

Evaluation of the Effectiveness of Topical Anaesthetic Gel and Needle Free Jet Anaesthesia in Root Planing: A Cross-sectional Study

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ABSTRACT

Introduction: Although traditional local anaesthetic technique by injection is considered as gold standard for dental procedure, the resultant pain and anxiety caused by the needle prick makes the patient less compliant for further treatment. Many alternatives have been developed by the researchers in the last two decades. Jet anaesthesia and the topical gel are the commonly used alternatives to anaesthetise the local area.

Aim: To evaluate and compare the effectiveness of topical anaesthetic gel (Mucopain^R gel) and jet anaesthesia (Sure Shot^R needle free jet injection) during root planing.

Materials and Methods: The present cross-sectional split mouth study was conducted on 20 patients who required root planing in the maxillary quadrant bilaterally, where one quadrant was anaesthetised with benzocaine 20% (Mucopain^R) gel, and sure

shot^R jet anaesthesia was used on the adjacent quadrant. The side and order of placement of topical gel and jet anaesthesia were randomised. The same operator delivered anaesthesia on both the sides. The root planing was carried out by another operator at two sittings and pain was assessed immediately using Visual Analogue Scale (VAS), Numerical Rating Scale (NRS) and Verbal Response Scale Statistical .

Results: The mean NRS score of the jet injection group was 1.50±1.54 and that for the gel group was 3.15±2.16. Also, the mean VAS score of the jet injection group was 1.50±1.54 and that for the gel was 3.15±2.16. The difference between two groups were statistically significantly (p-value=0.008).

Conclusion: Jet anaesthesia was significantly superior to gel in providing anaesthesia during root planing.

Keywords: Benzocaine gel, Eutectic mixture of lidocaine and prilocaine, Periodontal medicine, Periodontal pocket

INTRODUCTION

The treatment of periodontitis primarily consists of mechanical debridement i.e., scaling and root planing followed by periodontal surgery, if required. Even though the periodontal diseases are not painful, the treatment for the same results in pain occasionally and mandates the local anaesthesia. The most commonly used anaesthetic technique in dentistry is the local anaesthesia by nerve block or infiltration. Although nerve block by needle injection is considered as gold standard for dental procedure, the resultant pain and anxiety caused by the needle prick makes the patient less compliant for further treatment. According to a study by Ali FM et al., 27.9% patients avoided the dental treatment due to the needle phobia [1]. Needle phobia increases the risk of morbidity and mortality, simply because patients deny healthcare until it becomes unavoidable. Patients with needle phobia, during a procedure, may undergo syncope, convulsions, loss of bowel-bladder control, and may show cardiac changes [2]. Jet anaesthesia and the topical gel are the commonly used alternatives to anaesthetise the local region.

The first local anaesthetic, cocaine, extracted from the plant and tested successfully to numb the tongue by the German Chemist Albert Niemann in 1960. It was a topical anaesthetic agent. Eventually, the development of amide and ester-based anaesthetics along with its topical formulations made anaesthesia easier [3]. In dentistry, the most commonly used topical anaesthetic system is the topical gel which induces temporary loss of sensation on the applied surface [4]. Currently, various topical anaesthetic agents are available and the efficacy depends on the components, concentration, and the site of application. A split mouth study compared topical 20% benzocaine gel, 2% lidocaine gel, and placebo paste (applied for one minute before needle insertion).

Lidocaine and benzocaine reduced pain significantly over the placebo [5]. Another study found that 77% of the patients preferred anaesthetic gel over an injection [6].

The primary adverse effects due to systemic absorption of topical anaesthetic are seen in the cardiac and central nervous systems. The symptoms include headache, dizziness, blurred vision, metallic taste, seizures, hypotension, bradycardia, dysrhythmia and even cardiac arrest. The minor adverse reactions are erythema, skin irritation, oedema, blanching vasoconstriction or vasodilation [7].

Jet anaesthesia uses a mechanical energy source to generate pressure, allowing a thin stream of anaesthetic fluid of sufficient strength to penetrate the soft tissues. It has some advantages over needle injection, as it is simple to use, causes less tissue damage, and renders limited or no pain. It has been shown that jet injection provided 100%, 96.3%, 83.5%, and 100% successful pain control in children for tooth preparation, extraction, pulp therapy and miscellaneous clinical procedures (abscess drainage, rubber dam clamp placement etc.), respectively [8]. A study concluded that local anaesthesia using jet technique showed less pain perception during various dental procedures [9].

However, only a few studies compared the topical gel and jet anaesthesia. Gupta R et al., evaluated the needleless jet anaesthesia (MADA Jet) and Eutectic Mixture of Lidocaine and prilocaine (EMLA) during scaling and root planing [10]. EMLA gel has already been proven to be effective topical gel, in various dental procedures. Few studies compared the effectiveness of EMLA and benzocaine gel and showed that both have a similar effect [11,12]. Hence, the present study aimed to evaluate and compare the effectiveness of topical anaesthetic gel (Mucopain^R gel) and jet anaesthesia (Sure Shot^R needle free jet injection) during root planing.

