A cadaveric study of needle insertion at PC6 in eight wrists of four subjects and an understanding of the anatomy

Hyun Joo Oh, Yee Kyoung Ko, Sa Sun Cho, Sang Pil Yoon

ABSTRACT
The anatomical structures vulnerable to acupuncture around the PC6 acupuncture point were investigated. Needles were inserted in PC6 of eight wrists from four cadavers to a depth of 2 cm, the forearms were dissected and the adjacent structures around the path of the needles were observed. The needles passed between the tendons of the palmaris longus and flexor carpi radialis muscles and then penetrated the flexor digitorum superficialis, flexor digitorum profundus and pronator quadratus muscles. The inserted needles were located adjacent to the median nerve. To minimise the risk of unintended injury by acupuncture, it is recommended that needles should not be inserted deeply at the PC6 acupuncture point. An understanding of the anatomical variations of the median nerve and the persistent median artery in the forearm is of clinical importance when performing acupuncture procedures.

INTRODUCTION
Acupuncture is one of the most common complementary therapies in many countries and is considered as a relatively safe procedure. Many acupuncture points in the limbs are located in close proximity to peripheral nerves, but injuries of peripheral nerves caused during the acupuncture procedure have rarely been reported compared with serious complications such as pneumothorax, cardiac tamponade, brain and spinal cord injury. Median nerve neuropathy and peroneal nerve palsy related to acupuncture are the only reported peripheral nerve complications.

PC6 Nei guan is one of the acupuncture points in the anterior forearm. It is located between the tendons of palmaris longus and flexor carpi radialis as well as 2 cm proximal to the wrist crease on the anterior forearm, one-sixth proximal to the wrist crease. Owing to its close proximity to PC6, the median nerve is vulnerable to penetrating injury during the acupuncture procedure. This study was designed to investigate if acupuncture at PC6 can cause unintended injury to adjacent structures and to provide an anatomical understanding necessary for safer procedures.

ANATOMICAL OBSERVATIONS AT PC6 IN CADAVERS
During a routine dissection carried out at Jeju National University Medical School in 2011, we observed the anatomical structures relevant to PC6 of eight arms in four cadavers who did not have any known pathology in the forearm (table 1). The protocol for the current report did not include any specific issue that needed to be approved by the ethics committee of our institution. A needle 30 mm long and of 0.6 mm diameter was inserted by an acupuncture practitioner at PC6 on both sides of the cadavers’ forearms. The angle of needle insertion was perpendicular to the skin surface and the depth of insertion was 2 cm. After placing the needles, dissection of the forearms was carried out.

Seven needles were inserted between the palmaris longus and flexor carpi radialis tendons (figure 1A) and then perforated the flexor digitorum superficialis, flexor digitorum profundus and pronator quadratus muscles. Two of the inserted needles punctured the interosseous membrane and extensor muscles. One of the eight needles penetrated the palmaris longus tendon (figure 1B). With respect to nerves, one needle partially came into contact with the median nerve (not shown) and the other seven needles passed the medial side of the median nerve without touching other structures.

In a living body the tendons of the palmaris longus and flexor carpi radialis muscles can be easily identified by physical examination. Because tendons are more movable and resilient, penetrating these structures at PC6 is less likely to occur than in the present case (figure 1C). On the contrary, anatomical variations of the median nerve with or without the persistent median artery in the forearm are more significant.

Table 1 Summary of characteristics of the cadavers used in this study

<table>
<thead>
<tr>
<th>No</th>
<th>Age</th>
<th>Sex</th>
<th>Cause of death</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>45</td>
<td>M</td>
<td>Hepatic failure due to rectal carcinoma</td>
</tr>
<tr>
<td>2</td>
<td>79</td>
<td>M</td>
<td>Unknown</td>
</tr>
<tr>
<td>3</td>
<td>72</td>
<td>F</td>
<td>Pneumonia</td>
</tr>
<tr>
<td>4</td>
<td>82</td>
<td>F</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

Anatomy of the median nerve with or without a persistent median artery
The median nerve descends between the flexor digitorum superficialis and flexor digitorum profundus muscles in the forearm. Near the wrist the nerve runs lateral to the flexor digitorum and passes more superficially between the tendons of the palmaris longus and flexor carpi radialis muscles. It enters the hand by passing through the carpal tunnel, posterior to the flexor retinaculum and anterior to the flexor tendons. The path of the needle at PC6 is therefore closely related to the median nerve. Since the median nerve runs 1–1.5 cm in depth at PC6, it is more likely to be penetrated during the acupuncture procedure, as previously reported. The mean distance from the needle tip to the median nerve was only 1.8 mm and the rate of median nerve injury appeared to be high. Despite a high incidence of penetration, it seems to carry no risk of neurological sequelae.

In addition, the median artery normally disappears after the second embryonic month and it’s function is replaced by the ulnar and radial arteries. Occasionally it remains as a thin artery, the persistent median artery that runs along the median nerve. In that case, unexpected bleeding or other complications may arise as a result of acupuncture.

Anatomical variations of the median nerve and PC6
Variations of the median nerve in the carpal tunnel have been reported in postmortem, radiological and surgical studies. According to Lanz, anomalies of the median nerve can be classified into four categories: (1) variations of the thenar branch; (2) the presence of accessory branches in the distal part of the carpal tunnel; (3) proximal division of the median nerve; and (4) the presence of accessory branches proximal to the carpal tunnel.

The third anomaly is related to the persistent median artery and is considered to be most vulnerable to acupuncture at PC6. The frequency of this anomaly has been reported to be 0.3–3% in anatomical and surgical studies, with the lowest in Koreans. Bilateral median nerve proximal to...
HOW CAN WE ACHIEVE SAFE NEEDLING AT THE PC6 ACUPUNCTURE POINT?

When needling acupuncture points on the extremities, the tip of the needle often lies in skin or muscle or overlies other structures including the nerves and vessels. The anatomical target where the tip of the needle is intended to lie at PC6 and the optimal depth of needle insertion have not been established and are inconsistent. However, the needling depth at acupuncture points including PC6 may not be as important as was previously thought by acupuncture practitioners. PC6 is frequently used for treating symptoms such as migraine, tension type headache and gastrointestinal problems. The evidence from systematic reviews shows that PC6 stimulation reduces postoperative nausea and vomiting (PONV). In addition, various methods of stimulation at PC6—including needle acupuncture, electro-acupuncture, transcutaneous nerve stimulation, laser stimulation, capsicum plaster, an acu-stimulation device and acupressure—are used in clinical trials to evaluate the efficacy of PONV. In addition to needle acupuncture, various modalities of non-invasive stimulations of PC6 are also effective in reducing PONV. It can be inferred from this report that the depth of needle insertion and the method of stimulation may not matter. Therefore, in order to minimise its adverse effect, the depth of needle insertion at PC6 should be considered carefully with respect to patients’ responses. However, it is difficult to determine a single unifying depth of insertion in millimetres because the tissue level in which the tip of the needle lies will be dependent on the thickness of the skin and muscles.

CONCLUSION

It is recommended that the acupuncture needle should not be inserted deeply at PC6 in order to minimise the risk of trauma. It seems likely that various kinds of non-invasive stimulation at PC6 may be similarly effective as needling. Therefore, our guidance is that safe and adequate needling at PC6 can be achieved by shallow angulation of the needle in a proximal direction so that the needle tip enters the flexor digitorum superficialis muscle. Careful insertion of the needle with respect to patients’ sensations and better anatomical knowledge of the forearm can help to prevent unexpected needle penetration of the median nerve or persistent median artery.

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