Posterior Superior Alveolar Nerve Blocks: A Randomised Controlled, Double Blind Trial

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Abstract

Background Local anesthesia has been a boon for dentistry to allay the most common fear of pain among dental patients. Several techniques to achieve anesthesia for posterior maxillae have been advocated albeit with minor differences. We compared two techniques of posterior superior alveolar nerve block (PSANB), the one claimed to be “most accurate” to the one “most commonly used.”

Aim This study was conducted to assess and compare the efficacy as well as complications of “the straight needle technique” to that of “the bent needle technique” for PSANB.

Patients and Methods We conducted a prospective, randomised, double blind study on 120 patients divided into two groups, using a 26-gauge, 38 mm long needle with 2 ml of 2 % lignocaine hydrochloride with 1:200,000 adrenaline solution. Objective symptoms were evaluated by a single investigator. Cold test using ice was used to evaluate the status of pulpal anesthesia. Data thus obtained was subjected to statistical analysis.

Results Out of the 120 blocks, 19 blocks failed. Statistical analysis found straight needle technique to be more successful than the bent needle technique ($p = 0.002$). Both the techniques were equally effective for the first molar

region on both right and left side ($p = 0.66$ on right side and $p = 0.20$ on left side). However, in the second and third molar region technique A was more effective than B ($p = 0.01$) on right side only. On Left side, both techniques were equally effective ($p = 0.08$). Sensitivity of the cold test was 82 % which is quite high but the specificity was 68 % which seems to be falling in the above average range only. Positive predictive value of 75 and negative predictive value of 76 was observed. We did not encounter any complications in this study.

Conclusion To the best of our knowledge, this is the first randomised controlled clinical study on PSANB techniques. This study suggests that the PSANB using the straight needle technique as advocated by Malamed [1] can be routinely and safely used to achieve anesthesia in the maxillary molar region and to great efficacy, with normal precautions.

Keywords Prospective · Randomised controlled · Double blind trial · Posterior superior alveolar nerve block

Introduction

The most common surgical procedure done by general dentists as well as oral surgeons is extraction of teeth, which is normally carried out under local anesthesia. Advances in pharmaceutical sciences have led to the discovery of newer anesthetic agents but hardly any new technique for delivery of local anesthetic solution has been described recently.

Anesthesia in the maxillary region has mostly been achieved by administration of local anesthetic solution

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using infiltration procedures. Even though nerve block techniques in the maxilla have been advocated, most of us have been reluctant to administer the same routinely, mainly out of fear of complications as well as uncertainty about their efficacy, an example being the posterior superior alveolar nerve block (PSANB).

Aim

This study was conducted to assess and compare the efficacy as well as complications of “the straight needle technique” [1] to that of “the bent needle technique” [2] for PSANB.

Materials and Methods

This prospective, randomised, double blind clinical study approved by the ethics and research committee of the institution was conducted among patients who reported for extraction of maxillary molars to the department of oral and maxillofacial surgery, D.J. College of Dental Sciences and Research, Modinagar during a 20 month period. A pilot study on 20 subjects helped us to standardize the length and gauge of needle and volume of the local anesthetic solution.

For the main study, a group of 120 patients were randomised using block randomisation method and divided into two categories (each consisting of 60 patients). Group A had patients who received PSANB via straight needle technique [1] while patients in group B received the same via bent needle technique [2].

Inclusion criteria consisted of patients of both genders above the age of 15 years. Those who refused to give informed consent, patients having infection/inflammation at the injection site, pregnant ladies, and medically compromised patients were excluded. Patients in whom second molar was missing were also excluded (as the block could not be given using straight needle technique). We used a 26-gauge long needle (38 mm) and 2 ml of 2 % lignocaine hydrochloride with 1:200,000 adrenaline to give the block in both the groups.

After the administration of block, objective symptoms were evaluated by a single investigator who was blinded to the group to which the patient belonged. Following symptoms were evaluated: pain on the buccal aspect of the maxillary molars using a periosteal elevator, pulpal anesthesia using cold test, pain during extraction(s). In case of failure of the block, it was repeated using the same technique. However, if there was inability to achieve anesthesia

Table 1 Mean age of patients

Group	N	Mean	SD	<i>p</i>
A	60	40.42	13.551	0.037
B	60	45.58	13.319	

Table 2 Overall failure rate—technique wise

Technique	Failure cases	Chi square	<i>p</i>
A	3	9.41	0.002
B	16		

Table 3 Gingival symptoms in 1st molar region (right side)—technique wise

Gingival symptoms	Technique A	Technique B	Chi square	<i>p</i>
Present	3	2	0.37	0.66
Absent	28	33		

following a single repeat injection, the block was considered to be a failure.

