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Age-related changes of the glenoid labrum: a narrative review

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ABSTRACT

An increased incidence of glenoid labral injuries has been reported, possibly due to advances in imaging procedures with an improved ability to define these injuries. This narrative review describes the common variations of the glenoid labrum, age-related changes and effects of sport- and occupation-related stress. Five electronic databases were searched using the following keywords: shoulder joint, glenoid labrum, age factors and age. Thirteen articles met the inclusion criteria: seven investigated cadavers, two throwing sportspeople and four patients undergoing shoulder arthroscopy. Normal anatomical variants include the sublabral foramen and recess, a mobile superior glenoid labrum, a cord-like middle glenohumeral ligament and the Buford complex. These changes start to appear around the age of 30 years with increasing incidence with age, while in throwing sportspeople changes and SLAP lesions commonly appear as early as adolescence. Longitudinal studies are needed to confirm the development of these changes, and whether or not they are associated with risk for future symptoms. However, based on current findings, the presence of the age- or activity-related changes is not always associated with symptoms. Thus, caution is needed when making decisions with regards to the labral changes as possible sources of a patient's shoulder symptoms.

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Key words: age factors, ageing, glenoid labrum, shoulder joint

INTRODUCTION

Shoulder pain remains one of the most common musculoskeletal disorders seen in general practice. Various disorders or pathology may contribute towards this pain, such as subacromial impingement syndrome, rotator cuff pathology and/or lesions of the glenoid labrum (Feleus et al 2008). The glenoid labrum consists of a ring of dense collagenous tissue fibres with fibrocartilaginous tissue in the peripheral attachment area (Prescher 2000). It expands the size and depth of the glenoid cavity, increasing the stability of the glenohumeral joint (Cooper et al 1992). It also provides an attachment site for the shoulder capsule, glenohumeral ligaments and the tendon of the long head of the biceps muscle. Vascularity of the labrum is limited to the periphery, being supplied from the suprascapular, circumflex scapular, and posterior circumflex humeral arteries (Cooper et al 1992). A cadaveric study showed a small number of free nerve endings in the fibro-cartilage tissue of the peripheral half of the labrum, with no evidence for mechanoreceptors (Vangsness et al 1995).

Injuries to the glenoid labrum are common in both the general and sporting population and are divided into superior labrum anterior to posterior (SLAP) lesions or non-SLAP lesions. SLAP lesions have been extensively described in the literature since the mid-1980s (Andrews et al 1985, Snyder et al 1995) and can be incurred through a traumatic incident, such as falling on an outstretched arm, or develop insidiously, often due to cumulative loading associated with throwing sports (Dutcheshen et al 2007). These injuries are treated by rehabilitation alone or by arthroscopic repair followed by rehabilitation (Dodson and Altchek 2009, Edwards et al 2010, Ellenbecker et al 2008, Gorantla et al 2010, Wilk et al 2005). Non-SLAP lesions include degenerative, flap and vertical tears, as well as Bankart lesions, avulsions of the anterioinferior labrum at its attachment to the inferior glenohumeral ligament (Wilk et al 2005).

Snyder et al (2010) described four types of SLAP lesions. Type I SLAP lesion is a partial tear and degeneration to the superior labrum where the edges are rough and frayed, but the labrum is not completely detached. Type II SLAP lesion involves the detachment of the superior labrum and long head biceps tendon from the supraglenoid tubercle. Clinically, it is believed to be difficult to discern this pathologic variant from a non-pathologic variant. Type III SLAP lesion is a bucket handle tear of the labrum where the torn labrum hangs into the joint and may cause 'locking'. For Type IV SLAP lesion the labral tear extends into the long head of biceps tendon (Snyder et al 2010).

With the emergence of sophisticated imaging processes and availability of arthroscopy over the past two decades, it appears that there has been an increase in the reported incidence of SLAP repairs. While figures are not available for New Zealand, SLAP repairs accounted for 9.4% of total shoulder surgical cases, in the United States of America during the period 2003-2008 (Weber et al 2012). Increases have been reported up to 464% from 2002 to 2010 in New York State (Onyekwelu et al 2012) and a national increase of 105% from 2004 to 2009 (Zhang et al 2012).

