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# Infraclavicular Brachial Plexus Block: Parasagittal Anatomy Important to the Coracoid Technique

[Regional Anesthesia And Pain Management]

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## Abstract

Infraclavicular brachial plexus block is a technique well suited to prolonged continuous catheter use.We used a coracoid approach to this block to create an easily understood technique. We reviewed the magnetic resonance images of the brachial plexus from 20 male and 20 female patients. Using scout films, the parasagittal section 2 cm medial to the coracoid process was identified. Along this oblique section, we located a point approximately 2 cm caudad to the coracoid process on the skin of the anterior chest wall. From this point, we determined simulated needle direction to contact the neurovascular bundle and measured depth. At the skin entry site, the direct posterior insertion of a needle will make contact with the cords of the brachial plexus where they surround the second part of the axillary artery in all images. The mean (range) distance (depth along the needle shaft) from the skin to the anterior wall of the axillary artery was 4.24 +/- 1.49 cm (2.25-7.75 cm) in men and 4.01 +/- 1.29 cm (2.25-6.5 cm) in women. Hopefully, this study will facilitate the use of this block. Implications: We sought a consistent, palpable landmark for facilitation of the infraclavicular brachial plexus block. We used magnetic resonance images of the brachial plexus to determine the depth and needle orientation needed to contact the brachial plexus. Hopefully, this study will facilitate the use of this block.

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The infraclavicular approach to brachial plexus block is an underused but effective technique. Anesthesiologists may opt for more familiar techniques of brachial plexus anesthesia, such as the axillary approach, given the common lack of experience with this technique and significant variation in infraclavicular anatomy among patients. Nevertheless, advantages of the infraclavicular approach include the ability to perform the block with the patient's arm in any position, avoidance of the neurovascular structures of the neck, minimization of the risk of pneumothorax, and ease of securing a continuous brachial plexus catheter to the chest wall at this site [1-4]. Magnetic resonance imaging (MRI) has emerged as the preferred radiological modality for studying the brachial plexus and the corresponding anatomy [5]. The purpose of this study was to use MRI and cadaver sections to define the anatomic measurements and variation relevant to the infraclavicular block to establish the orientation and depth of simulated needle placement required to reach the brachial plexus by using an infraclavicular/coracoid approach.

## Methods

After obtaining institutional review board approval, we reviewed the oblique parasagittal T1-weighted magnetic resonance images of the brachial plexus from patients undergoing imaging for other reasons. The oblique parasagittal view is used routinely in our institution to obtain optimal intersection (90[degree sign]) with the brachial plexus. Patients with distorted brachial plexus anatomy from mass effect or postprocedural changes were not included. Included in the review were 20 male and 20 female patients imaged in the supine position with the arms adducted, simulating the usual position for infraclavicular/coracoid block. The mean (range) age of the patients was 53.6 +/- 15.6 yr (26-82 yr). Using scout films, we identified the parasagittal section 2 cm medial to the tip of the coracoid process. Along this oblique imaging section, we located a point approximately 2 cm caudad to the coracoid process on the skin of the anterior chest wall. From this point, we determined the simulated needle direction required to contact the anterior aspect of the axillary artery (neurovascular bundle) and measured the depth for each subject (Figure 1). A representative image used in the study with a corresponding line drawing is depicted in Figure 2. In addition to MRI studies, parasagittal cadaver sections were prepared to further identify the anatomy relevant to this infraclavicular/coracoid block (Figure 3).

