

# Natural History of Rotator Cuff Tears

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## Abstract

Rotator cuff tears are a frequent phenomenon with an increasing incidence when the patient gets older. A considerable number of tears remain asymptomatic during a lifetime.

However, still, a substantial number of asymptomatic tears become symptomatic. There is, at present evolving evidence that surgical treatment of small to medium-sized tears does better than conservative treatment, even after a long term follow-up.

A treatment algorithm is suggested to help the clinician in decision making, where tear size and age are important factors in the prognosis of surgical treatment.

**Keywords:** Rotator cuff; Ruptures; Natural history.

## Introduction

Tendon degeneration is a natural process in many areas in the body, but it is by far more prevalent in the rotator cuff tendons compared to other tendons.

Both intrinsic and extrinsic factors have been proposed as a cause of the degeneration of rotator cuff tendons. Codman [1] suggested intrinsic factors in the tendon leading to a rupture, while Neer [2] assumed that abutment against the acromial arc is leading to impingement, tendinosis, and subsequent tearing of the tendons.

More recent research data supports the intrinsic theory: repetitive overloading, as well as decreased vascularity, contribute to tendon degeneration. In the process of the disease of the tendon, several inflammatory mediators play a role, leading to either apoptosis of cells or, sometimes, remodeling.

## Epidemiology

Rotator cuff disease increases with age. Teunis et al. [3] found a prevalence of rotator cuff abnormalities in asymptomatic patients, varying from 97 % in people 20 years or younger to 62% in people 80 yrs or older. Milgrom [4], using ultrasound, found a prevalence of asymptomatic cuff tears of 30% in the 6<sup>th</sup> decade to 80% in the 9<sup>th</sup> decade. Yamamoto [5] examined the population of a mountain village in Japan and found a prevalence of rotator cuff tears of 20.7%. In symptomatic patients, the prevalence was 36%; in asymptomatic people, the prevalence was 16.9%.

Considering all the available data, rotator cuff tears can be considered to be part of normal aging processes. Clinically a distinction is made between degenerative, non-traumatic, and traumatic tears. Still, it is assumed, that trauma can only cause a tear in an asymptomatic

diseased tendon or as an extension of a pre-existent asymptomatic tear.

## Patho-anatomy

Codman [6] described that the degeneration starts as a peel-off lesion, about 7 mm behind the biceps pulley. Kim [7] observed that degenerative tears initiate in a region 13-17 mm posterior to the biceps tendon, which is located in the posterior part of the supraspinatus and the anterior part of the infraspinatus. When the disease progresses, the tear propagates in a posterior direction from this area. They also showed that only 30% of the full-thickness rotator cuff tears are limited to the most anterior area of the supraspinatus footprint.

With the progression of the cuff tear, the anterior part of the supraspinatus, with the anterior rotator cuff cable, weakens and starts to disrupt from the footprint, thus damaging the biceps pulley and exposing the biceps tendon, which can lead to degeneration of this tendon, rupture or subluxation over the subscapularis tendon with subsequently tearing of the subscapularis tendon.

In an analysis of 251 rotator cuff tears with ultrasound Kim [8] showed a relation of size and location of cuff tears with fatty degeneration. This degeneration was in nearly all cases only visible in full-thickness tears. The more anterior the tear was located on the footprint, the more supraspinatus muscles with fatty degeneration were seen. Tear size was the most important predictor of the infraspinatus muscle degeneration, while tear disruption of the anterior supraspinatus tendon was the most important predictor of the supraspinatus muscle degeneration.

When the disease progresses, the change in normal glenohumeral

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kinematics leads to superior migration of the head. A tear area threshold of 175 mm<sup>2</sup> was identified as a critical size, which demonstrated a positive correlation to superior migration [8].

### **Tear Progression**

Progression of a degenerative rotator cuff tear is a common phenomenon but is not occurring in all cases. Keener [9] evaluated 224 asymptomatic rotator cuff tears in one shoulder and pain due to rotator cuff disease in the contralateral shoulder with a median follow-up of 5.1 years. Tear enlargement was seen in 49% of the cuff tear shoulders at a median of 2.8 years. 46% developed new pain; there was a relation between tear enlargement and pain, but this relation was not absolute (hazard ratio 1.66). The two and 5-year risks of tear enlargement were 11 and 35% for partial tears compared to 22 and 50% for full-thickness tears. In another study by the same author [10] of 346 shoulders over four years, it was shown that tear enlargement and pain development was more common in the dominant shoulder, while activity level and occupational demand were not related to tear enlargement. Patients with higher occupational demands developed more pain.

At present, we don't have data on the natural course of asymptomatic cuff tears with a more than five years follow-up.

