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ANATOMIE ARTHROSCOPIQUE DU LIGAMENT GLÉNO-HUMÉRAL MOYEN
Une série de 300 cas

ARTHROSCOPIC ANATOMY OF THE MIDDLE GLENOHUMERAL LIGAMENT
A series of 300 cases

Names of the authors

J. Bächler, S Bergman, R Lancigu, L Hubert, M Ropars, L Rony

Affiliations of the authors

J Bächler, Bone surgery department, CHU Angers, 4 rue Larrey, 49100, Angers, FRANCE.

S Bergman, Bone surgery department, CHU Angers, 4 rue Larrey, 49100, Angers, FRANCE.

R Lancigu, Bone surgery department, CHU Angers, 4 rue Larrey, 49100, Angers, FRANCE.

L Hubert, Bone surgery department, CHU Angers, 4 rue Larrey, 49100, Angers, FRANCE.

M Ropars, Orthopaedics and traumatology surgery department, CHU Pontchaillou, 2 rue Henri Le Guillou, 35033, Rennes, FRANCE.

L Rony, Bone surgery department, CHU Angers, 4 rue Larrey, 49100, Angers, FRANCE.

Conflict of interest

The authors declared no conflict of interest

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Corresponding author:

Julien Bächler M.D. : E-mail: julien.bachl@gmail.com Tel : 0033241354658

Fax: 0033241355427 / 0033241354844

RÉSUMÉ

INTRODUCTION : L'anatomie du ligament gléno-huméral moyen (LGHM) est rarement décrite en arthroscopie. L'objectif de notre étude était de déterminer les variations anatomiques arthroscopiques du LGHM.

MATERIEL ET METHODE : Nous avons réalisé une étude prospective observationnelle entre juin 2016 et juin 2017. Étaient inclus consécutivement tous les patients opérés d'une première arthroscopie gléno-humérale et sans antécédent chirurgical sur cette même épaule. Les variations de forme du LGHM, de ses insertions glénoïdales et distales étaient relevées au cours de l'intervention.

RESULTATS : 300 patients ont été inclus. La chirurgie était dans 31 % des cas d'une suture de coiffe des rotateurs, dans 32,7 % des cas d'une ténotomie/ténodèse du long biceps et dans 35,5 % des cas une acromioplastie sans suture. Le LGHM était absent dans 12 % des cas, en nappe dans 72 %, cord-like dans 14 % et un Buford complex était noté dans 1 %. L'insertion glénoïdale était située sur le labrum entre les ligaments gléno-huméraux supérieur (LGHS) et inférieur dans 43 % des cas, commune avec le tendon du long biceps (TLB) dans 7 %, commune avec le LGHS dans 29 % et commune avec le LGHS et le TLB dans 9 %. L'insertion distale était pour 67 % sur le tendon du subscapulaire et pour 21 % osseuse sur l'humérus.

CONCLUSION : Cette étude confirme et précise les variations anatomiques du LGHM tout en décrivant celles méconnues de l'insertion distale, mais interroge sur la nature du LGHM.

MOTS CLEFS : Variation anatomique, ligament gléno-huméral moyen, arthroscopie d'épaule, capsule antérieure.

ABSTRACT

PURPOSE: The anatomy of the middle glenohumeral ligament (MGHL) is seldomly described during arthroscopy. The aim of this study was to determine the arthroscopic variants concerning the anatomy of the MGHL.

METHODS: A prospective, observational, single-center study was conducted between June 2016 and June 2017. All patients undergoing a first-time arthroscopy of the shoulder and with no history of prior surgery or trauma of the same shoulder were consecutively enrolled. The variations of the MGHLs shape and of its glenoid and distal insertions were documented during surgery.

RESULTS: 300 patients were included. Surgeries included rotator cuff sutures, tenotomy/tenodesis of the long head of the biceps tendon (LHBT) and subacromial decompression in respectively 31%, 32.7% and 35.5% of cases. The MGHL was absent in 12% of cases, presented a flat structure in 72% of cases, a cord-like shape in 14% and a Buford complex was observed in 1%. Its glenoid insertion was located on the labrum between the superior (SGHL) and inferior (IGHL) in 43% of cases, presented a combined insertion with the LHBT in 7%, with the SGHL in 29% and with both the SGHL and LHBT in 9%. The distal insertion was located in 67% of cases on the subscapularis tendon (SCCT) or the capsule covering it, and on the humeral bone in 21%.

CONCLUSION: This study confirms and details the anatomic variants of the MGHL, notably describing the lesser-known variants of its distal insertion, yet arises the question of the exact nature and function of this so-called ligament.

KEYWORDS: Anatomical variation, middle glenohumeral ligament, shoulder arthroscopy, anterior capsule

1. INTRODUCTION

The glenohumeral ligaments strengthen the anterior aspect of the shoulder capsule [7,9,16]. Their insertions are found medially on the anterior labral edge and, distally, along the anterior rim of the articular surface of the humeral head. The middle glenohumeral ligament (MGHL), located between the superior (SGHL) and inferior (IGHL) glenohumeral ligaments, is subject to a number of variants regarding both its shape [1,3–5,9] and insertions [1,5,11,12,20]. Several studies disagree on the frequency of these variants. While it has often been described on the occasion of cadaveric dissections or during imaging studies, only one arthroscopic description by Collote [6] has recently appeared in literature, describing, in particular, the distal insertion of the MGHL on the subscapularis. The variants of its distal insertions remain unclear. Yang [21] was the first to broach the MGHLs possible insertion directly on the subscapularis tendon (SCCT). The aim of this study was to determine the arthroscopic variants concerning the anatomy of the MGHL, more particularly its distal insertions, based on 300 consecutive first arthroscopies. Our primary hypothesis is that the distal insertion of the LGHM is most frequently found to be on the subscapularis tendon. This frequency is largely underestimated to date. This work distinguishes itself from previous research that it provides an *in vivo* observation on a large sample of patients, whose ages range from 21 to 84 years-old.

2. PATIENTS AND METHODS

2.1 A prospective, observational, single-center study was conducted over a one-year period. Patients were treated by one of two different surgeons who recorded the data regarding the arthroscopic anatomy of the MGHL observed during surgery.

All patients undergoing a first-time arthroscopy of the shoulder were consecutively included, without any age limit. Were excluded from this study patients with an history of previous surgery or trauma on the same shoulder, or advanced degenerative lesions of the shoulder for obvious reasons of anatomical description.

2.2 The protocol upon which this study was based was approved by an ethical committee (2017-40). The computerized database was registered with the required authorities, “Commission Nationale de l’Informatique et des Libertés” (CNIL 2016-034).

2.3 Patients were positioned in beach-chair for surgery and the entire upper-limb was included in the sterile operative field. Arthroscopy was performed with a saline solution irrigation delivered by a pump with a pressure of 50 mmHg. Descriptive information regarding both the MGHL and the SCCT was collected by the surgeon during the exploration of the glenohumeral cavity, immediately after introduction of the scope through the posterior viewing portal, while simultaneously bringing the shoulder through different degrees of elevation and rotation. To facilitate observation, an instrument was inserted into the rotator interval via the anterior portal. All the data was registered with a computerized multiple-choice questionnaire (one answer allowed) produced by Microsoft® Excel software, which was readily available to the operator immediately after surgery.

