The usefulness of a drill stopper to prevent iatrogenic soft tissue injury when using a drill in orthopedic surgery

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Iatrogenic drill penetration injuries
- drilling a bone with high bone mineral density
- using a blunt drill bit

To prevent such injuries, some methods have been introduced
- dual motor drill
- two-hand technique

 Depend solely by the surgeon’s skill and concentration
• Previous technique depend on skill of the operator
  → need for compensatory way to prevent it by controlling such factor

• We introduce a novel method using the drill stopper to reduce the drill plunging depth and prevent iatrogenic injury such as neurovascular deterioration.
The experiment was divided into two groups

- 16 experienced surgeons vs 16 inexperienced surgeons

Each participant drilled a total of 12 trials on the synthetic bone model
(A) Drill stoppers and a screw driver. The stoppers are in various sizes to be assembled to fit drill bit sizes
(B) Screw driver and a stopper screw part
(C) Inserting the drill stopper into the drill bit and tighten the screw with a driver to complete the assembly
Participants performed 3 trials each using
- Free hand drilling using sharp drill bit (SF)
- Free hand drilling using blunt drill bit (BF)
- Drill stopper drilling using sharp drill bit (SS)
- Drill stopper drilling using blunt drill bit (BS)

Measure the plunging depth of each trial
Materials and Methods

• The tools and the procedures
  (A) The preparation tools
  (B) Drill stopper installed on drill
  (C, D) Drilling process
  (E) Measuring the bone depth
  (F) Measuring the total drilling depth (TDD)

• The plunging depth is equal to (TDD) minus the (Bone depth)
## Participants demographics

<table>
<thead>
<tr>
<th></th>
<th>Experienced</th>
<th>Inexperienced</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of participants</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Orthopedic service years</td>
<td>10.1</td>
<td>1.5</td>
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<tr>
<td>Dominant hand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rt.</td>
<td>16</td>
<td>15</td>
</tr>
<tr>
<td>Lt.</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
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<tr>
<td>Male</td>
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<td>15</td>
</tr>
<tr>
<td>Female</td>
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<td>1</td>
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</tbody>
</table>
Results

- Comparing plunging depth of experienced and inexperienced

<table>
<thead>
<tr>
<th></th>
<th>Experienced(mm)</th>
<th>Inexperienced(mm)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF (sharp free)</td>
<td>3.83</td>
<td>8.52</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>BF (blunt free)</td>
<td>11.02</td>
<td>18.75</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>SS (sharp stopper)</td>
<td>2.88</td>
<td>2.96</td>
<td>0.450</td>
</tr>
<tr>
<td>BS (blunt stopper)</td>
<td>2.75</td>
<td>2.83</td>
<td>0.869</td>
</tr>
</tbody>
</table>
Results

• Comparing plunging depth of experienced and inexperienced
Comparing plunging depth between each subgroups

<table>
<thead>
<tr>
<th></th>
<th>Free(mm)</th>
<th>Stopper(mm)</th>
<th>p value</th>
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</thead>
<tbody>
<tr>
<td>sharp</td>
<td>5.18</td>
<td>2.92</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>blunt</td>
<td>14.86</td>
<td>2.79</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

- The plunging depths of SF and SS were 5.18 (±4.208) mm and 2.92 (±0.536) mm, respectively (p<0.01)
- The plunging depths of BF and BS were 14.86(±5.494)mm and 2.79(±0.664)mm, respectively (p<0.01)
• Iatrogenic soft tissue injuries caused by drill penetration can be a common complication during the orthopedic surgeries.

• The drill plunging depth was statistically less when the operator was highly skilled, using the sharp drill bit, and when drilling the osteoporotic bone.

Discussion

- **Two handle technique and the dual-motor drill device**
  - Plunging depth could be minimized by using the two-hand smooth technique
    - Ding et al. *J Orthop Trauma*. 2019
  - Dual-motor drill can reduce plunging depth
  - Depend on skill of the operator and equipment is quite costly

- **Drill stopper**
  - Plunging depth is measured regardless of the operator’s experience
  - Can be utilized at a very low cost
Discussion

• Limitations
  − relatively small number of participants
  − femoral synbone used in this study is less dense than the normal bone
  − there may be bias in the free handle trial because the participants did not standardize the drilling method

• Strength
  − each participant performed a relatively large number of drilling (12 times for each surgeon) to minimize the errors
  − this technique is relatively intuitive and simple, and it is possible to control the accurate plunging depth during drilling, so the reproducibility is high regardless of performer's experience
Conclusion

• By utilizing the drill stopper, the risk of severe injuries from excessive drill penetration can be minimized, leading to improved patient safety and better surgical outcomes.

• We recommend its incorporation, particularly when using a blunt drill bit or when an inexperienced surgeon operates in an anatomically unfamiliar area.