SHORT COMMUNICATION

Topical Anesthesia in Pediatric Dentistry: An Update

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Abstract

Topical anesthetics are very important tools for improving comfort in any dental procedure in children. different methods, techniques of achieving topical anesthesia are reported in the literature. The present narrative review focuses on explaining different types of topical anesthesia with a special focus on pediatric dentistry.

Keywords: Children, Efficacy, Surface anesthesia, Topical anesthesia.

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Surface Anesthesia

Topical anesthesia also called surface anesthesia is effective only up to very few millimeters (2–3 mm) on to the surface of mucosa applied. Efficacy of topical anesthetic is dependent upon factors such as composition (simple or compounded preparation), concentration, and contact (type and duration).

Concentration: lignocaine (2–10%), benzocaine (10%) are reported to be used in children.

Composition: lignocaine, benzocaine is the most common anesthetic molecule that are used either singly or in combinations to form compounded preparations. An EMLA-Eutechtic mixture of local anesthesia is an 1:1 by weight combination of lignocaine (2.5%) and prilocaine (2.5%) in emulsion form. The melting point of EMLA is low hence local anesthesia molecules remain in liquid form. Available in cream, disc form. Previously used only as a cutaneous topical anesthetic but nowadays it is being used intraorally.[1] Cetacaine- it's a combination of contains benzocaine (14%) + butyl aminobenzoate (2%) + tetracaine + benzalkonium chloride (2%).[1-3] It is available in spray and liquid forms. Precaine-combination of 8% Lidocaine + 0.8% Dibucaine. TAC (tetracaine + adrenaline + cocaine) and XAP (xylo-adrenaline- phenylepinephrine) are few compounded topical anesthetic preparations available. In general compounded preparations are more efficacious than singular preparations.

Contact (type and duration): Mode of delivery (liquid, gel, spray, patch, and cream) and duration of application of topical anesthetic can influence the efficacy of topical anesthetic but sufficient evidence is not established on the same. There is no direct relationship between the duration of topical anesthesia and its improved clinical efficacy.[4-6]

Alternatives to Topical Anesthesia

Precooling, counter-irritation (vibration), pressure application, electronic dental anesthesia, iontophoresis, sonophoresis are a few alternatives to topical anesthesia administration in children.

Precooling: precooling is also called cryoanesthesia, it involves the application of cold to the surface of the oral mucosa. Unlike topical anesthesia, cryoanesthesia acts on all the cells. Many studies reported the use of precooling in children. For reducing pain due to needle insertion in block (IANB), palatal injections majority of the studies in children reported that a combination of precooling and topical anesthesia is better than the usage of topical anesthesia alone[7-10] (Table 1).

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Counter irritation or Counterstimulation: Vibration, Pressure application will come under counter-irritation, where we aim to stimulate larger A-delta fibers which block the transmission of nociception. Inhibitory neurons in the spinal cord are stimulated which reduces nociception by A-δ and C fibers. Many studies report the usage of vibration as a counter stimulant in children.[11-21] Some studies report that there are no significant added advantages of vibration over conventional methods in children.[16] This is especially true in younger children.[19] Vibration was performed mostly intraorally except in one study where vibration was performed extraorally.[13] Counter stimulation by inducing vibration with a thumb is also proved to be beneficial in some studies.[21] Pressure application in the injection site is also an effective counter-stimulation technique for pain reduction.[22] Combination of precooling and counter stimulation: Combination of precooling and vibration: for mandibular primary tooth extraction showed better results.[12] Combination of precooling and pressure application with an iced tooth bud was reported to be effective[23] (Table 2).

Other alternative topical anesthesia administration includes Electronic dental anesthesia, iontophoresis, sonophoresis, and liposomal encapsulation.

Electronic dental anesthesia: It is a modification of TENS for intraoral usage. It delivers a small current stimulus through the tissue to reduce pain sensation. Many studies reported the usage of EDA in children. EDA is reported to have a beneficial effect with minor

Table 1: Precooling/cryoanesthesia studies in children

S. No.	*Author-year*	*Intervention*	*Site/ process*	*Pain perception/ reaction measure*	*Results*
1.	Hameed et al. 2018. (Hameed, Sargod et al. 2018)	Children age group of 8–10 years Tetrafluorethane cryoanesthetic spray (10–15 seconds) compared to lignocaine spray	IANB with 26-gauge needle.	VAS SEM	Pain scores were less in tetrafluorethane group when compared with lidocaine topical spray group.
2.	Lathwal et al. 2015	Children age 5–8 years. One minute ice cone vs 5 seconds Refrigerant spray vs benzocaine.	IANB and Greater palatine block with 25 gauge needle.	SEM VES	Ice cone had shown significantly higher efficacy as compared to benzocaine and refrigerant.
3.	Ghaderi et al. 2013	Children age 8–10 years buccal infiltration (20% Benzocaine) on one side (control) for 1 min and topical anesthetic agent plus one minute of ice pack on the other side.	buccal infiltration with 27 gauge needle.	SEM VAS	Cooling the injection site before infiltration of local anesthetics in the buccal mucosa for 1 min, reduced pain perceived by pediatric patients.
4.	Aminabadi et al., 2009	Children aged 5–6 years of age Benzocaine for 1 min followed by a 2-min. Application of ice before injection of local anesthetics.	IANB with 27 gauge needle.	SEM	Precooling of the soft tissues of an injection site prior to the administration of a local anesthetic can minimize the discomfort and anxiety associated with the injection procedure.