When diagnosing musculoskeletal conditions, it is important to consider normal anatomic variations and age-related changes of implicated structures. Age-related changes have been defined for structures of the shoulder such as the acromial beak and rotator cuff muscles (reviewed by Lewis 2011). Despite many studies looking at the variations in the glenoid labrum, there is still lack of clarity over what is to be considered age-related changes and normal variants. The main aim of this narrative review is thus, to summarise the normal variations of the glenoid labrum and changes it undergoes with age. This review will also aim to address the effect of sport- and occupation-related stress on the glenoid labrum for different age groups. Knowledge of these variations is important in order to assist the clinician in the diagnosis of glenoid labrum injuries and to direct the treatment required for a pathological labrum. Alternatively, it may assist in deciding when changes identified with arthroscopy and/or imaging may be considered a normal variation or age-related changes as opposed to being pathological.

METHODS

A database search was conducted using PubMed, Scopus, Cinahl, Medline, and Embase from 1946 up until February 1st 2013. An update of studies was performed in December 2013. Search terms used in the database search included "age factors OR age AND glenoid labrum OR shoulder joint". Results were limited to English, Chinese, German language and human subjects. Inclusion criteria used in this review were: (1) male and female with no age restriction; (2) sportspeople, workers, undefined and cadavers; (3) cross-sectional, longitudinal and cadaveric study designs; (4) cadaveric, ultrasound, imaging, and arthroscopy methods of research. Articles which contained concomitant injuries (rotator cuff tear, Bankart lesion, glenohumeral instability and Hill Sachs lesion) were included if they clearly stated whether the labrum had normal segments. (A Hill Sachs lesion is a posterolateral humeral head indentation fracture due to an anterior shoulder dislocation). Studies including patients undergoing arthroscopy were excluded if they did not clearly state the diagnoses of the patients. Clinical commentaries were excluded.

RESULTS

The result of the initial database search was 832 articles and after removal of duplicates, 785 remained. Review of the titles and abstract yielded 17 articles relevant for this review. After reviewing the full text articles, 8 of the studies were considered to be appropriate for inclusion in the review. From the reference lists of these studies, a further three full text studies were reviewed and included in the narrative review. In total, 11 studies were initially included in the narrative review and with an updated database search in December 2013, two additional papers were found (Lesniak et al 2013, Tuite et al 2013) (Table 1). Seven studies investigated freshly frozen cadaver shoulder specimens with age at death ranging from fetal to 95 years, and two studies used MRI of baseball pitchers (Lesniak et al 2013, Miniaci et al 2002). Four studies reported on labral variations found on arthroscopy of patients presenting with shoulder pain (Clavert et al 2005, Davidson and Rivenburgh 2004, Rao et al 2003, Tuite et al 2013). No study was found to investigate normal variations or age-related changes of the labrum in occupational groups.

DISCUSSION

The anatomy of the superior labrum was described to be highly variable. Based on arthroscopical observations, three different types of glenoid labra were described in a series of patients as a bumper type (18% of shoulders), meniscal labrum (38%), and a triangular labrum (44%) (Davidson and Rivenburgh 2004). The superior part of the labrum appears to have a different morphology from the inferior part (Cooper et al 1992). The inferior part appears to be more rounded and continuous with the articular cartilage and firmly attached to the glenoid (Cooper et al 1992), whereas the superior part is more meniscoid and has a loose attachment to the glenoid (Cooper et al 1992). The superior part inserts directly in the biceps tendon: the collagen fibres of the labrum and biceps tendon intermingle at the insertion (Cooper et al 1992, Davidson and Rivenburgh 2004). The anterosuperior part of the labrum also inserted into the fibres of the middle or inferior glenohumeral ligament in many specimens (Cooper et al 1992). The close relationship between the labrum, biceps tendon and glenohumeral ligaments, described as a "basket of fibres" (Davidson and Rivenburgh 2004), makes it difficult to differentiate between symptoms emanating from one or the other, based on clinical examination.

The following section will describe normal variations and age-related changes to the labrum, followed by sports-related changes. An orthopaedic reference of describing shoulder lesions as a "clock" for the right shoulder will be used, thus the 12 o'clock and 3 o'clock positions depict the superior and anterior labrum, respectively.