Data was entered in Microsoft excel and subjected to statistical analysis using SPSS statistical package. Chi square test and student *t* test were used to compare the characteristics of the two groups. *p* < 0.05 was considered to be statistically significant.

Efficacy of the cold test as an indicator of pulpal anesthesia in both groups was measured and assessed using sensitivity, specificity, positive and negative predictive values.

Results

The patients in group B (mean age 45 ± 13.3 years) were found to be 5 years older than patients in group A (mean age 40 ± 13.5 years), with statistical significance (*p* = 0.03) (Table 1).

Out of 120 nerve blocks, 19 failed (group A: 3 and B: 16), suggesting that technique A was more successful than B in this study and this was statistically significant (*p* = 0.002), (Table 2).

When comparison was made to know which of the two techniques was more efficacious to obtain anesthesia in the first molar region quadrant wise, no statistically significant differences were seen (*p* = 0.66 on right side and *p* = 0.20 on left side) i.e. both the techniques were equally effective

Table 4 Gingival symptoms in 1st molar region (left side)—technique wise

Gingival symptoms	Technique A	Technique B	Chi square	<i>p</i>
Present	5	1		
Absent	24	24	2.38	0.20

Table 5 Gingival symptoms in 2nd and 3rd molar regions (right side)—technique wise

Gingival symptoms	Technique A	Technique B	Chi square	<i>p</i>
Present	29	24		
Absent	2	11	0.648	0.01

Table 6 Gingival symptoms in 2nd and 3rd molar regions (left side)—technique wise

Gingival symptoms	Technique A	Technique B	Chi square	<i>p</i>
Present	28	20		
Absent	1	5	3.72	0.08

for the first molar region on both right and left side (Tables 3, 4). However, similar comparison of the two techniques to obtain anesthesia in the second and third molar region revealed technique A to be more effective than B ($p = 0.01$) on right side only. On left side, both techniques were equally effective ($p = 0.08$), (Tables 5, 6).

From the gross unadjusted data, sensitivity, specificity, positive and negative predictive values were calculated. This was performed as a general overview of the significance of using a negative response to the cold test as an indicator of pulpal anesthesia. Sensitivity of the cold test was 82 % which is quite high but the specificity was 68 % which seems to be falling in the above average range only. Positive predictive value of 75 and negative predictive value of 76 was observed.

No complications such as hematoma, diplopia, esotropia or other visual disturbances were observed.

Discussion

Different techniques [1–4] of PSANB have been proposed by several authors albeit with minimal differences between them. The aim of every technique is to deposit the solution as close to the main trunk as possible before it enters the

bone or deeper tissues. The posterior superior alveolar nerve(s) enters the posterior surface of maxilla midway between alveolar border and orbital surface of maxilla. This is the target area for deposition of local anesthetic solution to block this nerve's conduction.

The straight needle technique as described by Malamed [1] seems to be the most common one employed for the same. According to him, this technique has been successful in more than 95 % cases of upper molars. Lawrence Pfeil et al. [5] used this technique and achieved 97 % success rate for second molars whereas it was 77 % for first molars. The results of our clinical trial showed 86 % success rate for second and third molars while a very low rate for first molars (9 %) was noted which could be because of the presence of the middle superior alveolar nerve in most of our patients. But then, there are other studies quoting that around only 28–70 % [3, 6, 7] of the population have middle superior alveolar nerve.

Jorgensen and Hayden [2] advocated the bent needle technique, opining that it would be more accurate, “considering all the dimensional variations”. However, we found a higher success rate using the straight needle technique. No other mention of this technique was found in a thorough search of literature. Though both the techniques were equally effective in first molar region, the bent needle technique was not that efficacious in second and third molar regions.

