Factors Influencing the Discomfort of Intraoral Needle Penetration

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This study with 24 volunteers compared the discomfort produced by needle penetration in different parts of the palatal mucosa. In addition, comparing a fresh needle to one that was used for a previous penetration in the same patient, we assessed the influence of the status of the needle on insertion discomfort during buccal mucosal penetration. The results showed that needle penetration in the anterior hard palate was more uncomfortable than in the posterior palate. Although men could not differentiate between fresh and used needles for a second buccal mucosal penetration, women reported a significant increase in discomfort with used needles.

Key Words: Injection discomfort; Intraoral injection; Dental local anesthesia; Needles.

Anxiety is a barrier to dental attendance.¹ One reason why a patient may be apprehensive about dental treatment is fear of pain. Unfortunately, the most common form of pain control in dentistry, namely local anesthesia, can itself produce anxiety. A number of factors may influence pain during the administration of dental local anesthetics. A variety of techniques are used to overcome injection discomfort, including the use of topical anesthetics² and inhalation sedation.³

One factor that governs the discomfort is the area of the mouth injected. Injections in the palatal mucosa are uncomfortable, and injections in the anterior part of the hard palate are perceived to be more uncomfortable than those more posteriorly. The first part of this investigation was designed to test if the discomfort produced by needle penetration differed in different parts of the hard palate.

A number of studies have shown that the gauge of dental needle is irrelevant in relation to injection discomfort.^{4,5} Scanning electron microscope images of dental needles after use show that the point blunts even if bone has not been contacted.⁶ This suggests that penetrations with the same needle after an initial injection may be more uncomfortable. In the second part of this study, a

randomized, double-blind, split-mouth, volunteer trial investigated whether new needles differed from those used for a previous injection in the discomfort they produced during needle penetration in the maxillary buccal sulcus.

MATERIALS AND METHODS

Ethical Approval

Approval for this study was obtained from the local research ethics committee.

Power Calculation

On the basis of the Visual Analogue Scale (VAS) scores obtained in a previous investigation,⁷ a sample of 24 volunteers gave a 90% chance of detecting a difference of 10 mm in VAS scores assuming a significance level of 1%. Twenty-four healthy volunteers (12 men, 12 women) aged 19–34 years participated. The same subjects participated in both studies described below.

Palatal Penetrations

Each of the 24 subjects received a needle insertion down to periosteum in the palatal mucosa with a 27-gauge short needle (Carpule, Heraeus Kulzer, Hanau, Germany) attached to a dental cartridge syringe. No

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Figure 1. The mean Visual Analogue Scale scores for the entire study population for buccal needle penetrations with new and used needles and anterior and posterior palatal needle insertions. The asterisk indicates significant differences between columns on either side of the asterisk.

topical anesthetic was used before needle insertion. Two areas were penetrated: palatal to the upper left lateral incisor and palatal to the upper left first molar. A new needle was used for each insertion. No solution was injected. The order of penetration was randomized, and the same operator performed each insertion at the same rate that he used for a standard intraoral injection. After each penetration, the subject assessed discomfort on a 100-mm VAS with end points "No pain" and "Unbearable pain."

Buccal Penetrations

This study was performed 15 minutes after completing the study described above. Each of the 24 subjects received a needle penetration down to periosteum in the upper canine buccal sulcus bilaterally with a 27-gauge short needle (Carpule) attached to a dental cartridge syringe. No topical anesthetic was used before needle insertion. No solution was injected. Each subject assessed discomfort on a 100-mm VAS with end points "No pain" and "Unbearable pain." The same operator performed all penetrations and performed the right-sided penetration first. In a randomized order determined before the visit, each insertion was performed with either a new needle or the needle that had been used earlier on the same patient to penetrate the palatal mucoperiosteum down to bone in the upper left molar region in the study described above. The operator giving the buc-

Figure 2. The mean Visual Analogue Scale scores for women for buccal needle penetrations with new and used needles, first and second buccal penetrations, and anterior and posterior palatal needle insertions. The asterisk indicates significant differences between columns on either side of the asterisk.

cal penetrations was blinded to the choice of needles as another individual attached them to the syringes. Randomization meant that some of the right (ie, first) buccal penetrations were performed with new needles and the remainder with used needles. When a new needle was utilized on the right, a used one was utilized on the left, and vice versa.

Statistical Analyses

Data were analyzed by analysis of variance and Student's paired and unpaired *t* tests.

RESULTS

All 24 subjects completed the trial. The mean VAS scores are shown in Figures 1 and 2, and Tables 1 and 2.

A significant difference in discomfort was reported between anterior and posterior palatal needle insertions. The mean $\pm$ SD VAS score was 28 ± 16 mm for posterior penetrations and 46 ± 16 mm for anterior penetrations ($t = 8.7$; $P < .001$). This difference in discomfort between injections was apparent for both men and women. In women (Figure 2), the posterior and anterior palatal insertion scores were 32 ± 18 mm and 46 ± 15 mm ($t = 2.3$; $P < .05$). The men's scores for posterior and anterior palatal insertions were 24 ± 12 mm and 45 ± 18 mm ($t = 3.5$; $P < .01$). There were no

Table 1. Mean $\pm$ SD Visual Analogue Scale Pain Scores (mm) for Palatal Needle Penetrations

	Anterior Palate	Posterior Palate	Average
Men	45 $\pm$ 18	24 $\pm$ 12	35 $\pm$ 18
Women	46 $\pm$ 15	32 $\pm$ 18	39 $\pm$ 18
Average	46 $\pm$ 16	28 $\pm$ 16	$F = 5.2$; $P = .004$

Table 2. Mean $\pm$ SD Visual Analogue Scale Pain Scores (mm) for Buccal Needle Penetrations

	New Needle	Used Needle	Average
Men	24 $\pm$ 21	16 $\pm$ 13	20 $\pm$ 17
Women	29 $\pm$ 18	41 $\pm$ 23	35 $\pm$ 21
Average	27 $\pm$ 19	28 $\pm$ 22	$F = 3.44$; $P = .025$

differences between men and women in the reported discomfort for either posterior or anterior palatal penetrations (posterior, $t = 1.25$; anterior, $t = 0.14$).