Normal variations and age-related changes

Four common anatomical variations were described: a sublabral recess, a sublabral foramen, the mobile superior labrum and the Buford complex. The labral recess is found in the superior labrum (11 to 1 o'clock position) (Kreitner et al 1998, Pfahler et al 2003), whereas the sublabral foramen is located anterosuperiorly (1 to 3 o'clock) (Rao et al 2003). The Buford complex is characterised by the complete absence of labral tissue at the anterosuperior aspect of the labrum (1 to 3 o'clock), in conjunction with a cord-like middle glenohumeral ligament (MGHL) which attaches to the superior part of the labrum at the base of the biceps (Rao et al 2003).

Cooper et al (1992) described the recess as a synovial reflection beneath the biceps tendon and the superior part of the labrum. The incidence was found to be 71% in cadaver specimens (above 60 years old at time of death) and can vary in depth between 1 to 10 mm (Kreitner et al 1998). Based on a study comparing two groups of cadaveric specimens, with an average age of 84 and 49 years at death, respectively, Harzman et al (2003) found a higher incidence of sublabral recesses

Table 1: Characteristics and main outcomes of included studies

Authors	Study aim	Participants	Main outcomes
Clavert et al (2005)	To describe the anteriorsuperior glenoid labrum and analyse findings as a function of the patient's age.	100 patients undergoing shoulder shoulder arthrocopy, mean age 56 years (range 17 – 79), divided into two groups: Group 1: < 30 years Group 2: > 30 years	Increasing incidence of mobile superior labrum after 30 years.
Cooper et al (1992)	To describe the cross-sectional anatomy of the glenoid labrum, its microvascularity and its attachments.	23 fresh-frozen cadaveric shoulder specimens, aged 30-90 years at time of death.	The superior and anterosuperior portions of the labrum were loosely attached to the glenoid, and also inserted directly into the biceps tendon. The superior and anterosuperior parts of the labrum had less vascularity than do the posterosuperior and inferior parts, and the vascularity was limited to the periphery of the labrum.
Davidson and Rivenburgh (2004)	Descriptive anatomic study to describe variant anatomic patterns of the superior labrum.	191 consecutive patients, mean age 50 years (range 23-83), were prospectively evaluated arthroscopically to quantify the dimensions of the labrum and articular cartilage on the supraglenoid tubercle.	49 patients (25%) had articular cartilage on the supraglenoid tubercle, a mobile labrum and no fibrous tearing or evident injury in this region. Only 1 (2%) of these patients reported shoulder symptoms 1 year post-arthroscopy.
Harzmann et al (2003)	To define the incidence, location and depth of the sublabral recess of the labrum in a sample of cadavers specimens.	Group A: 20 cadaveric shoulder specimens, average 84 years at time of death; Group B: 11 cadaveric shoulder specimens, average 49 years at time of death.	On magnetic resonance arthrography, 75% of Group A specimens had a recess between 2 and 7 mm. With macroscopic inspection, 85% of these specimens had a recess greater than 1 mm deep. In Group B, 64% had a sublabral recess on macroscopic inspection.
Kreitner et al (1998)	To analyse the anatomic relationship between the superior labrum, the superior glenoid rim, the superior glenohumeral ligament, and the long head of the biceps tendon.	17 fresh-frozen cadaveric shoulder specimens (6 men, 3 women; mean age 76 years, range 64-87) underwent axial, oblique coronal and oblique sagittal MR imaging.	The superior labrum was normal in 6 shoulders; 3 shoulders had severe degeneration with scar tissue formation. A sublabral recess was evident in 12 shoulders: high variability was found for the attachment of the superior glenoid labrum.
Lesniak et al (2013)	To examine the relationship between MRI findings of the shoulder for asymptomatic professional pitchers and subsequent time on the disabled list.	21 asymptomatic professional baseball pitchers (mean age 29 years) from a baseball league organization underwent preseason MR of the dominant shoulder. Demographic and training data were collected, and subsequent time on the disabled list was monitored.	In total, 18 of the 21 pitchers (86%) had a labral lesion: 10 pitchers had an isolated SLAP lesion, 13 had either anterior or posterior labral tears, of which 5 had a SLAP lesion and an anterior/posterior tear. A moderate correlation ($r = 0.43$, $P = 0.09$) was found between the number of career innings pitched and presence of a combination of SLAP and anterior/posterior labra tears. SLAP lesions by themselves were not significantly correlated with innings pitched. No significant findings were found between single preseason MRI finding and subsequent time on the disabled list within one season of the MRI.

