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ORIGINAL PAPER

In-office shoulder arthroscopy and tenotomy of the long head of the biceps tendon—a cadaveric feasibility study

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Abstract

Purpose Studies have shown that isolated tenotomy of the long head of the biceps (LHB) improves significantly pain scores, active range of motion and Constant score in elderly patients with massive and irreparable cuff tears with no osteoarthritis. This cadaveric study was performed to assess the feasibility of a tenotomy of the LHB and subacromial corticosteroid injection using a minimally invasive in-office setting under local anaesthesia on awake patients.

Materials and methods Twenty scare-free shoulders were included in the study. We performed the procedure in an in-office setting using a wrist arthroscope with no fluid, connected to wireless camera and light source. A standard shoulder arthroscopy was finally performed in order to analyse the tenotomy quality and detect possible iatrogenic lesions.

Results The LHB tendon was cut fully in all cases, the mean length of the proximal stump of the LHB was 0.4 cm (range, 0.3–0.7 mm) and the mean duration of the surgery was 3.5 minutes (range, 2.43–3.86 min). No iatrogenic lesion occurred during the in-office procedure.

Conclusion This cadaveric study suggests that it is feasible and safe to perform, under local anaesthesia, a minimally invasive arthroscopic tenotomy of the LHB and subacromial injection using an in-office setting. Further clinical studies are needed to confirm the reliability, indication and effectiveness of this technique.

Keywords In-office surgery · In-office arthroscopy · Shoulder arthroscopy · Long head of the biceps · Biceps tenotomy · Massive rotator cuff tear

Introduction

Tendinopathy of long head of the biceps (LHB) is a common cause of chronic shoulder pain [1]. Many studies have shown that isolated tenotomy of the LHB improves significantly pain scores, active range of motion and Constant score in elderly patients with massive and irreparable cuff tears with no osteoarthritis [2, 3].

In a degenerative shoulder, the tendinopathy of the LHB is frequently associated with subacromial impingement syndrome and bursitis with or without rotator cuff pathology [4–7]. Modern diagnostic methods (MRI, CT arthrography, ultrasonography) are failing in providing reliable information on the LHB pathology, especially in cases with an intrinsic lesion of the tendon [8]. A diagnostic arthroscopy is commonly indicated after failure of conservative treatment (NSAIDs, rehabilitation and sometimes corticosteroids injections), in order to detect the source pain and perform a surgical treatement. Often during shoulder arthroscopy, an inflammatory, flattened and/or instable LHB is revealed and an isolated tenotomy of the LHB becomes the treatment of choice [7–11].

Shoulder arthroscopy is a cost-intensive procedure requiring an operating room, a trained anaesthetist (in both general and loco-regional anaesthesia) and arthroscopic equipment (arthroscope, light source, wired camera, fluid management pump and instruments). However, some patients are not willing to undergo surgery in the operating theatre and other patients may have comorbidities with contraindication to general and/or loco-regional anaesthesia.

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Due to existing technological advancement in medical industry, smaller-sized wireless endoscopes can be used on awake patients through smaller incisions while using only skin anaesthesia or no anaesthesia at all, making the procedure similar to a diagnostic infiltration of the joint. An in-office shoulder arthroscopy could be, in selected cases, an option to decrease the operative time, the surgical morbidity and the cost related to a standard arthroscopy.

The purpose of this cadaveric study was to assess the feasibility of a minimally invasive in-office arthroscopic tenotomy of the LHB and subacromial corticosteroid injection, under local anaesthesia, using a small diameter arthroscope connected to a wireless camera.

Materials and methods

Specimens

All specimens were selected from the anatomy lab of Paris (Ecole de Chirurgie du Fer à Moulin). They had been kept in storage at 4 °C before the study. Twenty scare-free shoulders were included. Those whose long head of the biceps was not found to be intact during arthroscopic exploration were excluded.

The specimens were installed in the 'Beach-chair' position with the arm hanging freely in order to allow mobilization. The bony landmarks of the shoulder and the portals were drawn with a marker on the skin (Fig. 1). The senior shoulder surgeon (IAP) performed all the in-office procedures.