MATERIALS AND METHODS

This cross-sectional, split mouth study was conducted in the Department of Periodontology, Faculty of Dental Sciences, Ramaiah University of Applied Sciences, Bangalore, Karnataka, India, from April 2022 to May 2022. This study was approved by the Institutional Ethical Committee (Reference No: EC-2022/PG/120). Patient's informed consent was obtained prior to the procedure.

Inclusion criteria: Patients with age ranging from 18-60 years, good general health and minimum of 20 erupted teeth, having chronic periodontitis (stage 1, grade 1) [13] with probing pocket depth of ≥ 5 mm and loss of clinical attachment of ≥ 2 mm in at least five teeth and requiring root planing in the maxillary quadrant bilaterally were included in the study.

Exclusion criteria: Patients who were allergic to benzocaine, or those who have taken antiinflammatory/non steroidal anti-inflammatory drugs within last two days, or those with severe systemic disease that preclude root planing and administration of local anaesthetics, and also the pregnant and lactating women were excluded from the study.

Sample size calculation: The sample size has been estimated using the GPower software v. 3.1.9.4 (Franz Faul, Universität Kiel, Germany). Considering the effect size to be measured at 80%, power of the study at 80% and the margin of the error at 10%, the total sample size needed was 40. Hence, each study group comprised of 20 samples. Since the study incorporates split mouth design, the above sample size was achieved in 20 patients.

Study Procedure

The study group was divided into topical gel group and needle free jet group. The side and order of placement of topical gel and jet anaesthesia were chosen by coin toss method. In gel group benzocaine 20% (Mucopain[®]) gel was applied with the help of a standard dental-cartridge system with a blunt applicator [Table/Fig-1], left in the periodontal pocket for two minutes, whereupon root planing was performed. An average of 0.2 gm of gel was applied in each tooth, and if there was any interruption due to pain the gel was reapplied. If there was further pain, rescue anaesthesia was infiltrated.



[Table/Fig-1]: Application of the topical gel subgingivally, using a cartridge with blunt applicator.

The sure shot[®] needle free jet injection system was used in this study for the other group. The device was charged using the charger box prior to each patient. The syringe volume was adjusted and filled (with 2% lignocaine solution) using the adapter by connecting it to the vial. The syringe was put into the sure shot[®] pen and rotated clockwise until it was fully in. The adapter cap was inserted into the device and was placed at 90° on the attached gingiva/ palatal mucosa of the desired area and proceeded with the infusion by pressing the firing button [Table/Fig-2]. The jet and gel anaesthesia was delivered on the chosen side by the same operator for all the participants. The root planing was carried out by another operator in two sittings. The jet technique was used first and the gel was used

the next week. Pain was assessed immediately after the treatment using NRS and VAS, which were scored from 0 to 10. This was followed by Verbal Rating Scale (VRS) which recorded pain as mild, moderate and severe.



[Table/Fig-2]: Infusion of anaesthetics solution (lidocaine 2%) using sure shot[®] needle free jet injection.

STATISTICAL ANALYSIS

Statistical Package for Social Sciences (SPSS) for Windows, software version 22.0 released in 2013, Armonk, NY: IBM Corp., was used to perform statistical analyses. Descriptive analysis includes expression of all the explanatory and outcomes variables in terms of frequency and proportions for categorical variables, whereas in terms of mean \pm Standard Deviation (SD) for continuous variables. Mann-Whitney U test was used to compare the mean NRS and VAS scores between Jet and Gel groups and similar comparisons based on the age and gender differences in each group using the same test. Chi-square test was used to compare the VRS scores between the groups and similar comparisons based on the age and gender differences in each group using the same test. The p-value <0.05 was considered statistically significant.

RESULTS

Twenty subjects were participated in this study, whose demographic details were similar [Table/Fig-3]. The mean NRS score of Jet injection group was significantly lesser (1.50 \pm 1.54) as compared to gel group (3.15 \pm 2.16) [Table/Fig-4]. The mean VAS score of Jet injection group was significantly lesser (1.50 \pm 1.54) as compared to gel group (3.15 \pm 2.16).

The VRS in the gel group showed that, majority of the patient had mild pain (35%), followed by moderate (30%) and severe pain (10%). Whereas, in the Jet group, majority had no pain (50%), and the remaining few had mild pain [Table/Fig-5].

Variables	Category	n (%)
Age group (years)	≤ 30	8 (40)
	31-40	5 (25)
	≥ 40	7 (35)
	Mean \pm SD age in years	35.9 \pm 11.11
Gender	Males	12 (60)
	Females	8 (40)

[Table/Fig-3]: Age and gender distribution among study subjects.