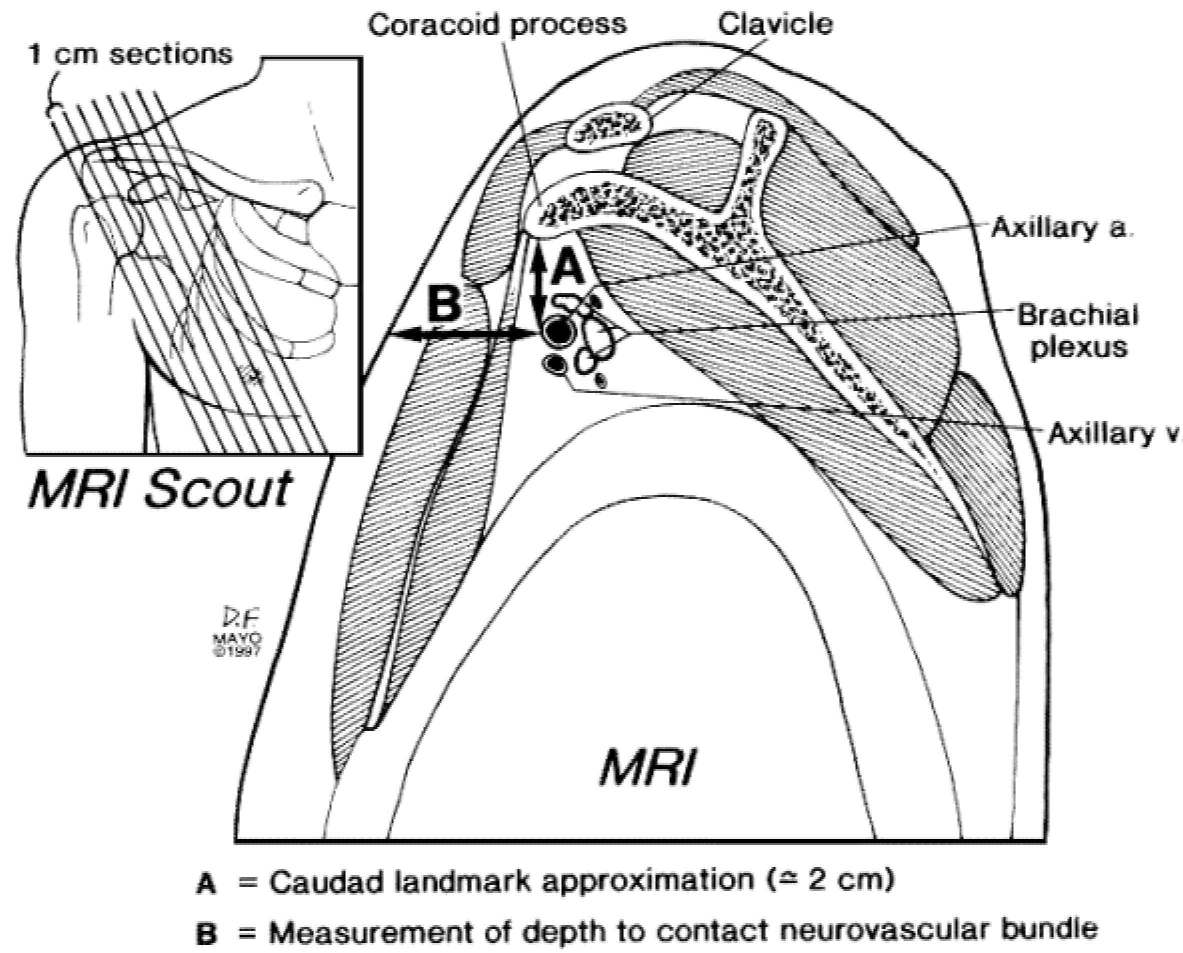


Figure 1. Magnetic resonance imaging measurements for localization of the brachial plexus on oblique parasagittal sections.

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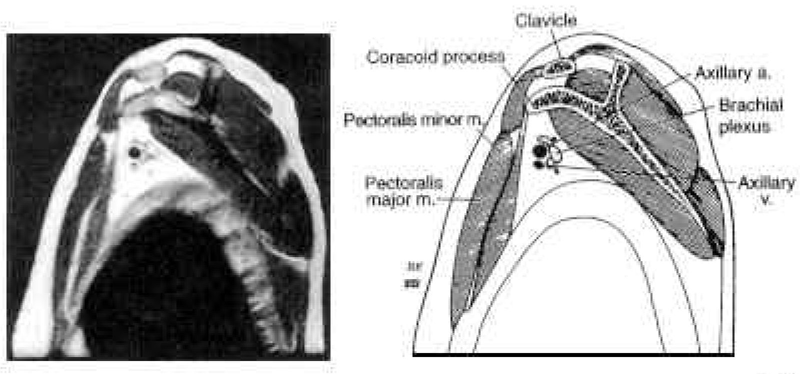


Figure 2. Representative magnetic resonance image used for study measurements.

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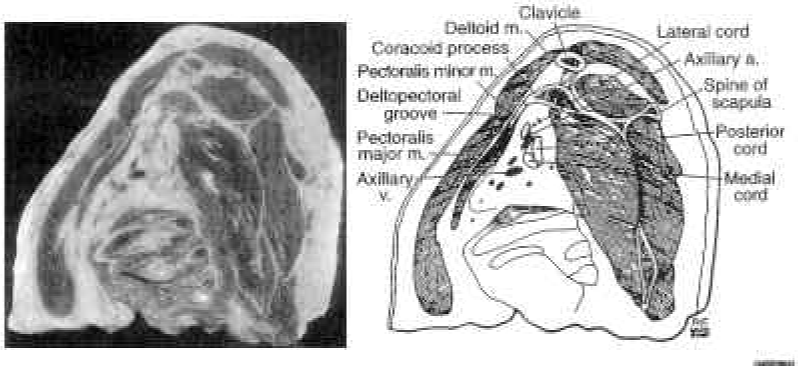

Figure 3. Sagittal cadaver section through the brachial plexus at the coracoid process level.