For any nerve block to be effective, an adequate amount of anesthetic solution should be injected. Loetscher et al. [8] found that second molars were successfully anaesthetised with PSANB whereas only 88 % of first molars were anaesthetised when only one cartridge (1.8 mL) was used. Even though Adatia [9] believed that the ‘presence of thick fibrous tissue of the periosteum over the posterior superior alveolar nerve could further reduce the amount of local anesthetic solution diffusing towards the nerve’, we could not find any literature that supports his statement. Pfeil et al. [5] in their cross-over design study comparing 1.8 ml of local anesthetic solution to 3.6 ml found no statistically significant difference in achieving anesthesia between the two volumes. In our study, we used 2 ml of local anesthetic solution in both the groups and found it to be sufficient to achieve anesthesia.

The size of the needle has long been considered to influence the pain a patient feels during any injection. It is believed by several authors that bigger the gauge of the needle more is the pain felt by the patients [4]. Flanagan et al. [10] in their study did not find any significant difference in the pain perception by patients when various needle gauges were used. Malamed [1] advocates the use of a 25-gauge, short dental needle for PSANB as a means of

decreasing the risk of hematoma. According to him, in its absence a 27- gauge needle may be used. The latter is also advocated by Dionne et al. [11] as well as Roberts and Sowray [3]. The average depth of soft tissue penetration from the mucobuccal fold over the second molar to the area of posterior superior alveolar nerves is said to be 16 mm [1]. According to Dionne et al. [11], hematoma is seen more in cases where the needle is advanced more than 15 mm. Pfeil et al. [5] penetrated up to 18 mm and found no incidence of hematoma formation. We used a 26- gauge, long needle (38 mm) for the block in both the groups. The depth of penetration in both groups was approximately 23 mm and we did not encounter any positive aspiration or hematoma formation. Loestcher et al. [8] also observed no hematomas following PSANB(s). Roberts and Sowray [3] advocate penetrating up to 25 mm opposite the mesial root of the third molar, 'thus passing around the curvature of the posterior aspect of the maxillary tuberosity.' According to them, on no account should the needle penetrate more than 25 mm as the risk of hematoma is increased.

Literature [12–20] reports several other complications of PSANB ranging from relatively minor problems such as trismus to potentially disabling ophthalmic complications with all these being case reports and no study identifying their relative incidence. We did not come across any complication in our clinical trial.

One of the added advantages of using PSANB for the third molar region is the palatal anesthesia that is achieved with no additional palatal injection. Thus, it helps to avoid the more painful palatal injection as noted by the randomised controlled trial conducted by Badcock et al. [21]. This was observed in our study as well.

To make sure whether the PSANB anaesthetised all the molars or not, cold test using "ice" was employed to check for pulpal anesthesia. Petersson et al. [22] conducted a comprehensive study on 65 patients comparing cold and hot (warm gutta-percha) tests and electrical pulp test. They found that the cold test scored better than the electrical and heat tests. Grace et al. [23] as well as others [24–27] have also reported similar findings. The cold test is inexpensive, easy to use, quick to perform, and well tolerated by most patients. There are also no reported detrimental effects to

the pulp with repeated use of thermal pulp vitality tests. In our study, positive predictive value of 75 % and sensitivity of 82 % was seen when the cold test was used as an indicator of pulpal anesthesia.

The gauge could be an important factor when selecting a needle for a particular injection, with needles being available in different lengths and gauges. Bennett [4] opines that the trend towards finer and finer needles is not warranted and is actually detrimental rather than an aid to successful anaesthesia. When a needle is to be inserted deep into the tissues, a 25- or preferably a 27- gauge is indicated, the advantages offered being rigidity to be guided directly to the target area without deviation, less chances of penetration into smaller blood vessels, easier aspiration and safety due to less chances of breakage. However, the same gauge needles also have a disadvantage of resulting in more painful injections which is again contested by others who are of the opinion that even a sharp 25- gauge needle can be inserted painlessly, provided it is done properly. One of the major drawbacks of bending a needle is that it makes the needle more prone to breakage. We bent the 26 gauge long needle in middle third which might weaken it. Also the bent long needle may be deflecting within the tissue, and therefore the tip may not be in the anatomical location as desired, thus accounting for its lower success rate.