non-invasive procedures such as cavity preparation, rubber dam clamp placement in children.[24-38] Few studies report inferior results with EDA use in children[29] (Table 3).

Iontophoresis: lignocaine and adrenaline which are positively charged molecules penetrate deeper into the tissues with the influence of constant low-intensity electrical charge. This process is called iontophoresis. This iontophoresis can be accomplished with a current of 0–3 mA current. This iontophoresis process is facilitated by two electrodes. Few studies reported painless extraction of primary teeth with the help of iontophoresis.[39,40] Nowadays, Iontophoresis is being tested on carious lesions to improve fluoride and calcium uptake.

Clinical Usage of Topical Anesthetics for Dental Use in Children

To reduce local anesthesia needle prick pain: Trypanophobia is the fear of needles. Injection with needles into the oral cavity is perceived as the most feared dental procedure. Most topical anesthetics are efficient in reducing needle prick pain in children. As mentioned earlier compounded preparations are more effective than simple preparations. Pain due to needle prick in the intraoral region depends on the site of administration. The palatal region is one of the most painful areas in the oral cavity due to firm adherence of mucosa to the palatal bone. Cetacaine, EMLA, benzocaine, lignocaine preparations are tested for palatal anesthesia in children[1,5,41-44] (Table 4). Studies on cetacaine are lacking so future research can be performed in this area in children. Many studies report varied efficacy of topical anesthetics for needle prick pain during buccal infiltrations in children, no significant differences are reported.[45-48] Only a few studies tested the efficacy of prick pain due to IANB injections.[49]

Pediatric teething pain: Traditionally topical anesthetic preparations (benzocaine and lignocaine) were used extensively to alleviate discomfort due to teething in babies. In 2011, FDA warned that using OTC benzocaine gels for teething pain can result in meth-hemoglobinemia which affects the oxygen-carrying capacity of red blood corpuscles which can result in death.[50,51] Hence, FDA recommended benzocaine products not to be used in children below 2 years of age. Later in 2014, FDA warned that 2% of oral lignocaine not be used to treat infants and children with teething pain because if too much is accidentally swallowed it can result in seizures, severe brain injury, and cardiac disturbances. Cryoanesthesia, using chilled teething rings is considered to be effective and safe for alleviating teething pain in children.[52,53]

Pediatric Restorative Dentistry

Cavity preparations: EMLA, EDA are proved to be beneficial for preparing cavities in primary teeth in children. Although both methods reported similar efficacy children preferred EDA.[28,36]

Rubber dam clamp placement: Studies reported on the efficacy of topical anesthetics in reducing pain due to clamp placement in children. Most of the studies show 20% benzocaine to be better than other agents for gingival anesthesia in children[54-57] (Table 5).

Pediatric exodontia: extraction of very mobile primary teeth with partially resorbed root stumps is accomplished under only application of topical anesthesia is reported successfully by a few authors.[58,59]

Pediatric oral surgery: compounded oral preparations such as LAT (lidocaine + adrenaline+tetracaine) and LPT (lignocaine + phenylepinephrine+tetracaine) are used in pediatric maxillofacial surgery for facial and oral laceration suturing.[60,61]

Pediatric endodontics: Topical anesthetics has limited application for use in endodontic treatments. Few authors reported topical application of EMLA in the buccal sulcus induced some degree of pulpal anesthesia. One study reported pulpal anesthesia resulted from direct pulpal application of 20% benzocaine.[62,63]