2.4 On the basis of published studies [1,3–5,9–12,20], the MGHLs shape is described as flat-like, cord-like, Buford complex or absent. Its glenoid insertion is located between the SGHL and IGHL, shared with the SGHL or shared with both the SGHL and LHBT. Its distal insertion is described as either bony or on the SCCT.

All the unique drawings included in this publication were created with the help of peroperative observations and careful study of anatomical cadaveric specimens, and aim to illustrate the many anatomical variants of the MGHL.

2.5 Statistical analysis was used to determine the percentage of patients out of the total population studied for each anatomic variation.

3. RESULTS

3.1. Population

Between the 1st of June 2016 and the 20th of June 2017, out of a total of 347 first-time shoulder arthroscopies, 32 were excluded preoperatively, 4 were excluded peroperatively because of non-suturable rotator cuff tears and a further 11 were excluded because of incomplete data. In the end, 300 consecutive shoulder arthroscopies meeting the inclusion criteria were selected. Data regarding the characteristics of the selected sample is shown in Table 1.

3.2. Shape of the MGHL body

Regarding the shape of the MGHL, data is presented in Table 2 and arthroscopic views are shown in Figure 1.

When the MGHL is absent (Figure 1a), the space it usually occupies remains vacant. The flat structure consists of a broad, flat, evenly thick band (Figure 1b) whereas the cord-like structure is a narrower but thicker cable (Figure 1c). The Buford complex is the rare association of a cord-like MGHL, an absence of the anterior-superior portion of the labrum and a shared insertion of the MGHL with the SGHL at the base of the LHBT (Figure 1d).

3.3. Glenoid origin of the MGHL

Regarding the glenoid insertion of the MGHL, data is presented in Table 2, arthroscopic views are shown in Figure 2 and drawings in Figures 3 to 6.

The most frequent type of glenoid insertion is found to be directly on the labrum, between the 2 and 4 o'clock position, and clearly distinct from the insertions of the SGHL and IGH (Figures 2a and 3). The second most common type is an insertion directly on the labrum, between 1 and 2 o'clock, shared with the SGHL (Figures 2b and 4) ; in this case, the two ligaments either fuse together before their insertion or both have a shared insertion on the labrum. Furthermore, two rarer types of glenoid insertions can be characterized: an insertion located at the base of the LHBT, whether conjoint (Figures 2c and 5) or distinct from the SGHL (Figures 2d and 6). In the latter case, the SGHL is often entirely absent. As it was assumed that the anatomic relation to the SGHL may be of significance, this latter distinction has been taken into account.

3.4. Distal insertion of the MGHL

Regarding the distal insertion of the MGHL, data is presented in Table 2 and arthroscopic views are shown in Figure 7.

An insertion on the upper third of the capsular side of the subscapularis tendon (Figure 7a) appears to be the most frequent type of distal insertion of the MGHL. In this photograph, the observation clearly shows that the MGHLs distal insertion is in its entirety located on the SCCT. The least frequent type of distal insertion is found to be on the medial aspect of the lesser tubercle, along the anterior rim of the articular surface of the humeral head (Figure 7b). In this photograph, the arthroscope has crossed anteriorly through the shoulder joint, the 30° optic is orientated towards the humerus and the shoulder is maintained in internal rotation in order to loosen the SCCT.

4. DISCUSSION

The MGHL is one of the elements contributing to the strength of the anterior aspect of the glenohumeral joints capsule [2,8,13,18], historically described as a flat structure [1,9,11] with a proximal insertion on the glenoid labrum between the SGHL and IGHL and a distal insertion on the medial aspect of the lesser tubercle [7]. This study confirms that the most frequent distal insertion of the MGHL is indeed located on the subscapularis tendon.

DePalma [8] and other authors [1,4,9,15,17,20] have already discussed the MGHLs variability among individuals and this study follows the results of these previous publications by finding a MGHL presenting predominantly a flat structure, a proximal insertion on the labrum between -yet distinct from- the SGHL and IGHL, and a distal insertion directly onto the subscapularis tendon.

Several cadaveric studies have brought to light the lack of consistency of the MGHL, namely DePalma [8] reporting an absence of this ligament in 15.3% of cases. In a series of 84 embalmed shoulders, Ide [11] showed the presence of the MGHL in 63.1% of cases ; similarly, Steinbeck [17] reported its presence in 84.6% in a series of 104 embalmed shoulders. In his systematic review of imaging literature, Beltran [1] also declared an irregular presence of the MGHL which was clearly identified in 70-85% of analyzed shoulders. In a more recent study, however, Collote [6] reports of a nearly constant MGHL, identified in 98% of shoulders in a series of 107 arthroscopies.

The MGHL was found to be present in 88% of cases in this study, which is higher than the rate suggested by cadaveric and imaging studies. Through direct and dynamic intra-articular visualization with virtually no alteration to the normal anatomical relationships between structures, arthroscopy allows us to by-pass the inevitable limits of imaging technology and approximations inherent to cadaveric dissections [14]. With a posterior viewing portal, the camera brings a direct view of the MGHL, with limited damage to adjacent structures, providing the most precise description possible. *In vivo* observation on a wide range of ages allowed us to overcome biases linked to post-mortem alterations and senile degeneration.

The difference found with Collotes study [6] can be explained by a difference of interpretation. In this series, both operators judged that certain forms of MGHL described by Collote were to be considered as vestigial pellucid remnants, not to be considered as ligaments but to be likened to synovial folds. Thus, the MGHL was considered absent in these cases. Taking this into consideration, both series find a similar rate of biomechanically competent MGHLs. Far from considering the vestigial pellucid relics as entirely devoid of any mechanical properties, a histological analysis would be valuable to determine their exact nature.

All the studies, either with imaging, arthroscopic or carried out on cadaveric specimens, agree on the preponderance of the flat structure variety of the MGHL. Collote [6] goes even further by distinguishing two sub-categories : a thick and taut type in 35% of cases and a thinner and slack type in 28% of cases. With 72% of the flat type variety, this study is in agreement with the global rate of this authors' series. However, due to an absence of distinction of the two sub-categories in this study, it was not possible to compare the rates.

With the presence of the cord-like type in 15% of cases, this series agrees with Ides [11] and Morgans [15] observations, reporting respectively 17.9% and 19% of cord-like type in a series of 182 embalmed shoulders [15]. This rate is however much lower than the rates of 41% found by DePalma [8] and 46% by Steinbeck [17]. Collotes [6] findings report a rate of 21% of isolated cord-like MGHL, which is much closer to the results of this study.

