How to Avoid Ulnar Nerve Injury When Setting the 6U Wrist Arthroscopy Portal

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J Wrist Surg 2014;3:128–131.

Abstract

The dorsal sensory branch of the ulnar nerve (DSBUN) is at risk in setting the 6U wrist arthroscopy portal. Although surgeons know the risk and are careful when they set the 6U portal, DSBUN injuries still occur.

The purpose of the present anatomical study was to evaluate the possibility that DSBUN undergoes dynamic anatomical variations in its location during wrist arthroscopy. The goal of the study was to clarify (1) whether the nerve-to-portal (NTP) distance changes with flexion/extension wrist and/or hand/forearm rotation, and (2) whether there is any particular combination of flexion-extension/hand-forearm rotation where the NTP distance is maximal.

Six fresh cadaver arms were suspended in a traction tower with forearm rotation locked, the skin and subcutaneous tissue around the ulnar head was removed, and the NTP distance measured in three predetermined loading/positional conditions.

Of all options, the one that consistently showed the longest and safest NTP distance involved wrist flexion and radiocarpal supination when forearm rotation is limited.

In conclusion, when an arthroscopic traction device restricts the forearm rotation, the 6U portal should not be set under traction with the hand passively pronated. Failure to observe this precaution can result in serious neuropathic pain.

Keywords

- arthroscopy portals
- dynamic anatomical study
- dorsal sensory branch of the ulnar nerve (DSBUN) injury
- DSBUN and wrist anatomy
- wrist arthroscopy complication

Although wrist arthroscopy without traction has been described,[1] most of the procedures use a traction tower. In some of these traction systems, finger traps suspend the hand and the forearm is secured in neutral rotation to a post by Velcro strap. In such cases, forearm rotation is very restricted and the hand and wrist are free to supinate or pronate around the forearm axis (►**Fig. 1**). The 6U portal is established just palmar to the anterior margin of the extensor carpi ulnaris (ECU) tendon and proximal to the medial prominence of the triquetrum.

In the last decade, several anatomical studies have warned about the risk of injury to the dorsal sensory branch of the ulnar nerve (DSBUN) during use of the 6U portal.[2–5] All those studies were based on static measurements of the so-called "nerve-to-portal" (NTP) distance, that is, the shortest distance between the DSBUN and the 6U portal. Obviously, it was assumed that this distance was constant regardless the position of the hand and forearm. To clarify that, we requested permission from our Institutional Review Board (IRB) to investigate this further.

If we could prove that the NTP distance is not constant but changes substantially from one wrist position to another, we would indirectly demonstrate that the risk of damaging the DSBUN is joint position dependent; in other words, that there are wrist positions where that risk is high and safer positions where the risk is low.

The goal of our study, therefore, was to provide data to prove that (1) the NTP distance varies by passively pronating or supinating the hand/wrist relative to the locked forearm, and (2) that there is a particular combination of traction and intracarpal axial rotation in which the DSBUN is at a reduced risk of being injured.

DOI http://dx.doi.org/10.1055/s-0034-1372517.
ISSN 2163-3916.

Fig. 1 When an arthroscopic traction tower is used, forearm rotation is blocked in neutral; hand and wrist are free to supinate or pronate around the forearm axis.

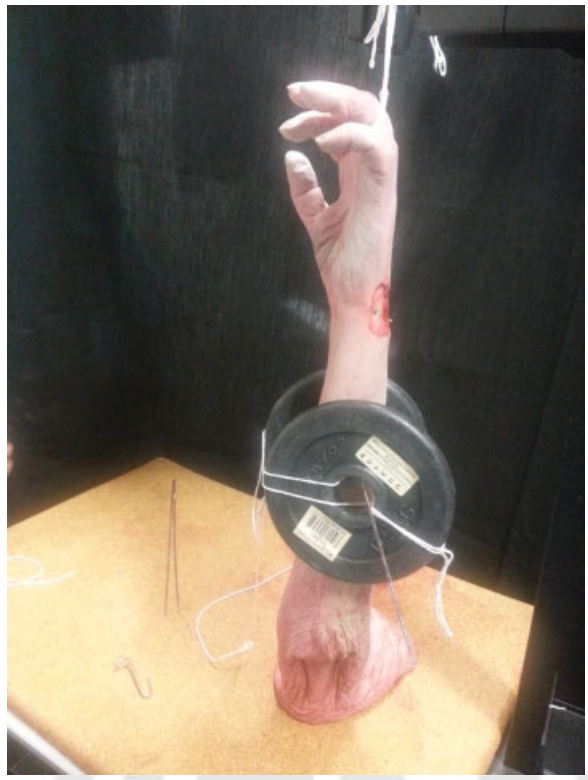

Fig. 2 Cadaver is suspended; forearm bones are blocked in neutral rotation, Elbow is secured manually.

