RESEARCH ARTICLE

Effect of pre-cooling agent on intensity of pricking pain at intraoral injection site in adults: An experimental study

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Abstract

Objective: To determine the effect of pre-cooling agent on the intensity of pricking pain at the intraoral injection site in adult patients.

Method: The in-vivo interventional study was conducted at the Department of Operative Dentistry, Dr. Ishrat-ul-Ebad Khan Institute of Oral Health Sciences, Dow University of Health Sciences, Karachi, from September 2018 to August 2019, and comprised adult patients of either gender. The pricking pain perception during needle administration was assessed using split-mouth technique. Topical anaesthesia benzocaine gel was applied on the left side, which was treated as controls, for 1 min, while on the right side, which was treated as the experimental side, refrigerated cartridge was placed for 2 min. Infiltration anaesthesia was then administered on both sides. Pain perception ratings were measured through visual analogue scale. After profound anaesthesia was achieved, restorative treatment was performed under rubber dam isolation. Data was analysed using SPSS 24.

Results: Of the 152 subjects, 77(50.65%) were females and 75(49.34%) were males. The overall mean age was 35.97±8.669 years (range: 21-50 years). The effect of refrigerated cartridge was significant on the intensity of pricking pain at the intraoral injection site in patients aged 41-50 years, and in female patients aged 21-30 years ($p<0.05$), whereas its effect was non-significant in males aged 21-30 years and patients aged 31-40 years ($p>0.05$).

Conclusion: Pre-cooling agent was found to be effective in decreasing pricking pain felt by patients.

Keywords: Pain, Cryoanesthesia, Infiltration anaesthesia, Visual analogue scale, VAS, Dental anxiety.

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Introduction

Pain is considered the fifth vital sign[1] and is an unpleasant emotional and sensory experience associated with likely tissue damage.[2] There are many factors,[3,4] out of which major factors are pricking pain and fear caused by the vision of the needle which is known as blenophobia.[5] Anticipation of pain due to needle prick is most commonly observed in dental procedures. Multiple methods, such as use of topical anaesthetic agent, like benzocaine, buffering the local anaesthetics, distraction methods, warming the local anaesthetic agents and adjusting the pace of the infiltration by lowering the speed of injection, are employed to alleviate such pain.[5]

One of the major techniques to relieve pricking pain is to cool the site of injection.[6] There are several ways to do this, such as use of refrigerant spray, like 1,1,1,3,3-pentaflouropropane or 1,1,1,,2-tetrafluoroethane, customised form of ice etc. The application of cold to a contained part of the body to obstruct the painful impulses generated by local nerve transmission is called cryoanaesthesia.[6] Refrigerant sprays or ice in customised form can be used to induce cryoanaesthesia. The major benefit of cryoanaesthesia is that it acts upon every cell compared to topical anaesthesia which acts on nerve cells alone. As such, cryoanaesthesia is regarded to be more efficient than conventional topical anaesthesia.[7]

Nearly all dental studies involving pre-cooling agents have been done in paediatric patients.[5] A study found that cooling the palatal area prior to injection alleviates pain.[8] Another study regarding the comparison between different pre-cooling agents and topical anaesthesia found that ice cone was more effective than refrigerant spray and topical anaesthesia in children aged 5-8 years.[6]

Even after the application of topical anaesthesia, majority of patients still feel some pricking pain at the intraoral injection site.[7] Literature supports the cooling mechanism to overcome pricking pain in paediatric patients. To date, there is only one study conducted in adults[9] which reported that use of ice had a positive impact. However, it used topical anaesthesia before the application of pre-cooling agents at the infiltration site in adult patients.[9] There is no need of topical anaesthesia when pre-cooling agent is used because cryoanaesthesia acts upon every cell, including the nerve cells.[7]

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The current study was planned to determine the response of needle prick by simple use of ice in the form of refrigerated cartridge at the injection site in adult patients.

Patients and Methods

The in-vivo, interventional study was conducted at the Department of Operative Dentistry, Dr. Ishrat-ul-Ebad Khan Institute of Oral Health Sciences, Dow University of Health Sciences (DUHS), Karachi, from September 2018 to August 2019. After approval from the institutional ethics review committee, the sample size of 152 was calculated in the light of literature[5] while using OpenEpi10 software with 95% confidence interval (CI) and 80% power of test. The sample was raised using non-probability purposive sampling technique. Those included patients of either gender aged 21-50 years coming for restorative treatment of bilateral maxillary premolars with carious lesions and symptoms of reversible pulpitis requiring direct restoration. The diagnosis of reversible pulpitis was established through clinical history, radiographical examination and objective test performed by cold test and electric pulp test (EPT).