Miniaci et al (2002)	To evaluate MRI findings in both shoulders of asymptomatic professional baseball pitchers.	14 baseball pitchers (mean age 20 years), without significant prior shoulder injury	Signal abnormalities were found in 22 of the 28 shoulders imaged (78.5%): 11 in the throwing shoulder, 11 in the non-throwing shoulder. Most common abnormalities were anterior-superior, anterior- inferior and posterior-inferior labrum, including Type 3 tears of the labrum (36% of throwing and of non-throwing sides). Abnormal increase in intra-substance signal for 43% of throwing and 50% of non-throwing shoulders. No significant differences were found for the labral changes between the throwing and non-throwing shoulders. One pitcher had SLAP lesions in both shoulders.
Pfahler et al (2003)	To evaluate the glenoid and labrum of normal shoulders at different ages and characterize any apparent age-dependent changes.	32 normal cadaveric shoulder specimens, mean age 57 years, range 18-89 years, at time of death (22 male, 10 female, mean age of 57 years). Group 1: 10 shoulders, aged 18 – 40 years; Group 2: 10 shoulders, aged 41 – 60 years; Group 3: 12 shoulders: aged 61 – 89 years. Shoulders with macroscopic signs of injuries were excluded.	Labrum fissures were found in 6 shoulders (19%), detachment of the labrum in 3 (10%) across all age groups. Group 1 and 2: lesions at the superior and anterior- superior positions were the most prevalent and the incidence increased with age. Group 3: circumferential labral lesions were common.
Prodromos et al (1990)	To determine the composition of the glenoid labrum and to describe age-related changes	38 cadaveric shoulder specimens, aged 0 (or fetus) to 95 years at time of death. Both shoulders were taken from 8 cadavers.	Under 30 years of age the labrum was firmly attached to glenoid rim. Over 30 years of age the labrum showed signs of aging with fibrillation of the labral articular surface and the intercellular matrix. Decreases vascularity and increased severity of degenerative change were also observed with increasing age.
Rao et al (2003)	To describe anteriorsuperior labral variations and the prevalence thereof, and determine their clinical importance in a sample of patients undergoing shoulder surgery.	546 patients undergoing shoulder arthroscopy.	73 patients (13.4%, average age 42 years) had one of three variations of the anteriorsuperioer labrum; the remainder (86.6%, average age 45 years) had normal glenoid labra, defined as being present and attached to the glenoid labrum throughout. No significant differences were found for these two groups in terms of gender distribution, age, occupation, participation in sport and primary diagnosis for the shoulder disorder. Labral lesions were associated with anteriosuperior labral fraying, an abnormal superior glenohumeral ligament and increased passive internal rotation range of motion.
Smith et al (1996)	To evaluate size, location, and appearance of the sublabral recess of the superior glenoid labrum with conventional MR imaging, MR arthrography, gross dissection, and limited histologic evaluation.	26 freshly frozen cadaveric shoulder specimens.	A sublabral recess was present in 19 shoulders and was deeper than 2 mm in 10 shoulders. In 16 of 19 shoulders, the sublabral recess was located in the most anterior section obtained through the superior labrum. No definite correlation was found between subject age, sex and glenolabral junction type.
Tuite et al (2013)	To determine the prevalence of a normal variant cleft/recess at the labral-chondral junction in the anterior, inferior, and posterior portions of the shoulder joint.	103 patients (106 shoulders) undergoing MR arthrography and shoulder arthroscopy, mean age 36 years (range 14 to 76 years)	A 1-mm cleft of the labral-chondral junction was found in 40% of arthroscopically normal labral segments. A 2- to 3-mm recess was found in 3-8% of labral segments. Age and gender did not correlate with presence of a cleft/recess.
Waldt et al (2006)	To evaluate the anatomical variability of the superior labrum and the labro-bicipital complex with the use of MR arthrography and multi-slice CT arthrography	43 cadaveric shoulder specimens, mean age at death 78 years, range 61 – 89.	On macroscopic inspection, a sublabral recess was found in 32/43 (74%) cases and one shoulder had a SLAP type 3 lesion.

greater than 1 mm in the older group, suggesting these to be age-related changes. However, a recent study with patients undergoing arthroscopy indicated an incidence of 40% for 1 mm recesses, and that age and gender were not correlated with these changes (Tuite et al 2013).