Scales	Group	Mean \pm SD	p-value
NRS	Gel	3.15 \pm 2.16	0.008*
	Jet	1.50 \pm 1.54	
VAS	Gel	3.15 \pm 2.16	0.008*
	Jet	1.50 \pm 1.54	

[Table/Fig-4]: Comparison of mean NRS and VAS scores (Mann-Whitney U test). SD: Standard deviation; NRS: Numerical rating scale; VAS: Visual analogue scale

VRS	Gel	Jet	p-value
	n (%)	n (%)	
No pain	5 (25)	10 (50)	0.04*
Mild pain	7 (35)	9 (45)	
Moderate pain	6 (30)	1 (5)	
Severe pain	2 (10)	0	

[Table/Fig-5]: Comparison of Verbal Rating Scale (VRS) scores (Chi-square test).
*p-value <0.05 was considered statistically significant

DISCUSSION

Since every dentist's goal is to provide treatment to the patient with least pain and discomfort, there is a need for an effective alternate anaesthetic preparation to needle anaesthesia which is painless and easy to deliver during the procedures involving the tooth supporting structures like root planing. Although the anaesthetic effect is less, topical anaesthesia causes least pain compared to the needle injection, hence, generate positive responses in patients for the dental treatments [14].

Visual analogue scale is a valid, reliable and frequently used pain outcome measure, consisting of a bidirectional straight line with two markings. That is 'no pain' and worst possible pain located at either side of the line. The NRS is preferred over VAS by the elderly population since it is easy to understand and administer. The NRS is an 11-point scale comprising a number from 0 through 10, where 0 indicates no pain, and 10 indicates the worst imaginable pain. The VRS is a valid scale consisting of a list of descriptors used to represent various levels of pain, including none, mild, moderate, and severe [15]. In the present study, it was found that the jet anaesthesia was more potent in providing local anaesthesia compared to the topical gel.

The topical gel used in this study was benzocain 20% (Mucopain^R gel). Benzocaine is an ester-based local anaesthetic agent available in 6-20% concentration, typically produce its effect in 30 seconds and having duration of action for 15 minutes [16]. Studies reveals that benzocaine gel is a good topical anaesthetic agent which can be used for minor dental procedures [17]. A study compared the efficacy of EMLA and benzocaine gel in children prior to inferior alveolar nerve block. Physical changes were checked by measuring arterial pressure and heart rate as well as the subjective pain response via facial image scale. It was seen that both EMLA and Benzocaine gel had similar effect in reducing pain [18]. But in the study by Al-Mehl MA et al., where EMLA was found to be more effective in providing palatal analgesia compared to benzocaine [19]. A randomised control trial compared 2% lignocaine and 20% benzocaine gel, assessed pain perception by the child. Benzocaine showed better result than the lignocaine gel [20]. In another study, comparing the benzocaine 20% and lidocaine 60%, found that lidocaine was more effective compared to benzocaine 20% in reducing pain severity before injection [21].

The effectiveness of jet anaesthesia in various dental procedures has been evaluated in several studies. Dabarakis NN et al., reported that both the jet anaesthesia and needle injection have similar onset of action, however duration of action was more for needle injection [22]. In another study by Theocharidou A et al., compared the efficacy, acceptance and preference of conventional infiltration technique with needle less jet anaesthesia. Both the techniques showed similar anaesthetic effects, and the efficacy of injection was found to be more at 20 minutes. However, the participants preferred conventional injection over jet which could be because the participants were non fearful and the preference would be different in anxious and needle phobic patients [23]. A randomised control study was conducted by Shankar P et al., using jet anaesthesia as test group and conventional injection as control during periodontal surgery. Patients were at ease with lesser anxiety and more comfort

in the jet group compared to injection, where few subjects reported lingering pain postoperatively [24].

In the present study, it was found that jet anaesthesia was significantly superior to Mucopain^R gel in providing anaesthesia during root planing. This is in accordance with the study conducted by Gupta R et al., where Madajet^R was better in relieving pain than EMLA, even though the patient preference was more for the anaesthetic gel. The application of gel was least traumatic, on the other hand, patient showed apprehension to jet anaesthesia due to its bulky appearance [10].

There are few limitations to jet anaesthesia over conventional needle injection. First and foremost, the bulky appearance of jet anaesthetic instrument makes patients apprehensive [24]. Another important drawback is the gunshot like sound which might make a patient nervous [24].

Limitation(s)

The limitations of the present study was the small sample size and the inability to blind the procedure from subjects due to the obvious difference between the two techniques.

CONCLUSION(S)

Both benzocaine gel and jet techniques were effective in providing local anaesthesia during root planing procedure. According to the NRS, VAS and VRS scores the sure shot^R jet anaesthesia was more effective than the topical benzocaine gel. Future studies should be focussed on using jet anaesthesia in minor periodontal procedures like frenectomy, gingivectomy as well as localised flap surgeries. The needle phobic and anxious patients could benefit from its use for minor periodontal procedures mandating anaesthesia. In addition, it can also be used in the subjects with special needs, with an increased risk of needle stick injuries.

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