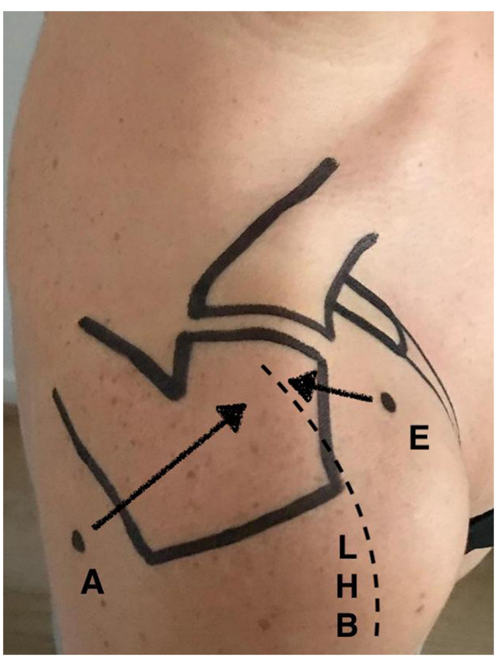

Fig. 1 Arthroscopic portals on a right shoulder (A: posterior portal used for arthroscopic visualization; E: anterior portal, corresponding to the rotator interval, used for scalpel instrumentation). *LHB* long head of the biceps tendon. The arrows indicate the initial tool positions

'In-office' equipment

The equipment used for the cadaveric study were as follows:

- A 2.4 mm 30° wrist arthroscope (Karl Storz, Germany) with its corresponding sheath (2.7 mm) and blunt obturator
- A wireless camera with a light source (DE1250 Wireless Endoscope Camera, Firefly Global[R]) connected to a portable computer for live visualization and video capture (Fig. 2)
- An arthroscopic palpation probe
- An 18 gauge needle
- A no. 11 blade scalpel
- Xylocaine 2% (20 mg/ml) solution
- 1 ml Diprostene (bethamethasone 7 mg/ml) syringe

Protocol

The skin was anaesthetised using Xylocaine 2% solution at the level of the standard arthroscopic posterior portal (soft-point, 2 cm distal and 1–2 cm medial to the posterolateral tip of the acromion). An 18 gauge needle was then introduced in the glenohumeral joint allowing joint distension. No air insufflation or physiological serum is used. After removing the needle, the skin incision was made in the soft point with a no. 11 blade scalpel. The arthroscopic sheath with its blunt obturator was introduced in the glenohumeral joint; the obturator was then replaced by the wrist arthroscope connected to the wireless camera and light source.

After completing a dry arthroscopic diagnostic tour of the shoulder, the 18 gauge needle was again used, after skin anaesthesia, to localize the anterior arthroscopic portal through the rotator interval under direct arthroscopic visual control. Using

Fig. 2 Wireless camera and light source connectable to any portable computer using a USB wireless adaptor (DE1250 Wireless Endoscope Camera, Firefly Global[R])

the needle as a probe, one can mobilize the tendon from its groove to better observe the extent of the synovitis. The no. 11 blade scalpel was forwarded into the glenohumeral joint and positioned horizontally over the proximal part of the LHB at the level of the supraglenoid tubercle. The blade was then turned 90° downwards, and the LHB was cut close to its origin with a discrete handsaw movement (Fig. 3). An arthroscopic probe was finally used to palpate and measure the tendon stump and for finishing the diagnostic tour of the shoulder joint.

After tenotomy of the LHB, the scope was introduced in the subacromial space. A subacromial injection with 1 ml Diprostene syringe using the arthroscopic sheath was performed at the end of the surgery.

Validation of the protocol

For each specimen, a second shoulder arthroscopy was made by a second surgeon (AG) using standard shoulder arthroscopic tools (5 mm arthroscope, camera, light source, arthroscopy pump and palpation probe) in order to verify the tenotomy level and to identify iatrogenic lesions which occurred during the in-office procedure (cartilage and/or soft tissue lesions).

Results

The arthroscopic shoulder joint exploration, the tenotomy of the LHB and the subacromial corticosteroid injection were feasible with the in-office setting in all twenty shoulders.

The procedure was performed with 2 portals through skin incisions of less than 6 mm (range, 3.7–6.3 mm). The LHB tendon was fully cut in all cases. The mean length of the proximal stump of the LHB was 0.4 cm (range, 0.3–0.7 mm).

The mean duration of the surgery was 3.5 minutes (range, 2.43–3.86 min) including local anaesthesia (Table 1).

No iatrogenic lesion, including cartilage or cuff damage, occurred in any specimen during the in-office procedure. The wrist arthroscope delivers enough field of view making its use possible in the shoulder joint.

Discussion

The purpose of this study was to assess the feasibility of shoulder arthroscopy with LHB tenotomy and subacromial corticosteroid infiltration using a mini-invasive in-office setup. The presented technique is promising given the obtained results.

Many studies have shown shoulder pain reduction and range of motion improvement after isolated tenotomy of the LHB in elderly patients with irreparable rotator cuff tears with no osteoarthritis [1, 3, 12, 13]. Shoulder arthroscopy under general and/or loco-regional anaesthesia is today the gold standard technique for diagnostic visualization [8] and tenotomy of the LHB. This technique has been well proven to be effective; however, it cannot be adapted to patients who do not wish or cannot undergo surgery due to comorbidities that contraindicate a general anaesthesia with or without an inter-scalene block.