Various studies, including this one (1%), concur to describe the Buford complex as exceptional. Ide [11] reported its presence in 1.2% of cases and Williams [19] in 1.5% of cases in an arthroscopic study carried out on 200 patients. Collotes [6] study stands out with a rate of 6%.

In regards to the glenoid insertion of the MGHL, Ide [11] describes two main variants. He separated MGHLs presenting an insertion directly on the labrum and distinct from the SGHL (56.6%) from those sharing a common insertion with the SGHL (43.4%). While demonstrating a number of possible different insertions, the results of this study also find the MGHL to predominantly insert separately from the SGHL.

Beltran [1] described several possibilities concerning the glenoid insertion of the MGHL including a labral insertion between the SGHL and IGH, a shared insertion with the SGHL, a shared insertion with both the SGHL and LHBT and a shared insertion with the LHBT, but did not make mention of their rate of occurrence. This study arthroscopically confirms these different variants and reports them to be present in 44%, 28%, 9% and 7% of cases respectively.

Collote [6] recognizes two frequent types of insertion, a fibrous labral insertion and an osseous insertion on the anterior facet of the glenoid rim, from a rarer insertion located on the rotator interval. A comparison between the results of this study to this unusual description seems difficult, although a purely labral insertion as described in 46.5% of cases by Collote and 44% in this series is coherent.

With his biomechanical study of the shoulder, Yang [21] was the first to describe the distal insertion of the MGHL as a shared insertion with the SCCT on the lesser tubercle. Collote [6] goes further by making the distinction between several zones of insertion ranging from the humeral bone to directly on the SCCT in front of the glenohumeral joint space. This study is in agreement with the novel concept of a MGHL inserting on the upper third of the capsular side of the SCCT, found in 67% of cases in this series. As suggested by Collote, it is to be noted that it is difficult to discriminate medio-laterally because of the 30° obliquity of the arthroscope, the patients position during surgery and the orientation of the glenohumeral joint. This study therefore only makes the distinction between an osseous insertion on the edge of the lesser tubercle (found in 21% of cases versus 34% for Collote) and a tendinous insertion on the SCCT (67%). Despite this statistical discrepancy, this study confirms a distal insertion predominantly on the SCCT, thus challenging the ligamentous nature of the MGHL as the very definition of a ligament requires bone-to-bone fixation [10]. A histological analysis comparing the MGHL to authentic ligamentous tissue, synovial membrane and capsular tissue would seem judicious to further fuel this discussion. The semantic debate between « ligament » and « capsular reinforcement » remains open.

The population concerned by this monocentric study is primarily of white Eurasian origin which implies a geographic and ethnic bias. Generalization of these results to other populations should be confirmed by further studies. Furthermore, this study exclusively included a population of patients presenting chronic shoulder pain which introduced a recruitment bias further restricting the generalization of these results. Indeed, certain variations could be over or underestimated in this series of patients if a causal link between their existence and shoulder cuff pathology was to be found.

5. CONCLUSION

Subject to a number of anatomical variants regarding its shape and insertions, the MGHL is traditionally described as presenting a flat structure, inserting proximally on the glenoid labrum between the SGHL and IGHl and, distally, on the medial aspect of the humeral lesser tubercle. However, this description is mainly based on cadaveric and imaging studies.

This study is an innovative approach, providing a more “surgical” description of the MGHL. This series of 300 shoulder arthroscopies finds the MGHL to be present in 88% of cases. These results align with existing scientific literature with regards to the shape of the MGHL body and its glenoid insertion, and also details the occurrence of its multiple variants. The rate of the rarer types, namely the cord-like structure and Buford complex, are similar to those published in previous studies.

This dynamic analysis highlights the different variants of the MGHLs distal insertions, an anatomical characteristic largely neglected to this day. It has been found that the most common type (67%) is a tendinous insertion directly on the SCCT.

This wide array of possible variants of the MGHLs anatomy may have an implication in the development of rotator cuff pathology, a hypothesis that needs to be explored and would lead us to question the ligamentous nature of the MGHL.

FIGURES

Fig. 1 Arthroscopic views of right shoulders showing the MGHL

a. Absent MGHL b. Flat MGHL c. Cord-like MGHL d. Buford complex

MGHL: Middle glenohumeral ligament, SGHL: Superior glenohumeral ligament, LHBT: Tendon of the long head of the biceps, G: Glenoid fossa, H: Humeral head, L: Labrum, SC: Subscapularis

Fig. 2 Arthroscopic views of right shoulders showing the proximal insertion of the MGHL

**a. Insertion on the labrum, between the SGHL and IGHL b. Shared insertion with the SGHL
c. Shared insertion with SGHL and LHBT d. Shared insertion with LHBT, no SGHL**

MGHL: Middle glenohumeral ligament, SGHL: Superior glenohumeral ligament, LHBT: Tendon of the long head of the biceps, G: Glenoid fossa, H: Humeral head, L: Labrum

Fig. 3 Lateral view of the scapula: LGHM insertion between SGHL and IGHL

Fig. 4 Lateral view of the scapula: MGHL shared insertion with SGHL

Fig. 5 Lateral view of the scapula: MGHL shared insertion with SGHL and LHBT

Fig. 6 Lateral view of the scapula: MGHL shared insertion with LHBT

Fig. 7 Arthroscopic views of right shoulders showing the distal insertion of the MGHL

