

Original article

Brachial plexus endoscopic dissection and correlation with open dissection

Description anatomique de la dissection endoscopique du plexus brachial et corrélations à ciel ouvert

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Abstract

Shoulder endoscopy is evolving and becoming extra-articular. More and more procedures are taking place in the area of the brachial plexus (BP). We carried out an anatomical study to describe the endoscopic anatomy of the BP and the technique used to dissect and expose the BP endoscopically. Thirteen fresh cadavers were dissected. We first performed an endoscopic dissection of the BP, using classical extra-articular shoulder arthroscopy portals. Through each portal, we dissected as many structures as possible and identified them. We then did an open dissection to corroborate the endoscopic findings and to look for damage to the neighboring structures. In the supraclavicular area, we were able to expose the C5, C6 and C7 roots, and the superior and middle trunks in 11 of 13 specimens through two transtrapezium portals by following the suprascapular nerve. The entire infraclavicular portion of the BP (except the medial cord and its branches) was exposed in 11 of 13 specimens. The approach to the infraclavicular portion of the BP led directly to the lateral and posterior cords, but the axillary artery hid the medial cord. The musculocutaneous nerve was the first nerve encountered when dissecting medially from the anterior aspect of the coracoid process. The axillary nerve was the first nerve encountered when following the anterior border of the subscapularis medially from the posterior aspect of the coracoid process. Knowledge of the endoscopic anatomy of the BP is mandatory to expose and protect this structure while performing advanced arthroscopic shoulder procedures.

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Keywords: Brachial plexus; Anatomical study; Periarticular endoscopy

Résumé

Avec le développement de l'arthroscopie d'épaule au-delà de l'articulation scapulo-humérale, il devient indispensable de maîtriser l'anatomie endoscopique du plexus brachial (PB). Nous avons réalisé une étude cadavérique descriptive de l'anatomie endoscopique du PB et des nerfs autour de l'épaule. Nous avons confronté les constatations endoscopiques avec une dissection à ciel ouvert. Nous avons réalisé la dissection endoscopique du PB de 13 sujets anatomiques par les voies d'abord arthroscopiques de l'épaule. Nous avons disséqué les racines et les troncs, puis les faisceaux et les branches terminales du plexus brachial. Nous avons réalisé une dissection à ciel ouvert pour corroborer les constatations endoscopiques. Dans la région supraclaviculaire, nous avons exposé les racines C5, C6 et C7, les troncs supérieur et moyen, puis avons exposé la partie infraclaviculaire du plexus dans 11 des 13 cas, et le faisceau médial dans 3 cas. Le nerf musculocutané a été vu dans tous les cas, c'était le premier nerf repéré lors de la dissection débutée en avant du processus coracoïde en se dirigeant médialement. Le nerf axillaire était le premier nerf visualisé en débutant la dissection en arrière du processus coracoïde, en se dirigeant médialement. Nous décrivons l'anatomie endoscopique du PB, qu'il est désormais indispensable de maîtriser afin de protéger le plexus dans les interventions endoscopiques de l'épaule se déroulant au-delà de l'articulation. Nous détaillons la technique chirurgicale de l'abord du PB basée sur un travail anatomique de dissection endoscopique, avec une corrélation à ciel ouvert.

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Mots clés : Plexus brachial ; Étude anatomique ; Endoscopie périarticulaire

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1. Introduction

Shoulder arthroscopy techniques have been developing rapidly in recent years. The evolution of arthroscopic techniques allows experienced surgeons to switch from open to arthroscopy procedures. The working space needed to perform these new arthroscopic techniques is becoming larger and extra-articular. Shoulder “arthroscopy” has become “periarticular endoscopy” [1,2]. Surgeons are now able to perform complicated procedures with controlled risks. Nevertheless, shoulder arthroscopy remains technically demanding and is not easily reproducible. In less experienced hands, endoscopy of the periarticular area can be hazardous and severe complications have been reported, including neurological ones [3,4]. The anatomy of the shoulder and the brachial plexus (BP) are interrelated. Periarticular endoscopy takes place close to the BP. The nerves around the shoulder must be located in order to be protected. We started performing endoscopic neurolysis of the BP in 2003 while dissecting the subscapularis muscle during the repair of large and retracted tears [5]. As arthroscopic Latarjet procedures were developed [6], we started dissecting the BP in order to protect it.

In order to describe the endoscopic anatomy of the extra-articular space around the shoulder and the relationships between the nerves and the shoulder, we performed an anatomical study of the endoscopic dissection of the brachial plexus. We compared our findings with those of open dissection. We described the anatomy and the technique for endoscopic dissection of the brachial plexus. The primary aim of the study was to determine if each part of the BP could be identified and dissected by endoscopy. Secondary goals were to precisely describe the endoscopic findings, and to assess which nerves were exposed in each portal.

2. Material and methods

We performed anatomical dissection of fresh cadavers provided by the anatomy laboratory of the surgery school of the Fer à Moulin in Paris. For each cadaver, endoscopic dissection of the supraclavicular part of the brachial plexus (SCBP) and the infraclavicular part of the brachial plexus (ICBP) was performed through pre-defined portals. When the endoscopic dissection was complete, open dissection was performed to verify the endoscopic findings.

The cadavers were placed in a beach chair position, to allow for extended dissection of the BP. The dissections were made using a 5-mm arthroscope, arthroscopy instruments and saline solution. The same surgeon performed all the dissections (T.L.), and one assistant held and manipulated the upper limb of the cadaver in order to facilitate the exposure (T.B.).

Our main outcome criterion was the feasibility of endoscopic nerve exposure. It was considered positive if the nerve could be identified and dissected, and negative if the nerve was not seen, could not be identified precisely, or could not be dissected, even if partially visible.

2.1. Endoscopic portals

Nine portals were used (Fig. 1). There were five supraclavicular portals, and four infraclavicular portals.

2.1.1. Supraclavicular portals

There were two subacromial and two transtrapezial portals. The C portal was a subacromial portal. It was located at the middle of the acromion, 2 cm distal to its lateral border. Through this portal, the target nerves were the suprascapular nerve and the superior trunk. The D portal was a subacromial portal. D was anterolateral, 2 cm distal to the anterior angle of the acromion. Through this portal, the target nerves were the suprascapular nerve and the superior trunk.

The lateral transtrapezial (LT) (TT1 on Fig. 1) and the medial transtrapezial (MT) (TT2 on Fig. 1) portals were both located 2.5 centimeters distal to the upper border of the trapezius. The LT portal was at the level of the suprascapular notch; it was created under endoscopic control from the C and D portals. The target nerves were the suprascapular nerve, the superior, middle and inferior trunks, and the roots of the BP. The MT portal was at the level of the middle of the clavicle. It was created under endoscopic control from the D and LT portals. The target nerves were the trunks and roots of the BP.

The anterior supraclavicular portal was at the level of the middle of the clavicle, immediately posterior to the posterior border of the sternocleidomastoid muscle (arrow on Fig. 1). It was created under endoscopic control from the LT and MT portals. The target nerves through this portal were the trunks and roots of the BP.

2.1.2. Infraclavicular portals

The E portal was anterior, 2 cm distal to the acromioclavicular joint, facing the rotator interval. The target nerves through this portal were the BP cords, the musculocutaneous (MC), axillary and radial nerves from retrocoracoid dissection.

The I portal was in the axis of the coracoid process and across from it, 2 to 3 cm below.



Fig. 1. Supraclavicular and infraclavicular endoscopic portals for the brachial plexus. Arrow: anterior supraclavicular approach; TT1: lateral transtrapezial approach; TT2: medial transtrapezial approach.

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