Greditzer et al. suggested in their study [14] that an in-office ultrasound-guided percutaneous tenotomy is feasible under local anaesthesia. Recent cadaveric and pilot studies on ultrasound guided tenotomy of the LHB demonstrated the limited feasibility of this procedure due to its associated downsides and risks [15]. Firstly, the tenotomy cannot be made at a proximal level, thus leaving a long proximal tendon stump inside the joint that may behave as an intra-articular loose body and cause discomfort. Secondly, incomplete tenotomies, as well as different iatrogenic lesions of the cuff, were reported [16]. Moreover, the ultrasound diagnostic and guided tenotomy of the LHB requires a trained surgeon in ultrasonography [15]. However, performing a tenotomy of the LHB under direct arthroscopic visualization is an easy, reproducible and already known technique that can be safely performed in an in-office setting.

Current technological advancements in medical industry allow us to perform arthroscopic diagnosis and simple surgical procedures using minimally invasive wireless endoscopes and an in-office setting. Furthermore, since LHB tendon is not vascularized at the level of proximal tenotomy [17] and only small incisions are required, a dry arthroscopic procedure may be possible on awake patients receiving only skin and soft tissue anaesthesia around the portals.

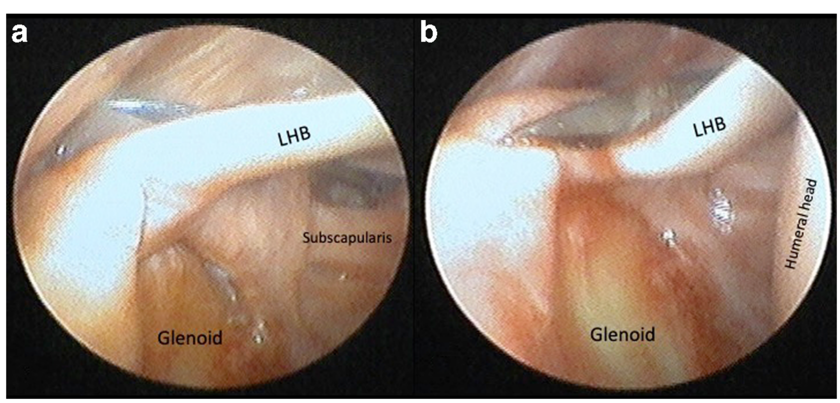

Fig. 3 **a** Right shoulder, posterior view. Entering the rotator interval with a no. 11 blade scalpel. **b** Posterior view. Biceps tenotomy using the same blade

Table 1 Surgical steps breakdown with time duration for the in-office shoulder arthroscopy

Surgical steps	Duration (range)
Local anaesthesia posterior portal	60 (50–70) s
• Skin incision posterior portal	3 (1–5) s
• Glenohumeral arthroscopic round diagnosis	30 (20–40) s
Local anaesthesia anterior portal	60 (50–70) s
• Skin incision anterior portal	4 (2–6) s
• Biceps tenotomy	12 (8–16) s
• Subacromial visualization and corticosteroid injection	20 (15–25) s
Total duration	189 (146–232) s

The arthroscopic diagnosis and tenotomy of the LHB is indicated according to preoperative clinical examination and imaging findings [9]. Suitable candidates for an in-office procedure may be patients with isolated tendinopathy of the LHB, not willing to undergo surgery in the operating theatre, or patients with high comorbidity contraindicating general and/or loco-regional anaesthesia.

Our study proved the feasibility of an in-office shoulder arthroscopy with LHB tenotomy and subacromial infiltration. Similar to other cadaveric studies, the limitations are related to soft tissue relationships that might be different than the living human anatomy. Anatomic or pathologic variation of the biceps tendon [18], or for example the 'hourglass biceps' described by Boileau et al. [19], may require other therapeutic approaches: resection of the intra-articular portion of the LHB whereas its tenotomy is contraindicated. We have not found any hourglassbiceps tendon in our series; however, we consider that an in-office tendon resection may be also feasible.

Although the neurovascular surgical risks as well as local or regional anaesthesia requirements or even an eventual need of conversion to general anaesthesia can be insufficiently defined, estimations in a cadaveric simulation environment are important to assess surgical feasibility on awake patients. Other risks like breakage of the mini-invasive instruments into the joint during the intervention must be well defined, even if no force is required to use an arthroscope during the round diagnosis of the shoulder. Nevertheless, patient-driven clinical studies are mandatory in order for this technique to confirm its feasibility in an in-office setting on awake patients under local anaesthesia.

Conclusion

Our anatomic study suggests that it is feasible and safe to perform, under local anaesthesia, a minimally invasive arthroscopic tenotomy of the LHB and a subacromial infiltration using an in-office setting. Selecting patients who can benefit from this procedure remains the main challenge, and clinical studies are needed to confirm its effectiveness.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study formal consent is not required.

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