Rao et al (2003) characterised the anatomical variants in the anterosuperior aspect of the glenoid labrum in a group of patients undergoing arthroscopic surgery, with the average age of 45 years. These patients had the primary diagnoses of rotator cuff disease, glenohumeral instability, acromioclavicular disease, frozen shoulder and 3% were classified as having "other" diagnoses. They considered the labrum to be normal when it was present and attached to the glenoid rim throughout the anterosuperior quadrant, which was present in 87% of their patients. In the remaining 13% of their study population, distinct normal variations of the anterosuperior portion of the labrum were recorded (Rao et al 2003). These findings agree with an incidence of 16% for a sublabral foramen in cadaver specimens (Pfahler et al 2003).

Based on a cadaveric study with 26 specimens, Smith et al (1996) suggested that the sublabral foramen was caused by a degenerative reorganisation process, which would agree with other findings that the foramen appeared to be an age-dependant change (Kreitner et al 1998, Pfahler et al 2003). Pfahler et al (2003) investigated 32 normal cadaveric shoulders macroscopically, histopathologically and radiologically, categorised into the following three age groups: Group 1, aged 18 to 40 years; Group 2, aged 41 to 60 years; and group 3, aged 61 to 89 years. Included specimens had not had previous shoulder surgery, fractures, dislocations, or any macroscopic signs of shoulder pathology (Pfahler et al 2003). Prodromos et al (1990) appear to have used the largest age range of cadaver specimens to investigate the attachment and shape of the superior glenoid labrum, which, from fetal life to old age are variable. Their findings supported those of other groups, namely that the glenoid labrum is circularly attached to the glenoid rim, with no irregularities up until the age of 10 years (Cooper et al 1992, Pfahler et al 2003).

Large variations in the incidence of the mobile superior labrum and their anatomic variations were reported, influenced by the age of the participants or specimens included in the different studies. A mobile superior labrum was reported in 25% of patients undergoing shoulder arthroscopy (Davidson and Rivenburgh 2004) and increased in incidence in patients above 30 years (Clavert et al 2005). While some authors (Davidson and Rivenburgh 2004) suggest that a mobile superior glenoid labrum overlying a smooth supraglenoid tubercle is a common morphologic variant, others suggest that it is an age-related change as cadaveric studies (Clavert et al 2005, Pfahler et al 2003) found an increase in the non-pathological "mobile labrum" type after 30 years of age. Cooper et al (1992) suggested this variation can be considered normal as long as there is no definitive tear or detachment. After 30 years, there may be some loosening of the upper part of the labrum (Pfahler et al 2003). Between the ages of 30 to 50 years, tears and defects begin to develop at the superior and anterosuperior aspect of the glenoid labrum. For participants around 40 years, mobility of the superior part of labrum was observed between 10 and 1 o'clock, progressing to 9 and 3 o'clock in the oldest patients (Clavert et al 2005). After 50 years it was noted that the labrum becomes thinner and absent in some areas (Pfahler et al 2003, Prodromos et al 1990). The glenoid labrum is inconsistently fixed to the glenoid rim in the person over 60 years of age (Pfahler et al 2003). An extending recess can overlap with a pathologic Type II SLAP lesion (Davidson and Rivenburgh 2004, Kreitner et al 1998, Pfahler et al 2003), thus care must be taken in differentiating this variant from the pathologic lesion. Based on these findings, it seems likely that the only time this condition requires repair is when the tissue has been subjected to specific trauma.

Regions of interest were also investigated histopathologically by Pfahler et al (2003) in relation to their clinical relevance by taking tissue blocks from areas of the labrum.

