Barbed needle and inexplicable paresthesias and trismus after dental regional anesthesia

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The tips of 100 needles that had been used clinically for the administration of mandibular block anesthesia (50 by students and 50 by staff) were examined individually under a dissecting microscope. Sixty percent of these needles were found to be barbed. With the use of an animal laboratory simulation, it has been shown that the tips of standard needles as used in general dental practice will barb if allowed to touch bone (medial aspect of the mandibular ramus) during the administration of a mandibular block for dentistry using the direct approach and that a relationship exists between the pattern of this barbing, the disposition of the bevel of the needle at the time of its insertion, and the likelihood of lingual or inferior dental nerve involvement on withdrawal of the barbed needle. Simple precautions are advanced for reducing the possibility of nerve or other tissue damage from this source. (ORAL SURG ORAL MED ORAL PATHOL 1994;77:585-8)

Limitation of oral opening and occasional paresthesias after local anesthetic injections for dental treatment continue to be problems in dentistry. Although the incidence of such morbidity is low, it is accompanied often by distress for both patient and attending clinician and could lead to litigation. The present study seeks to identify at least one cause for this complication and proposes techniques for preventing it.

The possibility of pain, dysesthesia, and hematoma after the use of barbed needles has been alluded to by authors,\(^{1-5}\) but little or no factual evidence that might explain this has been found in the literature. Sunderland\(^6\) indicates the possibility of needle point trauma inducing epineurial hemorrhage that can give rise to a constrictive epineuritis. Brown\(^7\) analyzed 20 cases of persistent limitation of oral opening after an inferior alveolar nerve block and discussed the various etiologic theories previously advanced. Brooke\(^8\) also mentioned needle trauma as a possible cause of trismus. Selander et al.\(^9\) showed that the technique of deliberately eliciting paresthesia during an axillary block injection risked postblock nerve lesions as a result of needle trauma and demonstrated experimentally that needle trauma can cause damage to perineurium, nerve fibres, and blood vessels. Selander et al. found that the risk of such traumatic nerve lesions from standard injection techniques was reduced when a short bevelled (45 degree) needle was used but, like Brown\(^7\) and Brooke,\(^8\) they made no reference to the added dangers of barbed needles. Rice and McMahon,\(^10\) in a convincing study, have recently questioned the advantage of short bevelled needles in medicine and have shown that the lesions induced in nerves by long bevelled needles are less severe. Standard needles widely used in dentistry have 9 to 15 degree bevels. Because of this very long bevel, such needles would be more susceptible to barbing of their tips thus making it even more dangerous for a dentist to elicit paresthesia as part of the technique of mandibular block than a medical practitioner inducing an axillary block. A biochemical basis for paresthesias of the inferior dental nerve has been discussed by Nickel,\(^11\) but his assumptions remain unconvincing. The hypothesis advanced in this article needs to be considered.

**MATERIAL AND METHODS**

**Clinical study**

Fifty tips of needles (27 gauge) that had been used only once for the administration of a direct mandibular block for minor oral surgical procedures in an oral surgery student outpatient clinic were examined un-

### Table I. Results of the examination of 50 needle tips used clinically for mandibular block by undergraduate students and by staff

<table>
<thead>
<tr>
<th>Needle tips</th>
<th>Inward barb</th>
<th>Outward barb</th>
<th>No barb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used by undergraduate students</td>
<td>Number</td>
<td>16</td>
<td>9</td>
</tr>
<tr>
<td>Percentage</td>
<td>52%</td>
<td>18%</td>
<td>50%</td>
</tr>
<tr>
<td>Used by staff</td>
<td>Number</td>
<td>13</td>
<td>22</td>
</tr>
<tr>
<td>Percentage</td>
<td>26%</td>
<td>44%</td>
<td>30%</td>
</tr>
</tbody>
</table>

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Fig. 1. Histologic evidence of axonal and fascicle sheath damage to porcine infra-orbital nerve after use of outwardly barbed needle. Arrow shows needle path. (Ammoniacal silver nitrate stain; original magnification ×90.)

Animal head experiment
Six sets of 15 standard dental hypodermic needles (75, gauge 27; 15, gauge 25) were made up by random selection. Each set represented a different needle manufacturer in an attempt to avoid bias. Each tip of these 90 new needles was examined under a dissecting microscope to determine the condition of the needle tip before it was used experimentally on a pig's head. Then these 90 nonbarbed needles were used in a simulation of the direct approach to the mandibular block with the use of intact pig heads in an animal laboratory situation. The porcine cheeks were cut back from the commissures of the mouth to allow ease of access to the experimental puncture point target area. In the wide-open mouth position and at random, 45 needles were introduced with the needle bevel facing the operator as the operator faced the animal head. The remaining number were then used in a similar way but with the bevel facing away from the operator. In each case the needle tips were allowed to touch bone at the mandibular sulcus in the same manner as occurs clinically with the direct technique of intra-oral mandibular block.