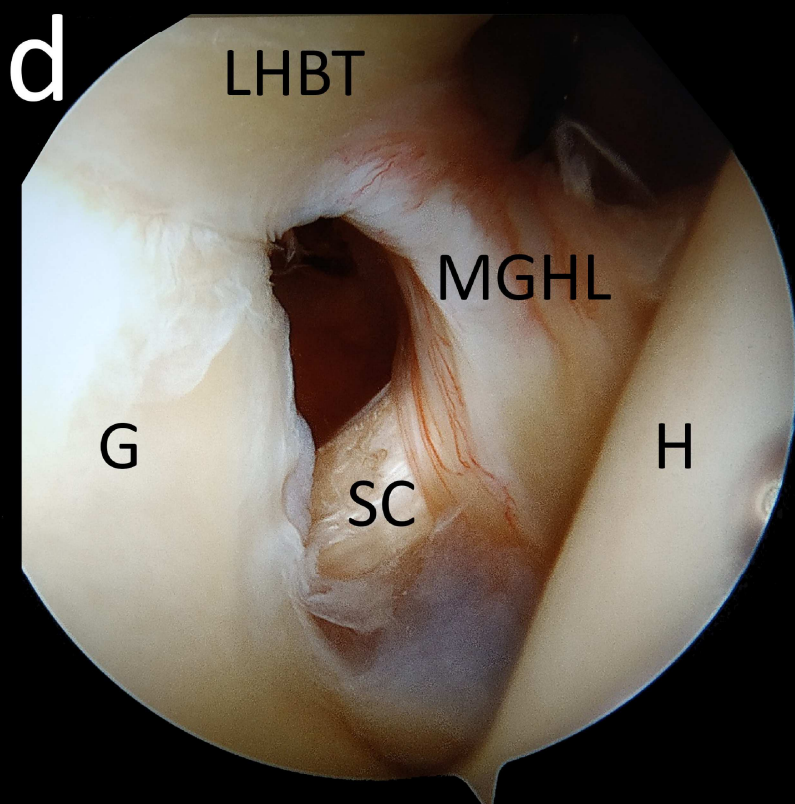
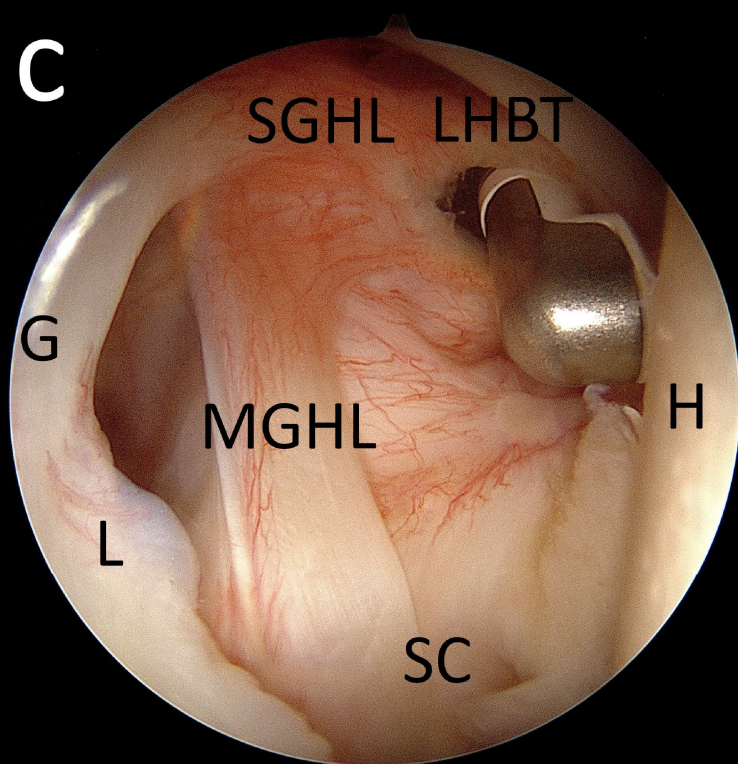
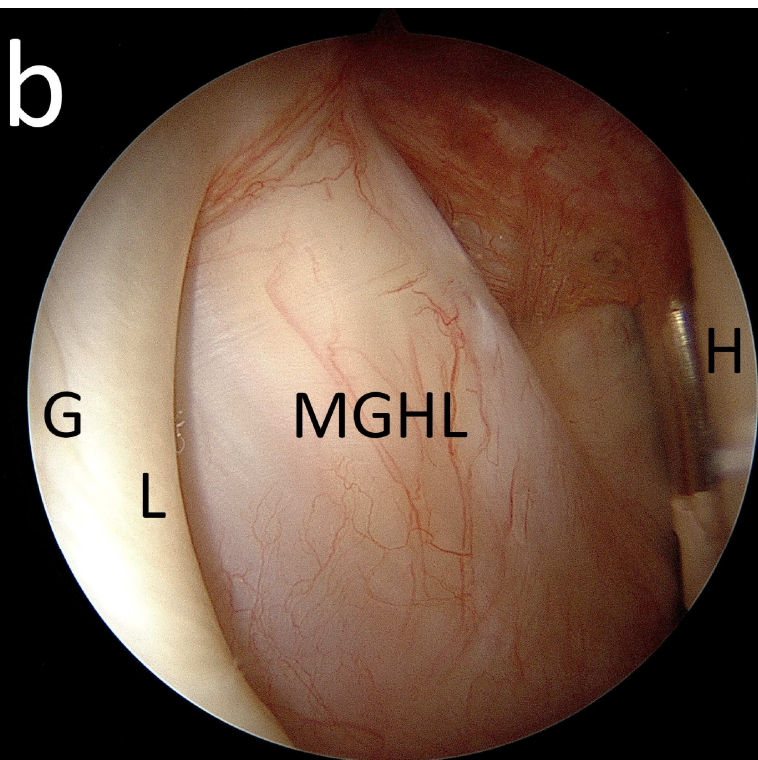
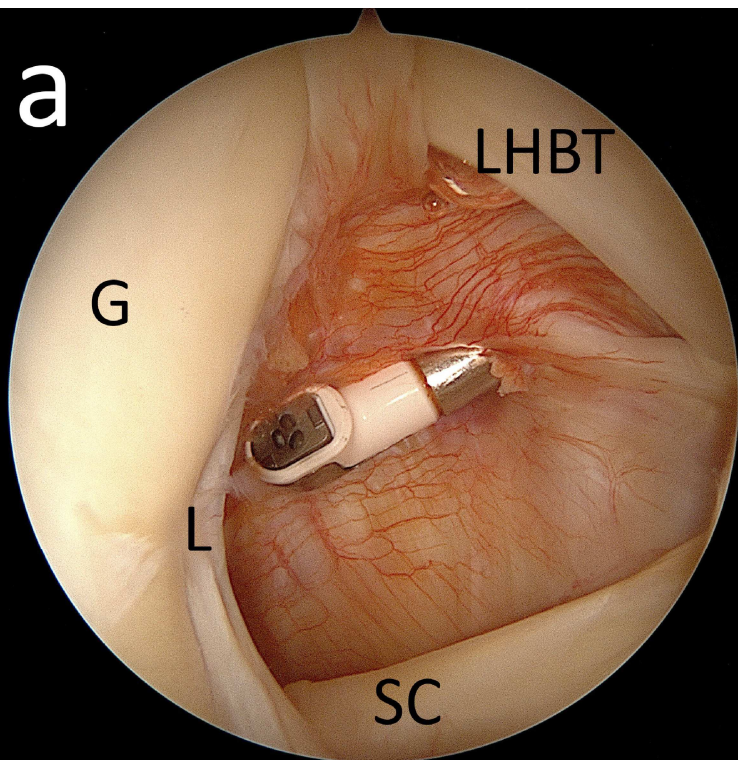
a. Tendinous insertion on the SCCT b. Osseous insertion on the humeral head