Increasing tears and structural defects, particularly of the superior and anterosuperior labrum were found with increasing age (Pfahler et al 2003). This region is commonly called the biceps anchor as it is the position where the long head of the biceps tendon originates. It appears to be the starting point for age-dependent and degenerative changes because of the biomechanical stressors during functional movements (Pfahler et al 2003). The anterosuperior (2 o'clock) position was found to be the area of highest stress distribution on the glenoid and was consequently the region of the glenoid with the highest lesion prevalence. Structural changes recorded in the labrum were accompanied by an increase in number of cells and hypervascularity, indicating the repair process. It is the second decade when changes to the labrum (e.g. fissures, detachments, tears) first appear, increasing in severity and number with age. In the oldest cadaveric specimens (group 3), these changes were seen around the entire glenoid cavity (Pfahler et al 2003). Above 60 years of age, the labrum changed on a global scale with notable fissures, tears and detachments (Pfahler et al 2003). The inferior (6 o'clock) and posterior (9 o'clock) positions had fewer and less severe tears and defects (Pfahler et al 2003). These findings support the notion that the variability seen in the superior half of the labrum may be in response to increased or repetitive forces.

The continuity of the labrum with the inferior glenohumeral ligament is thought to be biomechanically significant as detachment of this capsulolabral complex has been involved in glenohumeral instability. Interestingly, the findings of this complex were independent of age as no significant differences to changes in the inferior capsular-labral complex were found among the three age groups (Pfahler et al 2003). Thus, it appears that changes to the superior labrum may be age-related and do not always need to be repaired. However, changes to the inferior capsular-labral complex, including a Bankart lesion, are most likely due to trauma, and surgery is often needed.

Sports-related changes of the labrum

Pfahler et al (2003) hypothesised that the repetitive microtrauma from the shear forces created during sports and activities of daily living may gradually lead to early degenerative changes of the superior and anterosuperior labrum. Contraction of the long head of biceps muscle places high tensile forces on the labrum (Pfahler et al 2003). Findings of two studies investigated the incidence of SLAP lesions in baseball players (Lesniak et al 2013, Miniaci et al 2002) and appear to support the hypothesis of increased labral changes in this population. Miniaci et al (2002) evaluated the MRI findings of the labrum in both shoulders of asymptomatic professional baseball pitchers without significant previous shoulder injuries. Results showed that 45% of the throwing shoulders and 36% of the non-throwing shoulders of young pitchers had SLAP lesion(s), with no significant difference between the throwing and non-throwing shoulders of the individual athletes. Training and conditioning in baseball players

frequently involves both upper extremities which may explain the increased incidence in SLAP lesions in the non-throwing shoulder (Miniaci et al 2002).

In a more recent longitudinal study involving baseball pitchers (Lesniak et al 2013), 86% of pitchers (18 of 21) had labral lesions at the beginning of a season: 10 had a SLAP lesion, and 13 had either a posterior or anterior lesion, with 5 of these also having a SLAP lesion. This figure is clearly higher than the earlier study by Miniaci et al (2002) which may be explained, in part, by a younger group included in the earlier study. However, following the pitchers throughout the season, no correlation was found between the incidence of the lesions and subsequent days on the disabled list (i.e. unable to play due to shoulders symptoms). A moderate correlation was found between the presence of these lesions and number of career innings (Lesniak et al 2013), lending support for the hypothesis that these lesions may be activity-related.

Clavert et al (2005) reported that lesions found in professional baseball pitchers have been diagnosed with increasing frequency and excision of the labrum part has become a common treatment. The challenge remains to assess whether or not a labral lesion, such as a SLAP lesion, is the most likely source of the sports person's symptoms.

Clinical implications

The clinician assessing patients with shoulder disorders needs to decide whether labral abnormalities should be considered the pathological source of the patient's symptoms or whether they are "normal" age-related variations. This review found that anatomical changes of the labrum are common and appear to increase with age, particularly in the superior and anterosuperior region. While a sublabral recess and foramen were found to be common in the older population, it was suggested that if it was located anterior to the head of the biceps tendon, it should be considered a normal variant. A Type II SLAP lesion is diagnosed when the sublabral recess extends posterior to the biceps tendon (Kreitner et al 1998). Cooper et al (1992) suggested that a mobile and loosely attached superior labrum should not be considered abnormal unless there was definite tearing or detachment. As the anterosuperior labral variations have not been associated with shoulder instability, it was suggested that they may not always have to be repaired (Rao et al 2003).