Patients with systemic diseases, like diabetes, hypertension, human immunodeficiency virus (HIV), and liver or kidney transplant were excluded. Also excluded were patients with intellectual disabilities, psychiatric disorders, dental abscess and intraoral draining sinus or fistula. Patients taking any pain-killer prior to the procedure and those having a tooth with irreversible pulpitis and pulp necrosis were also excluded.

To determine the efficacy of pre-cooling agent on reducing the intensity of pricking pain, the split mouth approach was used on bilateral maxillary premolar teeth (Figure-1) after taking written informed consent from the subjects. Age was stratified into three groups; 21-30 years, 31-40 years, and 41-50 years. In each group the site of anaesthesia was cleaned with steriled gauze. On the left intraoral side, taken as the control side, topical anaesthesia (Dental Opahl 20% benzocaine), followed by maxillary buccal infiltration anaesthesia (Medicaine-1.8ml inj. [Lidocaine] with 1:100,000 epinephrine, using 27G needle) was applied. The area was first dried using triple air syringe and topical anaesthesia was applied using cotton-tipped applicator for 1 minute using rubbing motion and left for 30 sec to increase the penetration depth. On the right intraoral side, taken as the experimental side, refrigerated cartridges were used as a pre-cooling agent and were applied for 2 min. Refrigerated cartridges were made by emptying a number of commercially available lidocaine cartridges

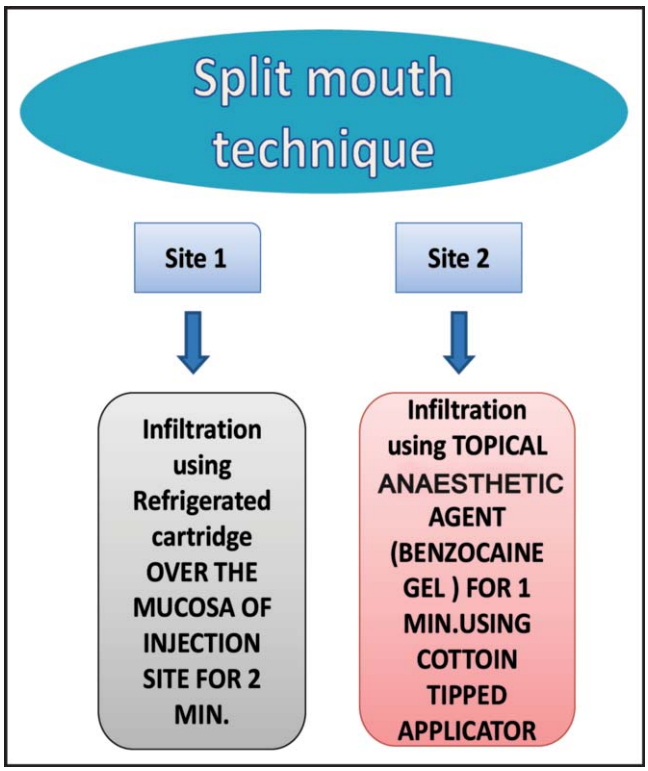

Figure-1: Split-mouth technique.

(MedicaineR inj.I 1.8ml). These cartridges were chemically disinfected with 70% ethyl alcohol, according to the manufacturers' recommendations.[11] They were later filled with distilled water and placed in the freezer at 0 degree Celsius for a minimum of 48 hours or until usage. Maxillary buccal infiltration anaesthesia was then administered.

To indicate the pain perceived on pricking the anaesthetic needle, each participant was asked to indicate the pain of the prick of anaesthetic needle on visual analogue scale (VAS). The pain rating score (PRS) of VAS scale consists of 0-10 readings in which 0 = no pain, 1-2 = mild pain, 3-6 = moderate pain, 7-9 = severe pain, and 10 = worst possible pain.[5] The readings were recorded for each participant by un-blinded principal investigator and was confirmed by the co-investigator who was blinded to the grouping. After profound anaesthesia was achieved, restorative treatment was performed under rubber dam isolation.

Data was analysed using SPSS 23. Significance of VAS scores in different age groups was calculated using Fisher Exact test. $P<0.05$ was considered significant.

Result

Of the 152 subjects, 77(50.65%) were females and 75(49.34%) were males. The overall mean age was 35.97± 8.669 years (range: 21-50 years). Of the total, 52(34.2%)

Table-1: Age- and gender-wise analysis of pain scores.