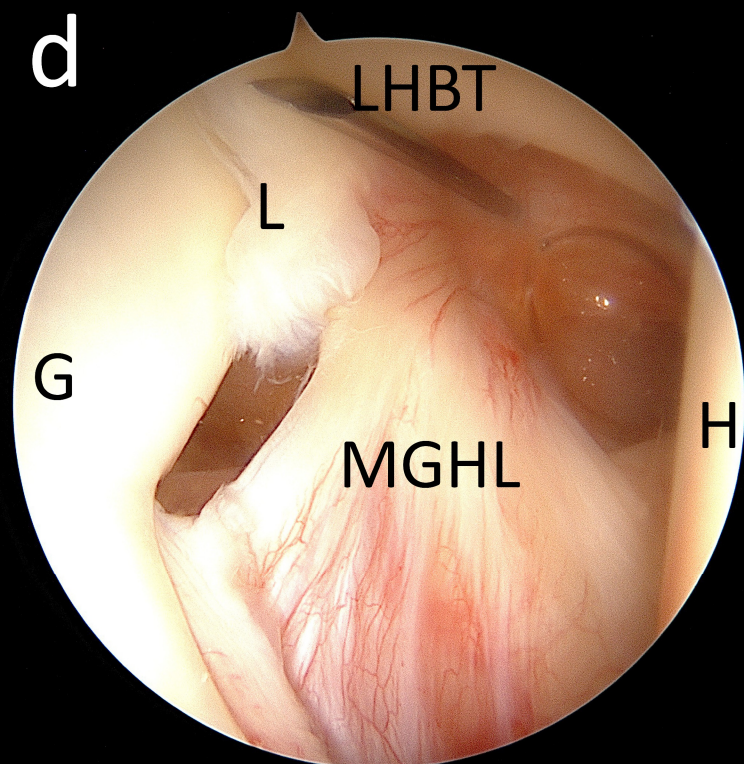
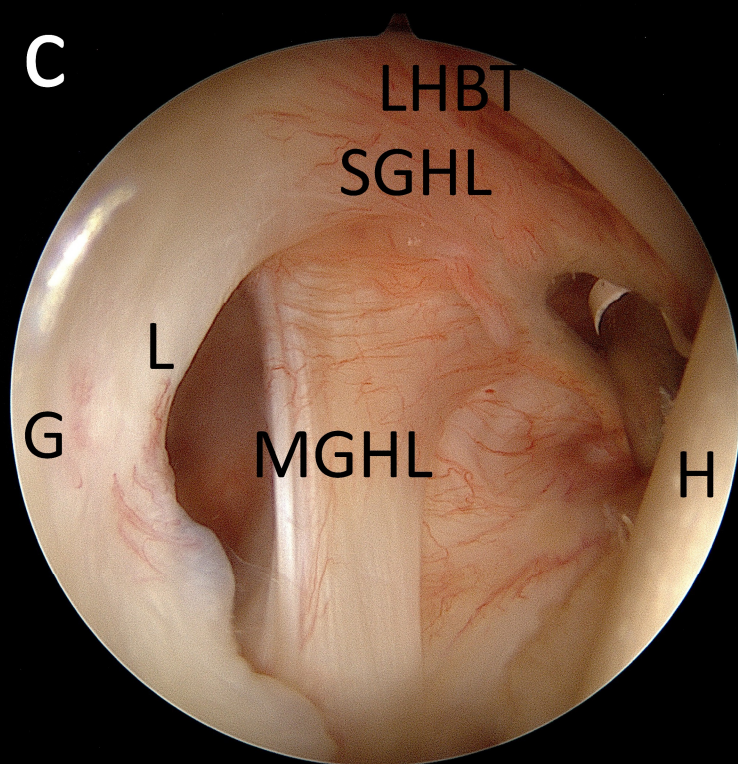
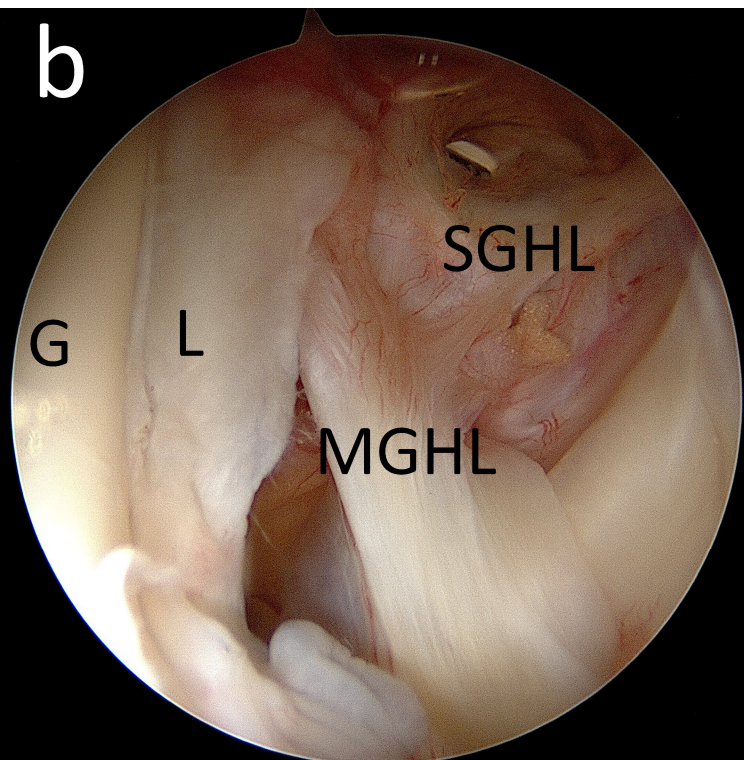
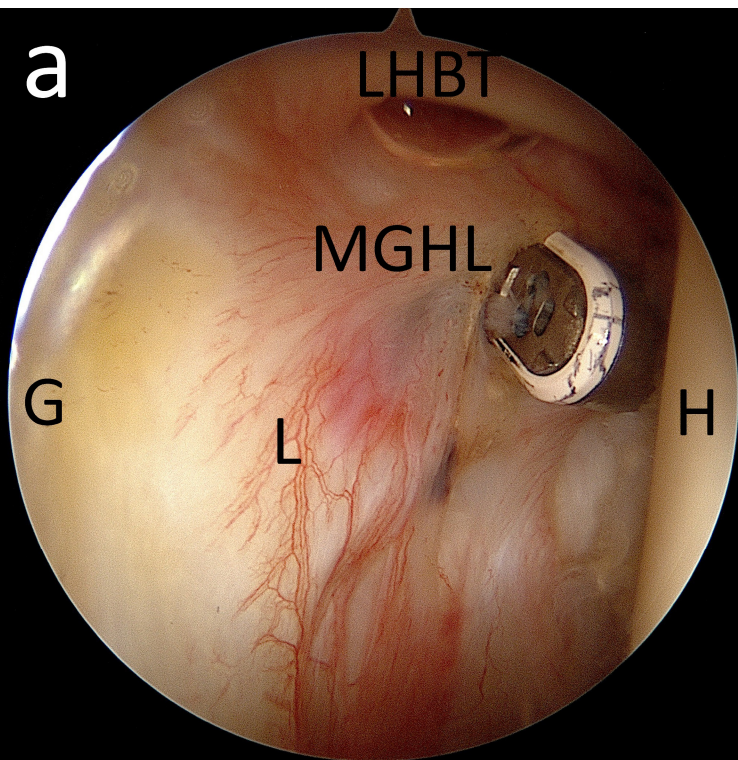
MGHL: Middle glenohumeral ligament, SCCT: Subscapularis tendon, H: Humeral head, L: Labrum