There were no differences in reported discomfort for buccal needle penetrations between used and new needles over the entire study population. The VAS score was 27 ± 19 mm for new needles and 28 ± 22 mm for used needles. When the genders were separated, some significant differences were noted ($F = 3.44$, $P = .025$). Although men could not differentiate between new and used needles ($t = 1.21$), women reported a significant difference in VAS scores. For women, the VAS score was 29 ± 18 mm for a new needle insertion and 41 ± 23 mm for a used needle insertion ($t = 2.98$; $P < .02$). Women recorded more discomfort for the buccal insertions compared with men (35 ± 21 mm vs 20 ± 17 mm; $t = 2.6$; $P < .02$). This was because women noted more discomfort with used needles than did men (41 ± 23 mm vs 16 ± 13 mm; $t = 3.2$; $P < .01$). The genders did not differ in the discomfort reported when new needles were used to penetrate the buccal mucosa ($t = 0.6$).

There was no difference in reported discomfort between first and second buccal injections for either men or women (first: 30 ± 21 mm, second: 25 ± 19 mm; $t = 1.0$) or women only (first: 35 ± 25 mm, second: 35 ± 18 mm; $t = 0.05$).

DISCUSSION

The discomfort of intraoral injections can be attributed to needle penetration and solution deposition. Recent studies suggest that needle penetration in the palate does not differ between conventional and computerized syringe systems but that the discomfort produced by deposition of solution varies among syringe types.⁸ This depends upon the speed of delivery.⁹ The present study was confined to assessing the discomfort of needle penetration in different areas of the palate. The results show that the discomfort of needle penetration varies in different parts of the palate. Penetrations in the anterior palate are more uncomfortable. This confirms the clinical impression that penetrations in the anterior hard palate are more uncomfortable than those more posteriorly and suggests that this is not merely because of deposition of solution in less compliant tissue. Other studies have demonstrated differences in needle penetration discomfort in the buccal sulcus, showing that posterior penetrations are more likely to be pain free than those in the anterior buccal sulcus.¹⁰

The results of the present study could be useful when assessing the efficacy of topical anesthetics. Evidence suggests that topical anesthesia is more effective in the

buccal sulcus compared with the palatal mucosa.² The results of the present study suggest that because needle penetration discomfort is most unpleasant in the anterior palatal mucosa, this is the most stringent test for assessing the effectiveness of topical anesthetics.

The buccal mucosa insertion study was designed to determine if there was any advantage to the recipient in changing needles during multiple injections at different sites in the same patient. An order effect has been demonstrated in studies addressing dental local anesthetic injection pain¹¹; namely, the first injection of a pair of identical injections is the less painful. Martin et al¹¹ reported that in patients receiving bilateral buccal injections in the maxillary premolar region, the second injection was reported to be significantly more uncomfortable than the first administration. Therefore, in the present study, it was not acceptable to give the first of a pair of similar needle penetrations with a fresh needle in every subject and use the same needle for the second injection. To isolate the effect of the condition of the needle point, the order of penetration of new and used needles was randomized. The results of this part of the study were surprising. Although no differences were detected between new and used needles overall, significant differences were noted between the genders. Wahl et al¹² reported that women recorded more pain than did men during dental injections, but this difference was not significant. The amount of discomfort produced in women by used needles in the present study was greater than that reported after the use of fresh needles. This was not apparent in the men. In addition, the reported discomfort of needle penetration between men and women differed when comparing used needles, with women reporting significantly more discomfort. In agreement with previous investigations, the use of fresh needles for buccal penetration produced similar discomfort in men and women.¹³

Other intraoral procedures have been reported to produce differing pain perception between men and women¹⁴; however, the reason for the difference in the present study is not clear. The fact that such a difference has been detected has implications when designing studies investigating injection discomfort.

The pain scores for buccal infiltrations reported in this study may have been influenced because they were recorded after the palatal injections were given. Some degree of conditioning may have occurred. Pain scores of less than 30 mm in a 100-mm VAS are regarded as mild.¹⁵ Table 1 shows that the only subjects who reported a mean score above 30 mm (regarded as moderate pain¹⁵) were the women when used needles were utilized. Thus, the results of this investigation have some clinical significance.

It is valid to point out that this study looked only at

the effect of used needles on injection discomfort when the subsequent injection was given at a different site to the initial needle penetration. If the same needle was used for a second injection at the same site, the effect of the initial anesthesia would mask the second penetration. Any effects on postinjection discomfort produced by inserting a used needle at an already-anesthetized site cannot be extrapolated from the results of the present investigation.

CONCLUSIONS

Needle penetration was more uncomfortable in the anterior compared with the posterior palatal mucosa. For women, the use of the same needle for a second needle penetration at a different location produced more discomfort than the use of a fresh needle.

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