Age Groups	Gender	Responses of control group		Experimental Pain Rating Score (PRS) 'n' count (%)			p-values	
		Category	'n' count (%)	No pain	Mild pain	Moderate pain		
21-30 years	Female	Mild pain	4(100)	4(100)	0(0)	-	0.03	
		Moderate pain	15(100)	4(26.7)	11(73.3)	-		
		Severe pain	6100)	2(33.3)	4(66.7)	-		
		Worst pain possible	2(100)	0(0)	2(100)	-		
		Total	27(100)	10(37.0)	17(63.0)	-		0.23
	Male	Moderate pain	16(100)	9(56.3)	5(31.3)	2(12.5)	0.86	
		Severe pain	9(100)	4(44.4)	3(33.3)	2(22.2)		
		Total	25(100)	13(52.0)	8(32.0)	4(16.0)		
31-40 years	Female	Mild pain	10(100)	6(60)	4(40)	-	0.70	
		Moderate pain	16(100)	8(50)	8(50)	-		
		Total	26(100)	14(53.8)	12(46.2)	-		
	Male	Mild pain	8(100)	4(50)	4(50)	-	0.22	0.21
		Moderate pain	12(100)	6(50)	6(50)	-		
		Severe pain	4(100)	4(100)	0(0)	-		
		Total	24(100)	14(58.3)	10(41.7)	-		
41-50 years	Female	Mild pain	2(100)	2(100)	0(0)	-	0.01	
		Moderate pain	16(100)	10(62.5)	6(37.5)	-		
		Severe pain	6(100)	0(0)	6(100)	-		
		Total	24(100)	12(50)	12(50)	-		
	Male	Mild pain	10(100)	10(100)	0(0)	-	0.00	0.00
		Moderate pain	13(100)	9(69.2)	4(30.8)	-		
		Severe pain	3(100)	0(0)	3(100)	-		
		Total	26(100)	19(73.1)	7(26.9)	-		

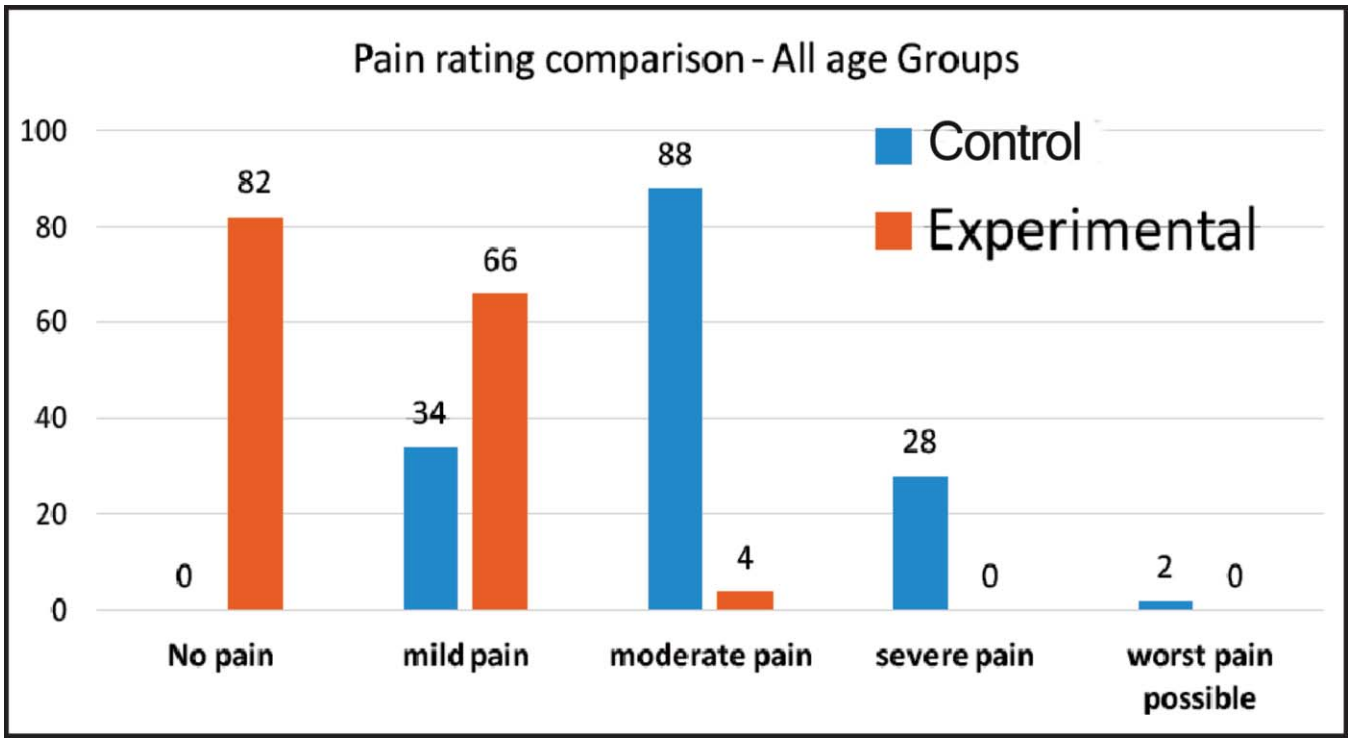

Figure-2: Overall comparison of pain rating scores (PRSs) in control and experimental groups.