Methods

Six fresh arms from six different cadavers, without preexisting wrist pathology, were assigned to this study. The arms were obtained from body donations.

First of all, we excised a 20 × 10 mm skin and subcutaneous window over the medial border of the wrist, leaving the ECU tendon and the DSBUN intact. Next, the forearm bones were blocked in neutral rotation by a transverse Steinmann pin to simulate the conditions present during wrist arthroscopy. After this, the arm was suspended by the third and fourth fingers and a 4-kg load was placed over the Steinmann pin (►**Fig. 2**). Finally, the 6U portal was established with the forearm in neutral rotation. It was set at the volar edge to the ECU tendon, proximal to the prominence of the medial aspect of the triquetrum, under direct vision in a standardized form for each specimen. To facilitate its recognition, the portal was marked with a colored needle.

With the wrist under traction and neutral flexion–extension, a precision vernier caliper was used to measure the NTP distance three times: in neutral intracarpal pronosupination, in maximal passive intracarpal supination, and in maximal passive intracarpal pronation. All these measurements were repeated with the wrist in 20° flexion.

The data were assessed statistically using analysis of variance (ANOVA) with repeated measures, and significance was set at a $P < 0.05$.

Results

As hypothesized, the NTP distance varies substantially with wrist flexion and/or intracarpal axial rotation when forearm rotation is restricted (►**Table 1**). Under traction and neutral wrist flexion–extension, the mean NTP distance was 2 mm (range: 1–3 mm) for the wrist in neutral radiocarpal pronosupination, 4 mm (3–5 mm) for the wrist in maximal passive

Table 1 Nerve-to-portal (NTP) distance in millimeters

	Neutral wrist flexion-extension			Wrist flexion 20°		
Specimen #	Pronation*	Neutral	Supination*	Pronation*	Neutral	Supination*
1	0	2	4	4	4	4
2	0	2	5	5	5	5
3	0	1	3	4	4	4
4	1	3	5	6	6	6
5	0	2	3	5	5	5
6	1	2	4	5	5	5

Forearm rotation is fixed in neutral rotation in all cases. Hand and wrist are under traction in all cases. Pronation*: maximal passive intracarpal pronation; Supination*: maximal passive intracarpal supination; Neutral: neutral radiocarpal pronosupination.

Fig. 3 Anatomical photography corresponding to specimen number 2. When forearm is kept in neutral rotation, wrist in neutral flexion–extension, and hand/wrist are submitted to maximal passive intracarpal supination, the distance DSBUN-to-6U portal is 5 mm.

Fig. 4 Anatomical photography corresponding to specimen number 2. When forearm is kept in neutral rotation, wrist in neutral flexion–extension, and hand/wrist are submitted to maximal passive intracarpal pronation, the distance DSBUN-to-6U portal is 0 mm.

supination (►**Fig. 3**), and 0 mm (0–1 mm) in full passive pronation (►**Fig. 4**). When the wrist was assessed in 20° of flexion, the average NTP distance was 5 mm (4–6 mm), regardless of the amount of passive pronosupination exerted on the wrist (►**Fig. 5**).

When forearm rotation is restricted under traction, wrist maximal passive supination or wrist 20° flexion (►**Fig. 3**) are the positions in which the DSBUN is at a reduced risk of being injured.

Fig. 5 Anatomical photography corresponding to specimen number 4. When forearm is kept in neutral rotation, wrist is 20° flexed, and hand/wrist are submitted to maximal passive intracarpal pronation, the distance DSBUN-to-6U portal is 6 mm.

Discussion

During a wrist arthroscopy, the surgeon is usually seated facing the back of the hand, as most arthroscopy portals are dorsal. In this situation, the ulnar margin of the ECU tendon is always out of the surgeon's sight. If in these circumstances the surgeon wants to see the entry point of the 6U portal directly, he or she might be tempted to pronate the hand passively. When an arthroscopic traction device is used, however, the forearm is often stabilized to a post by a tightened Velcro strap (►**Fig. 1**). Although it is true that the strap does not completely block the forearm rotation, it is important to note that it largely restricts it, especially if it is too tight. .In such cases, the main possible hand rotation is a passive intracarpal pronosupination of the suspended hand relative to the two blocked forearm bones.

According to the results of our study, this maneuver brings the DSBUN too close to the 6U portal, risking its integrity, especially if the nerve is taut because of the applied traction, and the wrist is not kept in flexion.

Although there are few reports of DSBUN injury during wrist arthroscopy, we would recommend flexing the wrist to 20° or supinating the hand while establishing the 6U portal in cases where the forearm is strapped to the post, along with using a shallow skin incision and careful wound spread technique.

Conflict of Interest
None

The use of human cadavers is in accordance with the regulations of our institutions.

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