In-plane ultrasound-guided needle insertion ALONG or ACROSS the visual axis hand positions

Editor—There are two common methods of holding the needle and transducer during an in-plane guided needle insertion (i.e. the needle is inserted in-plane to the ultrasound transducer beam). The long axis of the transducer can be oriented along the visual axis (ALONG hand position) or across the visual axis (ACROSS hand position). Needle advancement ALONG the visual axis has been recently reported to result in improved needle imaging and a shorter time to targeting.1 We designed a study to compare the use of the ALONG vs ACROSS hand positions on trainees’ performance of simulated in-plane ultrasound-guided nerve block on a phantom gel model.

This prospective randomized crossover study was conducted at Vancouver General Hospital after approval by the Research Ethics Board of the University of British Columbia (Date: February 1, 2013, H11-00774) and Research Access Committee of the Office for Undergraduate Medical Education. Medical students were randomized using sealed opaque envelopes to perform in-plane ultrasound-guided needle insertion on a gel phantom model beginning with either the needle and transducer being held ACROSS their visual axis (Fig. 1A) or the needle and transducer being held ALONG their visual axis (Fig. 1A). A gel phantom (Blue Phantom, Redmond, WA, USA) with an embedded simulated blood vessel filled with red dye was used as a target to confirm correct needle placement.2 A 22 G 50 mm Stimuplex needle (B Braun, Bethlehem, PA, USA) was inserted in-plane to the ultrasound transducer into the gel with the simulated blood vessel visualized in the short axis. All attempts were recorded and two anaesthesiologists trained in regional anaesthesia and blinded to the hand position independently measured the time the needle was visualized. After completion of the tasks with both hand positions, all participants completed a self-assessment of mental workload for each hand position.

The ALONG hand position significantly improved the needle visualization compared with the ACROSS hand position (observer 1: 35.6% vs 26.2%, P=0.009; observer 2: 39.4% vs 30.7%, P=0.023). The ALONG hand position showed reduced time to task completion (30.0 vs 50.1 s per trial, P=0.001) compared with the ACROSS hand position (observer 1: 35.6% vs 26.2%, P=0.009; observer 2: 39.4% vs 30.7%, P=0.023).

Fig 1 A schematic of the ultrasound hand positions used. The simulated vessel is represented by the blue dashed line. In both cases, the needle is inserted 90 degrees to the simulated vessel, i.e. the vessel was seen in short axis on the ultrasound monitor. (a): ACROSS the Visual Axis Hand Position (90 degrees to the student’s body); (b): ALONG the Visual Axis Hand Position.
with the ACROSS hand position. The ALONG hand position group was successful in target localization in 84.5% of the trials, while the ACROSS hand position group was successful in 75.6% of the trials ($P=0.21$). The average time to task completion was also calculated for the first set of three trials (regardless of starting hand position) compared with the second set of three trials to look for a learning effect. There was no significant difference in these times (40.6 vs 41.0 s for the first and second three trials, respectively). The ALONG hand position required significantly less prompting (average 0.47 vs 2.47 per three trials, $P=0.01$) and fewer restarts (average 2.0 vs 3.9 per three trials, $P=0.03$) compared with the ACROSS hand position. The results of a post-study NASA-TLX task load questionnaire are shown in Table 1.3 The ALONG hand position was associated with a significantly lower temporal demand compared with the ACROSS hand position. (9.40 vs 11.23, $P=0.05$). Performance was also better with the ALONG hand position (13.4 vs 10.5, $P=0.014$) compared with the ACROSS hand position. Participants ranked their own abilities higher with the ALONG position compared with the ACROSS hand position (6.53 vs 4.87, $P=0.005$). A majority of participants (21/30, 70%) expressed a preference for the ALONG hand position over the ACROSS hand position ($P=0.045$).

In conclusion, our study found that in trainees, needle advancement ALONG the visual axis minimizes needle passes, decreases the time required for task completion, improves ergonomic performance, and most importantly increased the proportion of the time that the needle tip is visualized. These results can potentially enhance patient safety and outcomes during regional procedures performed by trainees.

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**Declaration of interest**

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**Finding the bulging edge: a modified shamrock lumbar plexus block in average-weight patients**

Editor—The transverse process has been used as the marker to help identify the relative depth during needle advancement for landmark-guided lumbar plexus block. With ultrasound guidance, there is a trend towards avoiding contact with the transverse process in order to reach the lumbar plexus more directly, thereby minimizing needle redirection, either out-of-plane by trident sign guidance1 or in-plane by a paramedian transverse scan.2 Recently, we have recommended the shamrock method as the ultrasound standard for lumbar plexus block,3 where the transverse process has been viewed as the stem of the shamrock. In patients with average weight, usually the needle shaft could be kept vertical to the ultrasound beam and found more easily if the needle is inserted in the ultrasound plane according to the depth measured from the ultrasound image.4 In such circumstances, needle-transverse process contact seems to be redundant and only causes extra needle redirections. Therefore, after obtaining the shamrock view

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**Table 1 Results of the modified NASA-TLX post-study questionnaire. ALONG, along the visual axis hand position; ACROSS, across the visual axis hand position. 2, actual numbers with %; questions a–g were scored out of 20; questions i and j were scored out of 10**

<table>
<thead>
<tr>
<th>Task question</th>
<th>Along (so)</th>
<th>Across (so)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall value (a)</td>
<td>17.67 (1.9)</td>
<td>16.93 (2.8)</td>
<td>0.138</td>
</tr>
<tr>
<td>Mental demand (b)</td>
<td>11.40 (5.2)</td>
<td>12.47 (5.0)</td>
<td>0.219</td>
</tr>
<tr>
<td>Physical demand (c)</td>
<td>6.70 (4.2)</td>
<td>7.13 (4.2)</td>
<td>0.498</td>
</tr>
<tr>
<td>Temporal demand (d)</td>
<td>9.40 (5.6)</td>
<td>11.23 (5.3)</td>
<td>0.058</td>
</tr>
<tr>
<td>Performance (e)</td>
<td>13.40 (4.7)</td>
<td>10.50 (5.1)</td>
<td>0.014</td>
</tr>
<tr>
<td>Effort (f)</td>
<td>10.67 (5.0)</td>
<td>11.93 (4.2)</td>
<td>0.299</td>
</tr>
<tr>
<td>Frustration level (g)</td>
<td>7.77 (5.3)</td>
<td>9.50 (4.7)</td>
<td>0.125</td>
</tr>
<tr>
<td>Learner assessment of own ability (i,j)</td>
<td>6.53/10 (2.2)</td>
<td>4.87/10 (2.2)</td>
<td>0.005</td>
</tr>
<tr>
<td>Preferred modality (h)</td>
<td>21 (70%)</td>
<td>9 (30%)</td>
<td>0.045</td>
</tr>
</tbody>
</table>