For baseball pitchers, the high incidence of labral abnormalities demonstrated on MRI (Lesniak et al 2013, Miniaci et al 2002) indicates that only a relatively small percentage of these have "normal" labra, and those authors suggested that the mere presence of abnormalities do not confirm symptomatic pathological findings. Caution is therefore needed when interpreting these findings with imaging or arthroscopy. Changes to the glenoid labrum appear to be of minimal clinical relevance if the person examined is clinically asymptomatic. Such changes should be considered a normal age-dependent physiologic process (Pfahler et al 2003) or could also be considered an adaptive response to activity-related loading.

Assessment of labral injuries is further challenged by the low accuracy of many diagnostic procedures. For imaging of the labral-capsule ligamentous complex, magnetic resonance arthrography (MRA) has been suggested to be the most accurate (Pavic et al 2013). However, this procedure has also been shown to have low sensitivity (65%) for glenoid labrum tears, subsequently confirmed with arthroscopy in young patients with anterior shoulder instabilities (Jonas et al 2012). Furthermore, most of the clinical tests for the labrum lack sufficient accuracy (Hanchard et al 2013, Hegedus et al 2008, Sandrey 2013). This may be due in part, to the close structural relationships between the labrum, fibres of the long head of biceps muscle and the middle and inferior glenohumeral ligamentous complex. Differentiating between labral injuries and capsular or biceps tendon disorders can thus be very challenging, if not impossible, based on a clinical examination.

Considering labral lesions to contribute towards a patient's symptoms is thus complicated by two main issues, lack of accuracy of diagnostic tests and lack of clarity on what "normal" changes entail. If there is doubt regarding the possible association between symptoms and signs of labral abnormalities, it could thus be suggested that a conservative approach should be used in the first instance, such as treating the impairments associated with the patient's shoulder pain. Only if these are not successful, should further interventions, such as surgery, be considered.

Several limitations of this study influenced the findings. First, there are very few studies which recognise the posterior and inferior aspects of the glenoid labrum. Further research is needed to more clearly identify age-related changes of the labrum and differentiate between normal and pathologic variations. Also, only a small number of studies looked at the effect sport-related stress has on the glenoid labrum, and longer term studies are needed to determine whether changes observed for the labrum are associated with development of symptoms. This information is important as it may potentially prevent unnecessary costs of surgery should symptoms not emanate from the defined structural changes. Lastly, while it is known that labral changes often co-exist with other injuries, such as of the rotator cuff, the biceps anchor and capsuloligamentous complex, the scope of this review was limited to the changes of the glenoid labrum.

CONCLUSION

This review suggests that anatomical variations of the superior and anterosuperior glenoid labrum are common, including a labral recess and foramen, the Buford complex and a mobile superior labrum. These start to appear around the age of 30 years, increasing with age, while in throwing sportspeople changes such as SLAP and non-SLAP lesions appear to be common as early as adolescence. Cadaveric studies indicate that these may be age-related changes, however, reports also indicate that the changes may also be an adaptive response to the activity and training. Longitudinal studies are needed to confirm the development of these changes, and whether or not they are associated with risk for future symptoms. Furthermore, the close relationship between the long head of biceps, the labrum and the glenohumeral ligaments may make it difficult to clearly differentiate the patient's source of symptoms during a clinical examination. Based on these findings, initial management of patients with shoulder pain considered to be associated with labral changes should be approached conservatively, before considering surgical repair.

KEY POINTS

- Variations of the superior and anterosuperior labrum are common and increase with age, particularly above 30 years.

- Some of the variations, such as a sublabral recess or mobile labrum, may be similar to a Type II SLAP lesion.
- Throwing sportspeople appear to have an earlier onset of labral changes and SLAP lesions, and the relationship of these with risk for future symptoms needs to be explored further.
- Based on these variations and the close relationship between anatomical structures, clear differentiation of the source of a patient's shoulder symptoms as emanating from the glenoid labrum may be difficult.

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CONFLICT OF INTEREST

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