Table 2: Counter-stimulation studies in children

S. No.	*Author-year*	*Intervention*	*Site/ process*	*Pain perception/ reaction measure*	*Results*
1.	Hassanein 2020	Children age: 5–7 Vibration (Dental vibe) vs benzocaine gel 20%.	IANB	FLACC WB-FACES	Vibration better
2.	Hegde 2019	Children age: 6–11 Extraoral Vibration (vibratory toy fish) vs topical anesthesia spray.	IANB	FLACC WB-FACES Pulse rate	Vibration (extraoral) better.
3.	Tandon 2018	Children age: 6–11 Intraoral vibration (colgate 360 sonic toothbrush) vs precaine gel.	IANB 25 gauge	SEM WB-FPS	Vibration better.
4.	Tung 2018	Children age: 7–14 Vibration (Dental vibe)	IANB Maxillary infiltration 30 gauge needle.	WB-FPS Pulse rate.	Vibration better.
5.	Raslan and Masri 2018	Children age: 6–12 Vibration (Dental vibe)	Buccal and palatal infiltration on the maxilla and IANB.	FLACC WB-FPS	No significant difference between both the groups. Children did not prefer vibration.
6.	Bagherian and Sheikfathollahi 2016	Children age: 3.25–9.6 years Vibration was accomplished manually with cotton roll.	IANB and maxillary molar infiltration.	Author-evaluated their own scale: face, head, foot, hand, trunk, and cry (FHFHTC).	Vibration is better than conventional topical anesthetic.
7.	Shilpapriya 2015	Children aged 6–12 Vibration (Dental vibe)	Not mentioned clearly. 27 gauge	UPS-universal pain scale.	Vibration better.
8.	Elbay 2015	Children aged 6–12 Vibration (Dental vibe) with topical anesthesia.	IANB 27 gauge needle.	FLACC WB-FPS	No significant difference in younger age groups. In elder children vibration was better.
9.	Ching 2014	Children aged 10–17 years	Not mentioned.	WB-FPS	Vibration was better.

Table 3: Studies on EDA in children

S. No.	*Author-year*	*Intervention*
1.	Bansal 2014	Comfort control syringe, EDA + traditional syringe compared. EDA showed inferior results when compared to Comfort control syringe.
2.	Baghdadi 2000	Combination of audio-analgesia and EDA is beneficial for children.
3.	Munshi 2000	EDA is better for pediatric dental procedures.
4.	Baghdadi 1999	EDA better for cavity preparation in children.
5.	Baghdadi 1999	EDA better for rubberdam clamp placement and cavity preparation in children.
6.	Wison 1999	Activated EDA was better than non-activated EDA.
7.	Cho 1998	Negative results with EDA for restoration in children. Local anesthesia was better than EDA.
8.	Oztas 1997	EDA better than conventional local anesthesia for restorative treatments for primary molars in children.
9.	Johnson 1996	Efficacy of electronic dental anesthesia.
10.	teDuits 1993	EDA better than conventional local anesthesia for restorative treatments and rubber dam clamp placement in children.
11.	Jedrychowski and Duperon 1993	EDA well-accepted in children.
12.	Esposito 1993	Better than loca anesthesia for restorative procedures.

Table 4: Studies on Palatal needle prick pain in children

S. No.	*Author-year*	*Intervention*	*Site/ process*	*Pain perception/ reaction measure*	*Results*
1.	Dassaraju and Nirmala 2020	Children aged 7–11 years. Cetacaine, EMLA, 20% Benzoczine compared.	Palate Needle prick 27 gauge.	CPS FLACC	Cetacaine was best among all.
2.	Gupte 2019	Children aged 6–12 years. 2% lignocaine gel and 10% lignocaine spray.	Palate Needle prick 27 gauge	VAS	10% Lignocaine spray was better.
3.	Deepika 2012	Children aged 6–12 years Compared precaine (8% lignocaine + 0.8% Dibucaine) with 20% benzocaine.	Palatal needle prick. 27 gauge	VAS SEM	No significant difference between both.
4.	Kreider 2001	Children aged 6–15 years 20% benzocaine vs 20% lignocaine.	Palatal needle prick. 27 gauge	SEM WPB-FPS	20% Lignocaine in patch form was more efficient than 20% benzocaine gel.
5.	Primosch 2001	Children aged 6–15 years 20% benzocaine and 5% EMLA	Palatal needle prick. 27 gauge.	CPS FLACC	No significant difference between both.
6.	Meechan and Winter 2001	EMLA vs EDA	Palatal needle.		EMLA better than EDA.

Table 5: Studies on topical local anesthesia in rubber dam clamp placement in children

S. No.	*Author*	*Intervention*	*Results*
1.	Coudert 2014	Topical 2% lignocaine vs placebo-clamp placement pain in children.	2% lignocaine was better.
2.	Yoon 2009	EMLA gel and 20% benzocaine for rubber dam clamp.	Benzocaine 20% was better than EMLA in children.
3.	Lim 2004	Children EMLA vs placebo. Rubber dam clamp placement.	EMLA was better than placebo.
4.	Haasio 1990	EMLA and 10% lignocaine for achieving gingival anesthesia.	No difference Between both.

Pediatric orthodontics: compounded topical preparations are proved to be effective in reducing pain due to orthodontic mini-implant placement in children and adolescents. Kwong et al. in 2011 reported that TAC alternate was better than Oraqix in placing temporary anchorage devices.[64] Wax incorporated with 20% benzocaine reduced pain and mucosal irritation due to orthodontic brackets.[65]

Conclusion

Pain management is important for every pediatric dentist. Topical anesthesia forms a very important tool for managing pain efficiently in children. Knowledge about the proper selection of topical anesthetic is very important for the successful management of pain in pediatric dentistry.

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