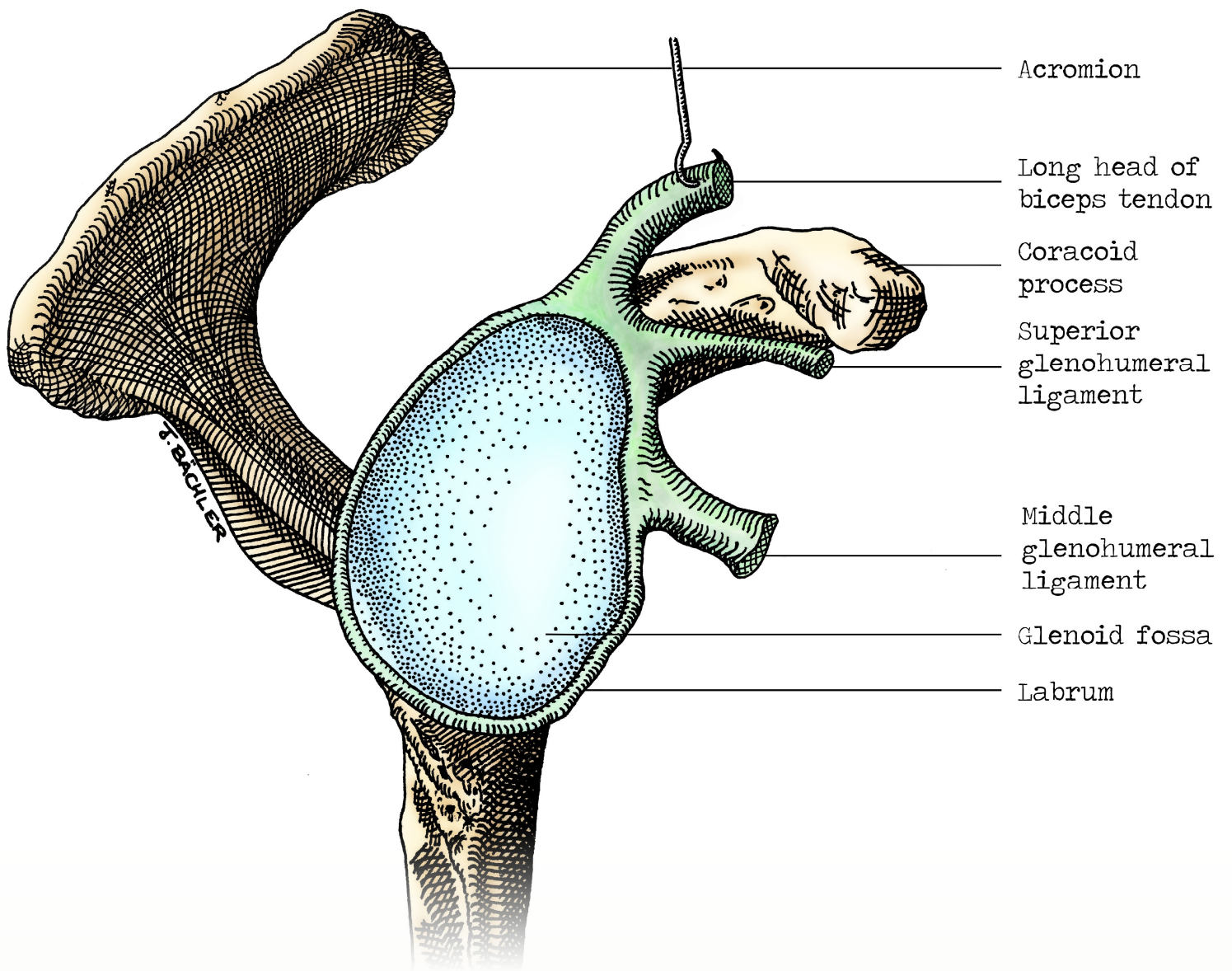
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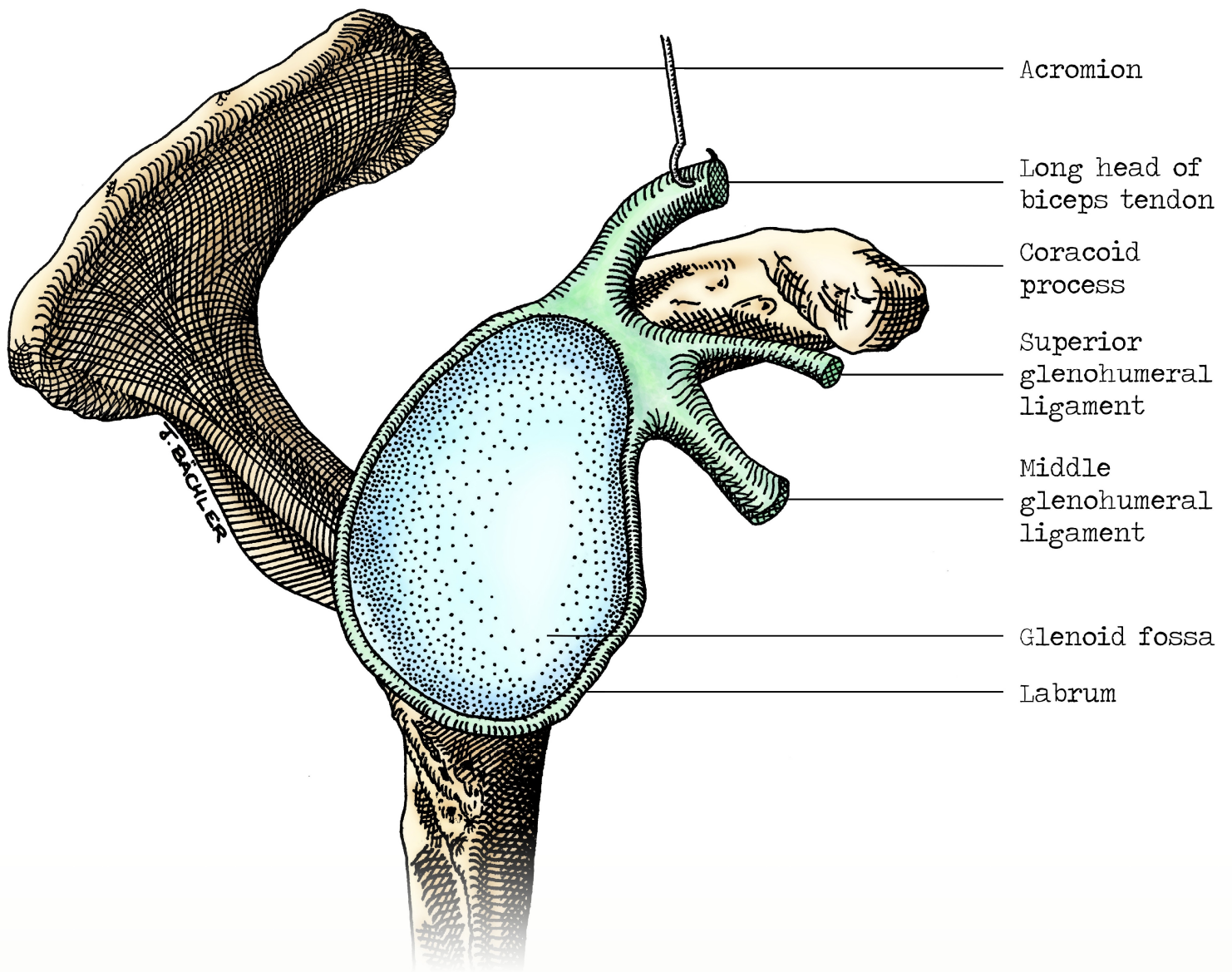
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Acromion