Table-2: Gender-wise analysis of pain scores in control and experimental groups.

Gender	Responses of control group		Experimental pain rating scores			p-value
	Category	'n' count (%)	No pain n (%)	Mild Pain n (%)	Moderate Pain n (%)	
Female	Mild pain	16(100)	12(75)	4(25)	-	0.008
	Moderate pain	47(100)	22(46.8)	25(53.2)	-	
	Severe pain	12(100)	2(16.7)	10(83.3)	-	
	Worst pain possible	2(100)	0(0)	2(100)	-	
	Total	77(100)	36(46.8)	41(53.2)	-	
Male	Mild pain	18(100)	14(77.8)	4(22.2)	-	0.346
	Moderate pain	41(100)	24(58.5)	15(36.6)	2(4.9)	
	Severe pain	16(100)	8(50)	6(37.5)	2(12.5)	
	Total	75(100)	46(61.3)	25(33.3)	4(5.3)	

were aged 21-30 years, 50(32.9%) were aged 31-40 years, and 50(32.9%) were aged 41-50 years. Age- and gender-wise analyses of pain scores were done for different age groups (Table-1).

Overall comparison of pain rating scores in control and experimental groups was done (Figure-2), and, separately, gender-wise analysis of pain score was done between the two groups (Table-2).

Discussion

The present study showed major effect of pain reduction through refrigerated cartridge that were used on the adult patients undergoing dental procedures. Fear associated with the dental treatment is prevalent even in the adults despite advancements in dental care. The fear of the needle is the commonest anxiety-provoking element seen not only in most females during their dental treatment, but also among the males.[12,13] Anxiety is the fear of staying in a dental office of dental care provider for therapeutic or preventive care.[14] Participants in the present study had received benzocaine gel on the control side, which is the standard procedure and is generally recommended to minimise the sensation of pain.[15-17] This topical anaesthesia is a fast-acting ester-type anaesthetic agent. It has low level of systemic absorption and has a pleasant taste. The major disadvantage of benzocaine gel is its low bio-adhesivity.[18] The major concern of the current study was needle-phobia due to the prick of the needle in the oral mucosa among the participants.[19] Findings suggest that the pain during needle penetration was less felt after the use of pre-cooling agent compared to the use of topical anaesthesia. The finding is in line with an earlier study.[20]

The results of the present study are also in line with a split-mouth interventional study[9] which used pre-cooling agent to distract mind of 33 patients to determine its effect during buccal infiltration. There were significant results (p=0.02) among the patients. Similar methodology was conducted as was the case with the present study, but the other study was limited by it small sample size and also there were vast differences in the patient allocation in age-based sub-groups.

In the present study, age-based comparison was done with the use of pre-cooling agent. The pain which was moderate to severe or even worst pain in the control group, was reduced to mild to no pain with the use of pre-cooling agent in the intervention group. This reduction of pain was more significantly found in those aged 41-50 years. The reason could be because the pain threshold of the elderly patients is more compared to younger participants, which can decrease the anxiety level, and, hence, reduce pain perception. Another reason of reduction of pain of in all age groups could be cryoanaesthesia. The topical anaesthesia in the control group acted only on the nerve cells, while the mechanism of cooling the tissues produces effect on every cell, including the nerve cells. Thus, there is no need of topical anaesthesia whenever pre-cooling agent is used.[21]

For gender-based comparisons, the percentage of effect of mild pain was high in females after the use of pre-cooling agent, while the percentage of 'no pain' was higher in the males after the use of pre-cooling agent. The reason for this could be that females are more anxious than males during dental procedures, thereby feeling mild pain even after the use of pre-cooling agent. The pain was significantly reduced after intervention among females compared to males. The reason for this could be that the females engaged more readily among new gadgets than the males, distracting their mind and the perceive pain was reduced. But due to the anxiety level, females still felt mild pain. The result is similar to a study[9] which revealed significant reduction in the elderly age groups.

The limitation of the current study is the absence of randomisation. The strength of the study is the use of split

mouth design which increases the study accuracy, and eliminates inter-subject variability and teeth-specific bias.[22]

Conclusion

Pre-cooling agent was found to be effective in decreasing pricking pain sensed by the patients of all ages during infiltrate anaesthesia. The score was found significant among the elderly participants as well as younger female participants. Also, pre-cooling agent can be used without topical anaesthesia before administering infiltration because of cryoanaesthesia.

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Conflicts of Interest: None.

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