.
13. Nove-Josserand L, Edwards T, O'Connor D, Walch G. The acromiohumeral and coracohumeral intervals are abnormal in rotator cuff tears with muscular fatty degeneration. *Clin Orthop*. 2005;433:90–6.
14. Ogawa K, Yoshida A, Inokuchi W, Naniwa T. Acromial spur: relationship to aging and morphologic changes in the rotator cuff. J *Shoulder Elbow Surg*. 2005;14(6):591–8.
15. Beall D, Williamson E, Ly J, Adkins M, Emery R, Jones T, et al. Association of biceps tendon tears with rotator cuff abnormalities: degree of correlation with tears of the anterior and superior portions of the rotator cuff. *American Journal of Roentgenology*. 2003;180:633–39.
16. Gerber C, Krushell R. Isolated rupture of the tendon of the subscapularis muscle. *The Journal and Bone and Joint Surgery*. 1991;73–B(389–94).
17. Mohammed K, Wilkinson B, Nagaraj C. Can imaging determine if a rotator cuff tear is traumatic? *The New Zealand Medical Journal*. 2010;123(1327).

18. Teratani T. Comparison of the epidemiology and outcomes of traumatic and nontraumatic rotator cuff tears. *Journal of Orthopaedics*. 2017;14:166–70.

19. McNamara W, Lam P, Murrell G. The relationship between shoulder stiffness and rotator cuff healing. *J Bone Joint Surg Am*. 2016;98:1879–89.

20. Melis B, Nemoz C, Walch G. Muscle fatty infiltration in rotator cuff tears: descriptive analysis of 1688 cases. *Orthop Traumatol Surg Res*. 2009;95(5):319–24.

21. Berhouet J, Collin P, Benkalfate T, Le Du C, Duparc F, Courage O, et al. Massive rotator cuff tears in patients younger than 65 years. Epidemiology and characteristics. *Orthopaedics & Traumatology: Surgery & Research*. 2008;95S:S13–S8.

22. Keener J, Galatz L, Teefey S, Middleton W, Steger-May K, Stobbs-Cucchi G, et al. A prospective evaluation of survivorship of asymptomatic degenerative rotator cuff tears. *The Journal of Bone and Joint Surgery, Incorporated*. 2015;07(2):89–98.

23. Moosmayer S, Smith H, Tariq R, Larmo A. Prevalence and characteristics of asymptomatic tears of the rotator cuff. *The Journal of Bone and Joint Surgery (British)*. 2009;91–B(2):196–200.

24. Nove-Josserand L, Hardy M, Leandro Nunes Ogassawara R, Carrillon Y, Godeneche A. Clinical and structural results of arthroscopic repair of isolated subscapularis tear. *Journal of Bone and Joint Surgery – American Volume* [Internet]. 2012; 94(17):[e125 p.].

25. Edwards T, Walch G, Sirveaux F, Mole D, Nove-Josserand L, Boulahia A, et al. Repair of tears of the subscapularis. *Journal of Bone and Joint Surgery – American Volume*. 2005;87(4):725–30.

26. Saupe N, Pfirrmann CW, Schmid MR, Jost B, Werner CM, Zanetti M. Association between rotator cuff abnormalities and reduced acromiohumeral distance. *AJR Am J Roentgenol*. 2006;187(2):376–82.

27. Zanetti M, Gerber C, Holder J. Quantitative assessment of the muscles of the rotator cuff and magnetic resonance imaging. *Investigative Radiology*. 1997;33(3):163–70.

28. Williams M, Ladermann A, Melis B, Barthelemy R, Walch G. Fatty infiltration of the supraspinatus: a reliability study. *Journal of Shoulder and Elbow Surgery*. 2009;18:581–87.

29. Milgrom C, Schaffler M, Gilbert S, van Holsbeeck M. Rotator cuff changes in asymptomatic adults. The effect of age, hand dominance and gender. *Journal of Bone and Joint Surgery (British)*. 1995;77–B:296–98.

30. Yamamoto A, Takagishi K, Toshihisa O, Yanagawa T, Nakajima D, Shitara H, et al. Prevalence and risk factors of a rotator cuff tear in the general population. *Journal of Shoulder and Elbow Surgery*. 2010;19:116–20.

31. Sher JS, Uribe JW, Posada A, Murphy BJ, Zlatkin MB. Abnormal findings on magnetic resonance images of asymptomatic shoulders. *J Bone Joint Surg Am*. 1995;77(1):10–5.

32. Tuite MJ. Magnetic Resonance Imaging of Rotator Cuff Disease and External Impingement. *Magnetic Resonance Imaging Clinics of North America*. 2012;20 (2):187–200.

33. Teunis T, Lubberts B, Reilly B, Ring D. A systematic review and pooled analysis of the prevalence of rotator cuff disease with increasing age. *Journal of Shoulder and Elbow Surgery*. 2014;23:1913–21.

34. Sorensen A, Bak K, Krarup A, Thune C, Nygaard M, Jorgensen U, et al. Acute rotator cuff tear: do we miss the early diagnosis? A prospective study showing a high incidence of rotator cuff tears after shoulder trauma. *Journal of Shoulder and Elbow Surgery*. 2007;16(2):174–80. Epub 2006 Dec 13.

35. Kim HM, Dahiya N, Teefey SA, Middleton WD, Stobbs G, Steger-May K, et al. Location and initiation of degenerative rotator cuff tears: an analysis of three hundred and sixty shoulders. *J Bone Joint Surg Am*. 2010b;92(5):1088–96.

36. Lafosse L, Jost B, Reiland Y, Audebert S, Toussaint B, Gobezie R. Structural integrity and clinical outcomes after arthroscopic repair of isolated subscapularis tears. *The Journal and Bone and Joint Surgery*. 2007;89:1184–93.

37. Bjornsoon H, Norlin R, Johansson K, Adolfsoon L. The influence of age, delay in repair, and tendon involvement in acute rotator cuff tears. *Acta Orthopaedica*. 2011;82(2):187–92.

38. Jost B, Christian W, Pfirrmann A, Gerber C. Clinical outcome after structural failure of rotator cuff repairs. *The Journal of Bone and Joint Surgery American*. 2000;82(3):304–14.

39. Robinson C, Shur N, Sharpe T, Ray A, Murray I. Injuries associated with traumatic anterior glenohumeral dislocations. *Journal of Bone and Joint Surgery – American Volume*. 2012;94(1):18–26.

40. Gomberawalla M, Sekiya J. Rotator cuff tear and glenohumeral instability: a systematic review. *Clinical Orthopaedics and Related Research*. 2014;472(8):2448–56.

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