Long head of
biceps tendon

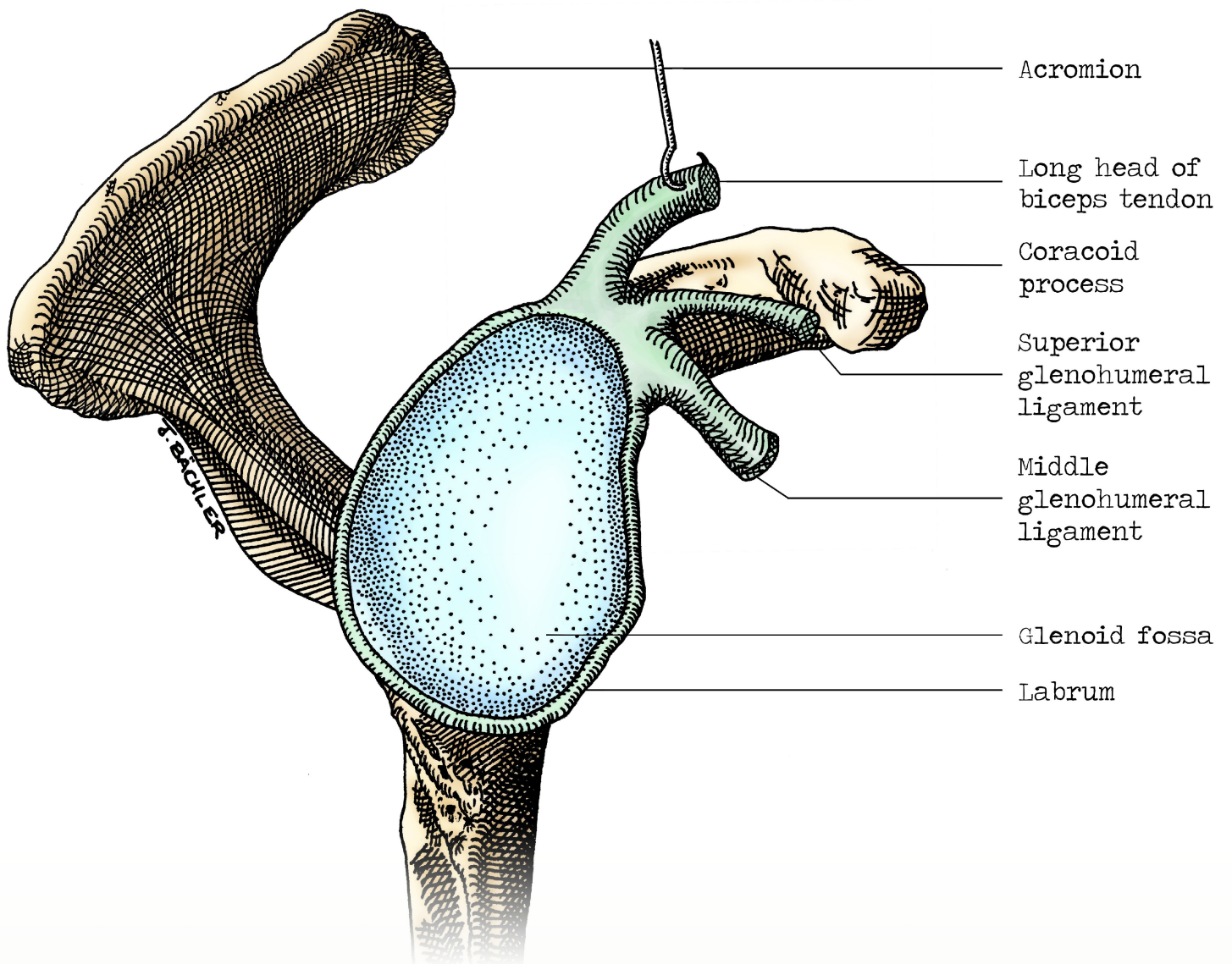
Coracoid
process

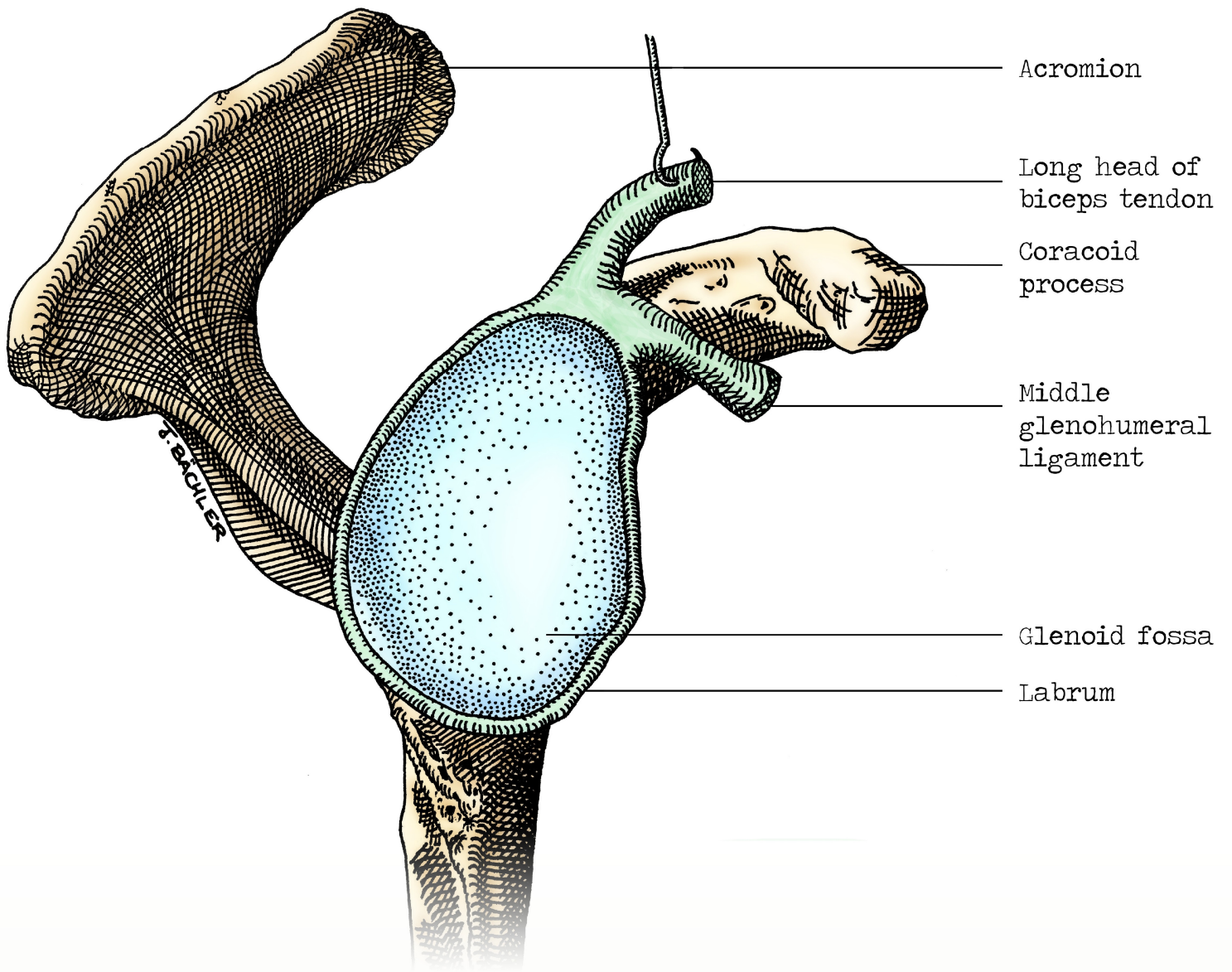
Superior
glenohumeral
ligament

Middle
glenohumeral
ligament

Glenoid fossa

Labrum





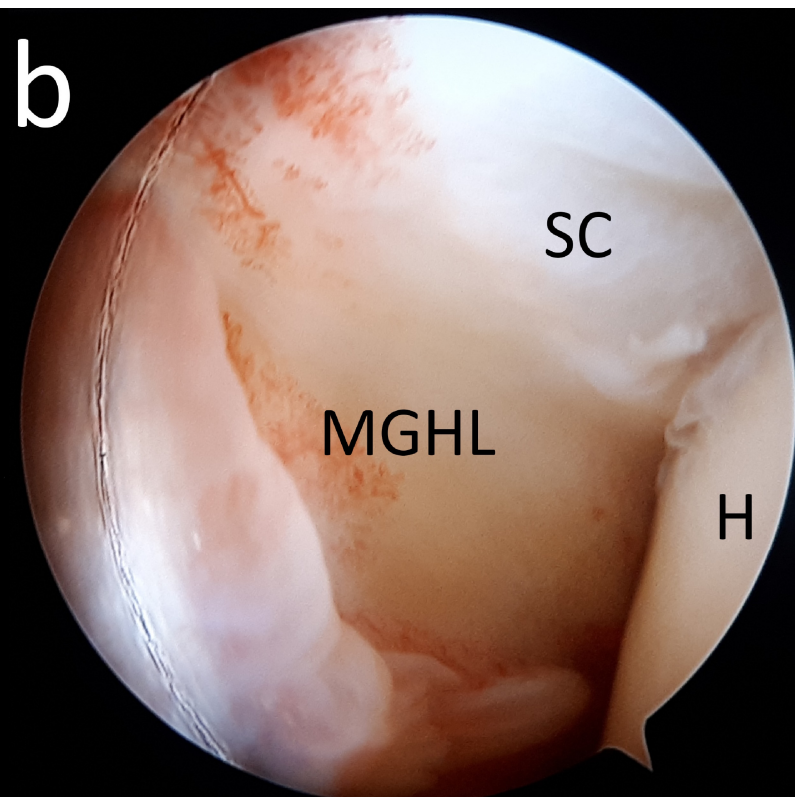
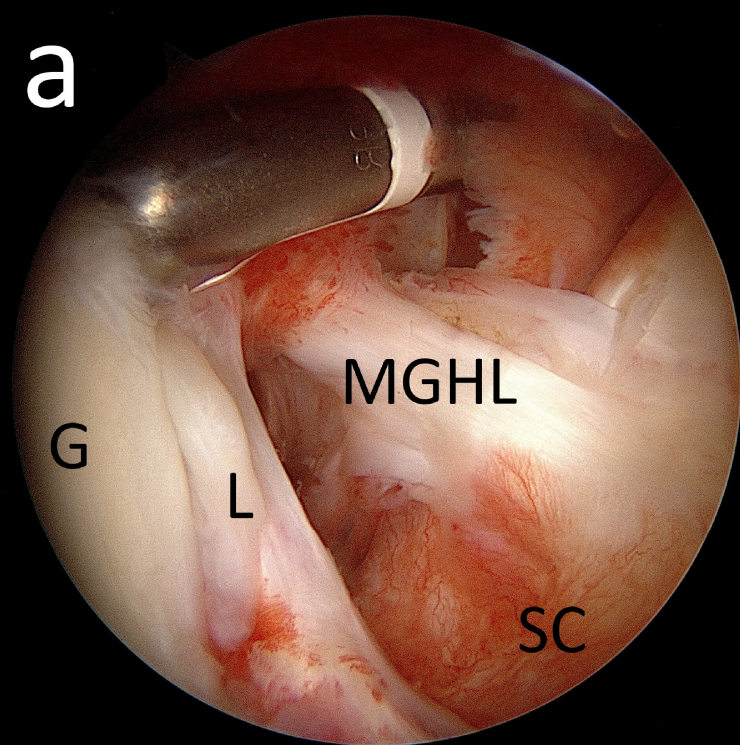


Table 1 – Population

Age		
Mean	53,9 y.o.	
Oldest patient	84 y.o.	
Youngest patient	21 y.o.	
Standard deviation of age	11	
Sex		
Male	136	(45.3 %)
Female	164	(54.7 %)
Operated shoulder		
Right	181	(60.3 %)
Left	119	(39.7 %)
Intervention		
Subacromial decompression	106	(35.3 %)
Tenotomy/tenodesis of LHBT	98	(32.7 %)
Rotator cuff suture	93	(31 %)
Other	3	(1 %)

LHBT: tendon of the long head of the biceps

Table 2 — Epidemiology of the different anatomical variants of the MGHL

Shape of the MGHL body		300
Absent	37	(12 %)
Flat structure	216	(72 %)
Cord-like	44	(15 %)
Buford complex	3	(1 %)
Glenoid insertion of the MGHL		300
Absent MGHL	37	(12 %)
Between the SGHL and IGHL	131	(44 %)
Shared with the SGHL	85	(28 %)
Shared with both the SGHL and LHBT	27	(9 %)
Shared with the LHBT	20	(7 %)
Distal insertion of the MGHL		300
Absent MGHL	37	(12 %)
Osseous insertion on the lesser tubercle	63	(21 %)
Insertion on the SCCT	200	(67 %)

MGHL: middle glenohumeral ligament ; SGHL: superior glenohumeral ligament ;

IGHL: inferior glenohumeral ligament ; LHBT: long head of the biceps tendon ;

SCCT: subscapularis tendon