Conclusion

To the best of our knowledge, this is the first randomised controlled clinical study on PSANB techniques. One of the limitations of our study was a large statistically significant difference in the age of the two groups of our study. However, we did not come across any literature that correlates the efficacy of the anesthetic technique age-wise. Another drawback is the fact that all the blocks were not given by a single operator. This study suggests that the PSANB using the straight needle technique as advocated by Malamed [1] can be routinely and safely used to achieve anesthesia in the maxillary molar region and to great efficacy, with normal precautions.

Appendix

SR. NO	AGE/SEX	TECHNIQUE OF BLOCK	TOOTH EXTRACTED	GINGIVAL SYMPTOMS	OBJECTIVE DENTAL SYMPTOMS	COMPLICATION	ATTEMPT
1	25/M	B	18	18,17, 16	✓	×	2 ND
2	50/F	B	26	26,27,28	✓	×	1 ST
3	22/F	A	16	18,17,16	●		1 ST
4	55/M	A	18,17	18,17,16	✓	×	1 ST
5	52/M	B	17	18,17,16	✓	×	1 ST
6	45/M	A	17	18,17,16	✓	×	1 ST
7	45/M	A	18	18,17,16	✓	×	1 ST
8	42/M	B	18	18,17,16	✓	×	1 ST
9	45/M	A	27	26,27,28	✓	×	1 ST
10	52/F	B	27	26,27,28	✓	×	2 ND
11	45/F	A	16	18,17,16	✓	×	1 ST
12	35/F	B	17	16,18,17	✓	×	1 ST
13	21/M	B	26	28,27,26	●	×	1 ST
14	17/M	A	16	18,17,16	●	×	1 ST
15	68/F	B	27	26,27,28	✓	×	1 ST
16	60/F	A	17	18,17,16	✓	×	1 ST
17	30/F	A	28	26,27,28	✓	×	2 ND
18	45/F	A	27,28	26,27,28	✓	×	1 ST
19	52/F	B	18	18,17,16	✓	×	2 ND
20	45/F	B	28	26,27,28	✓	×	1 ST
21	58/M	A	16	-----FAILURE-----			
22	30/F	B	27	26,27,28	✓	×	1 ST
23	50/M	B	17	18,17,16	✓	×	1 ST
24	60/F	A	27,28	26,27,28	✓	×	2 ND
25	52/M	B	16	18,17,16	●	×	1 ST
26	40/M	A	18,17	18,17,16	✓	×	1 ST
27	60/F	B	28	26,27,28	✓	×	1 ST
28	50/F	A	27	26,27,28	✓	×	1 ST
29	65/F	B	18	-----FAILURE-----			
30	55/M	A	17	18,17,16	✓	×	1 ST
31	60/M	A	18	18,17,16	✓	×	1 ST
32	52/M	B	18	18,17, 16	✓	×	1 ST
33	55/M	A	27,28	-----FAILURE-----			
34	38/F	B	17	18,17,16	✓	×	1 ST

35	30/M	A	17	18,17,16	✓	×	1 ST
36	55/M	B	17,16	-----FAILURE-----			
37	52/M	B	17	-----FAILURE-----			
38	24/M	A	17	-----FAILURE-----			
39	50/F	B	18	18,17,16	✓	×	1 ST
40	48/M	A	16	18,17,16	●	×	1 ST
41	30/F	A	18	18,17,16	✓	×	2 ND
42	48/M	A	26	26,27,28	●	×	1 ST
43	60/M	B	28	26,27,28	✓	×	1 ST
44	60/F	B	28	-----FAILURE-----			
45	42/M	A	18	18,17,16	✓	×	1 ST
46	60/M	B	17	-----FAILURE-----			
47	28/F	B	18	18,17,16	✓	×	2 ND
48	37/M	A	27,28	26,27, 28	✓	×	2 ND
49	45/F	B	28	26,27, 28	✓	×	1 ST
50	36/M	B	18	18,17,16	✓	×	1 ST
51	30/M	A	26	26,27, 28	●	×	1 ST
52	35/F	A	28	26,27,28	✓	×	1 ST
53	18/F	B	26	26,27, 28	●	×	1 ST
54	35/F	A	18	18,17,16	✓	×	1 ST
55	16/F	A	18	18,17,16	✓	×	1 ST
56	40/M	B	18	18,17,16	✓	×	2 ND
57	45/M	A	26	26,27, 28	●	×	1 ST
58	65/M	B	27	26,27,28	✓	×	1 ST
59	35/M	A	18	18,17,16	✓	×	1 ST
60	48/M	B	26	26,27,28	●	×	2 ND
61	37/M	B	27	-----FAILURE-----			
62	25/F	A	16	18,17,16	●	×	1 ST
63	45/F	B	18,17	-----FAILURE-----			
64	22/M	A	16	18,17,16	●	×	1 ST
65	65/F	A	27	26,27, 28	✓	×	1 ST
66	35/F	A	28	26,27, 28	✓	×	1 ST
67	36/F	B	28	-----FAILURE-----			
68	30/F	B	28	26,27, 28	✓	×	2 ND
69	35/M	A	27	26,27, 28	✓	×	1 ST