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## Results

At the point 2 cm medial and 2 cm caudad to the tip of the coracoid process, the direct posterior placement of a needle would contact the cords of the brachial plexus where they surround the second part of the axillary artery in all images (Figure 4). The distance from the skin to the anterior wall of the axillary artery was 4.24 +/- 1.49 cm (2.25-7.75 cm) in men and 4.01 +/- 1.29 cm (2.25-6.5 cm) in women. (Table 1)

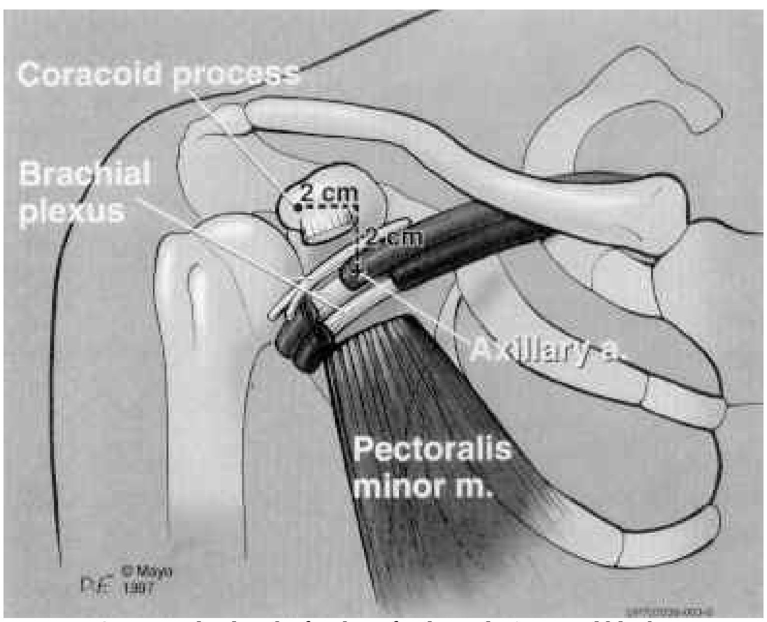

Figure 4. Anatomic landmarks for the infraclavicular/coracoid block.

| Age | Gender | Height (cm) | Weight (kg) | Distance (cm)[a] | Side | Diagnosis |
|---|---|---|---|---|---|---|
| 26 | M | 175 | 86 | 6.0 | R | Radial nerve lesion |
| 40 | M | 173 | 77 | 4.0 | R | Lung cancer/pain |
| 38 | M | 174 | 63 | 2.25 | R | Pancoast tumor/pain |
| 79 | M | 182 | 58 | 3.0 | L | Lung cancer/pain |
| 62 | M | 178 | 85 | 4.5 | R | Breast cancer/pain |
| 67 | M | 178 | 82 | 4.0 | R | Shoulder pain |
| 32 | M | 175 | 68 | 4.25 | R | Arm pain |
| 67 | M | 188 | 114 | 7.0 | L | C7 paresthesia |
| 30 | M | — | 85 | 3.0 | L | Trauma/brachial plexus |
| 39 | M | 173 | 78 | 5.0 | R | Postoperative shoulder pain |
| 68 | M | 175 | 75 | 3.0 | R | Lung cancer/pain |
| 75 | M | 178 | 91 | 3.0 | R | NS |
| 61 | M | 178 | 68 | 3.25 | R | Lung cancer/pain |
| 58 | M | — | 104 | 7.75 | L | Plexopathy |
| 66 | M | 183 | 74 | 3.5 | R | Pain |
| 61 | M | 173 | 82 | 3.5 | R | Pain |
| 33 | M | 180 | 73 | 4.0 | L | Weak upper extremity |
| 54 | M | 180 | 97 | 6.5 | L | Pain |
| 72 | M | 175 | 77 | 3.75 | L | Plexopathy |
| 82 | M | 169 | 73 | 3.5 | L | Plexopathy |
| 76 | F | — | 55 | 2.5 | L | Radial nerve lesion |
| 55 | F | 157 | 77 | 6.5 | L | Breast cancer/pain |
| 40 | F | — | 64 | 4.0 | R | Thoracic outlet syndrome |
| 57 | F | 166 | 70 | 5.0 | R | Thoracic outlet syndrome |
| 33 | F | — | 48 | 2.25 | L | Pain |
| 59 | F | 150 | 50 | 3.5 | R | NS |
| 68 | F | 163 | 62 | 2.5 | L | Breast cancer/pain |
| 53 | F | 155 | 61 | 4.25 | R | Ovarian cancer/upper extremity pain |
| 36 | F | 160 | 50 | 2.75 | R | Pain |
| 54 | F | 165 | 61 | 4.0 | L | Breast cancer/pain |
| 63 | F | 168 | 91 | 5.75 | R | Upper extremity pain |
| 39 | F | 162 | 57 | 4.0 | L | Breast cancer/pain |
| 49 | F | 167 | 116 | 6.5 | R | Breast cancer/pain |
| 38 | F | 154 | 65 | 4.5 | R | NS |
| 44 | F | 156 | 61 | 3.5 | L | Breast cancer/pain |
| 65 | F | 153 | 53 | 2.75 | L | Breast cancer/pain |
| 60 | F | — | 61 | 3.0 | L | NS |
| 49 | F | 165 | 70 | 3.5 | R | Pain |
| 69 | F | 157 | 66 | 4.0 | L | Pain |
| 27 | F | 165 | 78 | 5.5 | L | Thoracic outlet syndrome |