Isolated porcine nerve experiment
Three porcine infraorbital nerves were dissected carefully at autopsy, and three inches of their length displayed. With these nerve specimens used separately, a nonbarbed, an inwardly barbed, and an outwardly barbed needle were passed at right angles through the body of the nerves and withdrawn a single time. Appropriate cross sections were then cut to include the region of the needle path and the specimens immediately fixed in formal saline solution and routinely processed for light microscopic histologic examination with the use of an ammoniacal silver nitrate stain (Marsland, Glees and Erikson) (Fig. 1).

RESULTS
First investigation—Clinical study
The types of barbs found at microscopic examination of the needle tips are represented in Fig. 2. Fifty percent of the needles examined from the student clinic were not barbed after clinical use. Thirty-two percent were found to be inwardly barbed whereas 18% were outwardly barbed. Only 30% of the needles examined from the student clinic were found to be not barbed after clinical use; 26% showed an inward barb and 44% were outwardly barbed (Table I).

Second investigation—Animal head
The results of the laboratory simulation of the intra-oral clinical technique of the direct approach to the mandibular block are shown in Table II. It can be seen that the incidence of the more dangerous outward barb is almost doubled when the needle is introduced with the bevel facing away from the operator (operator facing subject).
Third investigation—Porcine Nerves

In the case of the outwardly barbed needle, the sections showed significant fascicle damage in the form of rupture of the perineurium with herniation of the endoneurium and transection of nerve fibers (Fig. 1).

This experiment had to be repeated twice before any notable damage to fascicles could be clearly identified and then only with outwardly barbed needles. We have concluded that nerves do seem to have a capacity to avoid damage from penetrating needles even when the needle tip is barbed. Presumably the fascicles will displace away from the needle tip in preference to being engaged by it, a fact that Selander et al. also noted when they commented that this capacity was particularly so with the short bevelled needle. This would correlate with our clinical experience of a low incidence of post injection paresthesia or trismus.

DISCUSSION
Hypothesis

It is hypothesized that the barbing of needles at the time of injection followed by tissue damage on withdrawal of the barbed needle is a likely explanation for some rare cases of postinjection persistent paresthesia, trismus, or paresis for which no obvious cause or explanation can be found. The investigations reported here would support this hypothesis.

These findings have significance beyond the administration of mandibular block anesthesia for dentistry using the direct approach. Any injection when bony landmarks are used and contacted, such as mental and infraorbital blocks, other mandibular block techniques, intra-articular steroid injections, etc., could be expected to produce similar results as described with tissue trauma being caused on with-
drawal of a needle tip that has barbed adversely after contact with bone.

**Mandibular block—Structures at risk**

It can be readily understood from the foregoing that structures particularly at risk in the path of withdrawal of a barbed needle during administration of a mandibular block with the direct approach are:

1. the inferior dental neurovascular bundle (nerve, artery, and vein);
2. the lingual nerve; and
3. the medial pterygoid muscle. Muscle fiber damage and violation of nerve and arterial supply might be expected if the needle is misdirected. The temporalis is also at risk but very much less so.

Fig. 3 represents the mechanism of such damage in the light of the experimentation described.

**Simple precautions**

Dentists and medical practitioners alike should be alerted to tissue vulnerability on needle withdrawal when barbing is deemed possible. They should be encouraged to modify their technique to help reduce the risk to our patients should be possible through attention to the following:

1. avoiding unnecessary bony contact. In determining and checking clinical landmarks during any hypodermic injection, particularly mandibular blocks, the avoidance of heavy pressure on bone may prevent bending of the needle tip and subsequent soft tissue injuries.
2. disposition of the needle bevel. Evidence from this present study would indicate that the introduction of the needle into the tissue for a mandibular block (intraoral direct approach) with the bevel of the needle facing toward the operator (operator facing patient) will reduce the incidence of adverse barbs by nearly half (Table II).
3. second injections. After this study it is suggested that if a second injection is required for the same patient the needle tip should be tested for outward barbing by stroking it across a piece of sterile gauze with the needle bevel away from the gauze. It has been found that an outwardly barbed needle will readily pick up fibers; if it does so, it should be discarded in favor of a new needle for the second injection. If this procedure is adopted, special care must be taken to avoid needlestick injury of staff by following strict universal precautions.
4. review of needle specification. A careful analysis and review of hypodermic needle design features might include the possibility of hardening the needle tip at the time of manufacture, looking at the real value of long bevel or bi-bevel pointing and very fine gauge needles, as well as the consideration of an increase in the angulation of the bevel of the tip to a more obtuse angle yet maintaining the sharpness of its leading edge.

In the light of this report, a possible review of the current equipment standards for dental hypodermic needle manufacture as endorsed by the Australian Standards Association and the American Standards Institute would seem to be indicated.

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**REFERENCES**

5. American Dental Association’s published recommended standards for needles, pp 352-3.

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