Dunn et al. [11] showed in a study of 393 patients treated conservatively, that the pain level was not related to the severity of the atraumatic tear. However, medical comorbidities, lower education level, and race rather than tear-related factors were associated with pain severity.

### **Fatty Muscle Degeneration**

Degeneration (also mentioned infiltration) of muscles in rotator cuff tears is a frequent phenomenon. Progression of muscle degeneration is studied in a group of 156 asymptomatic rotator cuff tears for 6.0 years [12].

Progression of muscle degeneration was greater in tears that enlarged compared to those that remained stable. Progression of muscle degeneration was also more frequent in tears that enlarged when the baseline size was larger and with disruption of the anterior supraspinatus insertion.

They found a wide distribution in time between tear enlargement and progression of fatty degeneration; however, the median time to progression of muscle changes in relation to tear enlargement was 1.0 year for the supraspinatus and 1.1 years for the infraspinatus.

### **Arthritis**

Chalmers et al. [13] showed in a study, where they followed 105 shoulders with a rotator cuff tear compared to 33 control shoulders for a period of average eight years, a significant progression of arthritis. Still, the changes remained minimal in this period. The degree of radiographic progression was independent of cuff tear size or tear enlargement.

There is no data in the present literature on the incidence and prevalence of more severe arthritis (Hamada grades 3 or 4) in untreated rotator cuff tears.

### **Non-operative Management Versus Surgery**

Moosmayer [14] re-examined 49 patients with asymptomatic cuff

tear after a follow-up of an average of 8.8 years, treated with three months or more of physiotherapy. Mean tear size increased by 8.3 mm in the anterior-posterior plane and by 4.5 mm in the medial-lateral plane. Progression of degenerative muscle changes to a Goutallier stage 3 or 4 was observed in 41% by MRI at the final follow-up. Large tear size increases and the progression of muscle atrophy were correlated to a poorer clinical outcome.

They made an important comment for clinical use: half of the shoulders progressed from an initially good prognosis for a successful anatomical repair to a poor prognosis.

Moosmayer [15, 16] compared the surgical treatment of small to medium size tears versus physiotherapy in 103 patients and published reports of 5 and 10 years follow-up. After 5 years the operated group had better clinical outcome, but not significant while the difference between groups did not reach the minimal clinically important difference for the outcome scales.

At 10 years, however, the difference increased in favor of the operated group, with a significantly better clinical outcome. Fourteen patients had crossed over from physiotherapy to secondary surgery and had an outcome on the Constant score that was 10.0 points inferior compared with that of the primary tendon repair group.

### **Acute Versus Non-acute Tears**

Acute, traumatic, full-thickness rotator cuff tears, with immediate weakness and pain, account for only 8% of those who present with symptomatic rotator cuff tears [17]. In these cases, during surgery, clear changes, suggesting an acute process, were seen; these were, however, combined with changes in the tendon adjacent to the tear, suggesting the acute tear is superimposed upon a chronic disease [17]. They occur in relatively young, mainly male patients after a fall or trauma in the abducted externally rotated arm [18].

Loew et al. [19] compared MRI's of traumatic and non-traumatic rotator cuff tears and found more edema in the injured muscles and a kinking, wave-like appearance of a torn tendon, while fatty infiltration was more prominent in the degenerative group.

Tan et al. [20] analyzed a large series of mainly small to medium-sized traumatic and non-traumatic cuff tears and found no difference in healing rate when the traumatic event was less than 24 months before repair.

Petersen et al. [21] analyzed the outcome of traumatic tears of all sizes, and found good clinical results, even of the large or massive tears, when operated within four months after the trauma.

### **Discussion**

There is abundant literature showing that three factors are important for cuff healing after repair: age, tear size, and severity of fatty muscle infiltration.

Collin et al. [22] demonstrated that repair of an isolated supraspinatus rupture in 288 patients with a follow-up of 10 years showed a durable good clinical outcome. Preoperative fatty infiltration and postoperative retear have a negative effect on the final outcome.

Bases on all present data, the following algorithm can be formulated.

- Patients with a symptomatic small to medium size cuff tear, acute or non-acute, younger than 65 years, with minimal or no fatty infiltration, should be advised to have their cuff tear repaired. The rationale is that this size of tears has a high healing rate after repair while, left alone, will have a high chance of progression, leading to less good results, when a

repair is indicated.

- In patients with degenerative tears and/or older than 65 years, a period of conservative treatment is justified. Surgery is indicated when 3-6 months of conservative treatment fails. Results will be less good when retraction and fatty degeneration is more advanced.

- Patients with an irreparable tear ( fatty infiltration grade 3 and 4, according to Goutrallier and considerable retraction) should have extensive conservative treatment before other options, depending on the severity of the pathology and the preference of the surgeon.

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