NS = not specified, R = right, L = left.
[a] From skin to axillary artery.

Table 1. Demographic Data

## Discussion

Our description of the coracoid approach to infraclavicular brachial plexus block may provide advantages over existing techniques. Raj et al. [4] described an approach to infraclavicular block using lateral needle orientation to overcome the risk of pneumothorax inherent with blocks performed under the clavicle with the needle directed medially. Other techniques using lateral needle angulation or different landmarks for infraclavicular blocks have been described. The technique described by Sims [3] has a more medial and cephalad needle entry site with a inferior and lateral needle angulation. Whiffler's technique [6] uses a needle entry site that is most often inferior and medial to the coracoid process determined by palpation of vascular landmarks with the affected arm abducted and the relevant shoulder depressed. The needle direction, such as that we describe, is directly posterior. The depth of needle insertion required to reach the brachial plexus often requires the entire length of the needle (51 mm). The risk of penetrating the thoracic cavity, as noted in the preliminary cadaver study, was zero with this method. Kilka et al. [7] studied 175 patients undergoing surgery of the upper limb and anesthetized them using an infraclavicular approach based on previous anatomic studies. They divided the distance between the fossa jugularis and the ventral process of the acromion into equal parts and inserted the needle under the clavicle at the midpoint. The needle was passed directly posterior. A nerve stimulator was used to obtain muscle contractions in the area to be operated on with a current <or=to0.3 mA. The success rate of the block (surgical anesthesia) was 94.8%. The remaining patients underwent general anesthesia but had complete blocks after surgery. Venous puncture occurred in 18 patients (10.3%), and Horner's syndrome was noted in 12 patients (6.8%). No arterial or pleural injury was noted.

The advantages of the coracoid/infraclavicular block are the ability to perform the block with the ipsilateral arm in any position and, more importantly, the presence of a consistent, palpable bony landmark. Additionally, the block is likely to be easily understood and taught because the needle insertion is directly posterior from the skin entry site. Other theoretic advantages common to other infraclavicular blocks include the ability to block the musculocutaneous nerve of the brachial plexus using a single injection, minimization of the risk of pneumothorax, and avoidance of neurovascular structures of the neck.

Our study is limited with respect to measurements of distance of the needle tip from pulmonary tissue. This is because the magnetic resonance images are directed lateral to medial inferiorly (oblique). Nonetheless, our clinical experience has not resulted in a pneumothorax while using this approach. In some cases, fluoroscopy was used to facilitate placement of a continuous catheter. Using our coracoid landmarks, no needle was close to the lung in the anteroposterior views. Vascular puncture with hematoma formation is possible with an infraclavicular approach to the brachial plexus, similar to other blocks along the plexus. A disadvantage with our technique is the inability to externally compress the source of hematoma. Proper technique and careful avoidance of the block in patients with coagulopathies would limit the occurrence of this problem.

Indications for this block are identical to those for an axillary approach and include surgery of the forearm and hand. Patients requiring prolonged analgesia or sympathectomy of the upper extremity for postoperative analgesia or complex regional pain syndromes may be especially suited for infraclavicular catheter placement because this site is ideal for effectively securing the catheter to the anterior chest wall [1,2].

In conclusion, using the infraclavicular/coracoid brachial plexus block in simulation, the brachial plexus would have been contacted in all subjects. The required depth of insertion varies with body habitus. This description of our infraclavicular/coracoid block and measurements related to the block may make anesthesiologists more comfortable in performing this technique.

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