70	32/M	B	28	26,27, 28	✓	×	1 ST
71	45/M	B	27	-----FAILURE-----			
72	35/F	A	26	26,27,28	●	×	1 ST
73	45/M	B	17	-----FAILURE-----			
74	23/F	B	28	-----FAILURE-----			
75	38/M	A	28	26,27,28	✓	×	1 ST
76	35/M	A	27,28	26,27,28	✓	×	1 ST
77	40/M	B	17	18,17,16	✓	×	1 ST
78	35/M	A	28	26,27,28	✓	×	2 ND
79	73/M	A	27	26,27,28	✓	×	1 ST
80	73/M	B	16	26,27,28	✓	×	1 ST
81	45/M	A	27	26,27,28	✓	×	2 ND
82	70/M	B	28	26,27,28	✓	×	1 ST
83	21/M	A	28	26,27,28	✓	×	1 ST
84	42/F	B	17	-----FAILURE-----			
85	25/M	B	16	18,17,16	●	×	1 ST
86	57/M	A	18	18,17,16	✓	×	1 ST
87	63/F	B	28	-----FAILURE-----			
88	45/M	A	26	26,27,28	●	×	1 ST
89	25/M	A	16	18,17,16	●	×	1 ST
90	45/M	A	16	18,17,16	●	×	1 ST
91	35/M	B	27	26,27,28	✓	×	1 ST
92	52/M	B	27	26,27,28	✓	×	1 ST
93	35/F	A	28	26,27,28	✓	×	1 ST
94	45/F	B	17	18,17,16	✓	×	1 ST
95	32/F	B	17	18,17,16	●	×	2 ND
96	51/F	A	27	26,27,28	✓	×	2 ND
97	40/M	B	17	18,17,16	✓	×	1 ST
98	50/M	B	28	-----FAILURE-----			
99	50/F	A	18,17	18,17,16	✓	×	1 ST
100	55/M	A	27	26,27,28	✓	×	1 ST
101	50/M	B	28	26,27,28	✓	×	1 ST
102	45/F	A	18	18,17,16	✓	×	1 ST
103	62/M	A	26	26,27,28	●	×	1 ST
104	38/F	B	16	18,17,16	●	×	1 ST

105	35/M	A	18	18,17,16	✓	×	1 ST
106	35/F	B	17	18,17,16	✓	×	2 ND
107	18/F	A	16	18,17,16	●	×	1 ST
108	80/M	B	18,17	18,17,16	✓	×	1 ST
109	52/M	B	27,28	26,27,28	✓	×	1 ST
110	20/M	A	16	18,17,16	●	×	1 ST
111	32/F	B	28	26,27,28	✓	×	1 ST
112	36/F	A	18	18,17,16	✓	×	1 ST
113	30/F	A	18	18,17,16	✓	×	2 ND
114	30/M	A	27,28	26,27,28	✓	×	2 ND
115	30/F	B	18,17	-----FAILURE-----			
116	37/F	B	18	18,17,16	✓	×	2 ND
117	58/M	A	27	26,27,28	✓	×	1 ST
118	58/M	B	18	-----FAILURE-----			
119	37/M	B	16	18,17,16	✓	×	1 ST
120	22/F	A	28	26,27,28	✓	×	1 ST

✓ - Tooth/teeth could be extracted without pain

● - Dental symptoms could not be evaluated

● - Dental symptoms (positive sensation to pain stimulus)

Teeth which had no pain on gingival evaluation with periosteal elevator

Teeth which had pain on gingival evaluation with periosteal elevator

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 - No complications were observed

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