ACTA
STOMATOLOGICA
CROATICA
www.ascro.hr

Acta stomatol Croat. 2014;48(3):193-198.
IZVORNI ZNANSTVENI RAD
ORIGINAL SCIENTIFIC PAPER

Ozgur Onder Kuscu[1,2], Nuket Sandalli[1], Esber Caglar[1,2], John G. Meechan[3]

Topikalno korištenje lokalnog anestetika radi umanjivanja neugodnog osjeta pri ubodu iglom

Use of Pre-Injection Diffusion of Local Anaesthetic as a Means of Reducing Needle Penetration Discomfort

[1] Zavod za pedodonciju, Stomatološkog fakulteta Sveučilišta Yeditepe, Istanbul, Turska
Dept.of Paediatric Dentistry, Dental School, Yeditepe University, Istanbul, Turkey
[2] Privatna praksa, Istanbul, Turska
Private practice, Istanbul, Turkey
[3] Stomatološki fakultet Sveučilišta Newcastle, Newcastle na Tynei, Velika Britanija
School of Dental Sciences, Newcastle University, Newcastle upon Tyne, UK

Sažetak

Svrha rada: Željelo se odrediti utječe li topikalna uporaba otopine lokalnog anestetika na neugodnu senzaciju pri ubodu igle u nepce. **Metode:** Provedeno je nasumično, dvostruko *slijepo* istraživanje uz sudjelovanje placebo-skupine. Odabrano je 25 zdravih dobrovoljaca koji su bili podvrgnuti dvostrukom ubodu igle tijekom jednog posjeta stomatologu. Mjesto uboda nalazilo se centimetar od marginalne gingive prvih maksilarnih premolara sa svake strane usta. Korištene su 13-milimetarske igle koje su bile pričvršćene na štrcaljke napunjene 2-postotnim lidokainom s 0,125mg/ml epinefrina ili fiziološkom otopinom. Prije svakog uboda stomatolog je istisnuo kap otopine na vrh igle te je 20 sekundi prislonio na nepce i vrh igle i kap. Neugodna senzacija ocijenjena je na 100 milimetarskoj vizualnoj ljestvici na kojoj su krajnje vrijednosti označene s *bez boli* i *nepodnošljiva bol*. **Rezultati:** Pri ubodu nije bilo statistički značajne razlike između dviju otopina na razini neugode (prosječna vrijednost = 26 80 ± 19,36 mm za lidokain i 26 20 ± 18,39 mm za fiziološku otopinu), iako su ispitanici naveli da je drugi ubod bio bolniji od prvoga (prosječna vrijednost = 31,00 ± 19,84 mm za lidokain i 22,00 ± 16,65 mm za fiziološku otopinu). **Zaključak:** Topikalna primjena otopine lokalnog anestetika nije utjecala na razinu boli nakon uboda iglom u nepce.

Zaprimljen: 10. ožujka 2013.
Prihvaćen: 13. svibnja 2014.

Adresa za dopisivanje
Assist Prof Dr Ozgur Onder Kuscu
Yeditepe University
School of Dentistry
Department of Pediatric Dentistry
Bagdat cad 238, Goztepe 34728 Istanbul
Turkey
tel.: + 90 216 3636044/6432
faks: +90 216 3636211
mobitel: +90 532 7690065
ookuscu@yahoo.com

Ključne riječi
anestezija u stomatologiji; igle; bol; anestetici, lokalni

Uvod

Tjeskoba, nelagoda zbog dentalnog zahvata velika je prepreka redovitim odlascima stomatologu (1). Jedan od najvećih uzroka, kako za malu djecu tako i za odrasle, jest injekcija lokalnog anestetika (2 – 7). Unatoč tomu, najčešća i najučinkovitija metoda smanjivanja i kontroliranja tjeskobe pacijenata u stomatologiji jest injekcija lokalnog anestetika koja i efikasno opušta pacijenta i omogućuje dentalnom liječniku bolje obavljanje posla (8 – 11).

Kako bismo omogućili optimalnu stomatološku uslugu, vrlo je važno odabrati bezbolni i optimalni lokalni anestetik (LA) koji ne potiče tjeskobu kod pacijenata. U ranijim istraživanjima istaknute su varijable koje mogu biti uključene u nastanak boli nakon injekcije LA te je testirano kako smanjiti nelagodu tijekom davanja injekcije. Varijable su uključivale rastezljivost tkiva, brzinu ubrizgavanja anestetika, dob, osobnost, prijašnja iskustva i karakteristike pacijenata (7, 12 – 13). Mnoge su tehnike korištene kako bi se smanji-

Introduction

Anxiety is a barrier to dental attendance (1). The most anxiety-provoking procedure for both children and adults is the local anaesthetic (LA) injection (2-7). However, the most common and efficient method of pain-anxiety control in dentistry is the local anaesthetic injection which also offers patients comfort and co-operation, and also better performance by the practitioner (8-11).

In order to provide optimal dental care it is important to deliver an LA that is pain free and does not give rise to patient anxiety. Previous studies have examined variables that might be involved in painful LA injections and tested possible ways of minimizing the discomfort perceived at the time of injection. Variables included tissue distensibility, speed of injection, age, personality, previous experience and patient characteristics (7,12-13). A variety of techniques have been used to overcome injection discomfort, including the use of topical anaesthetic gel, patches, electronic anaesthesia prior to in-

la neugoda tijekom davanja LA, primjerice, uporaba gela kao topiklanog anestetika, flastera, elektroničke anestezije prije injiciranja (14 – 16) ili korištenje elektroničkoga kompjutoriziranog sustava koji omogućuje kontrolu brzine ubrizgavanja, bez obzira na gustoću tkiva, kao što je Wand® (poslije preimenovan u CompuDent®, Milestone Scientific, Livingston, NJ, SAD) (6 – 9,17 – 21). Predložene su i ocijenjene tehnike koje umanjuju neugodu intraoralnih injekcija, poput produljenog davanja ili grijanja anestetika (22 – 24), različitih promjera igala te oštrine njezina vrha (25 – 30). No ni jedna nije mogla ublažiti neugodu povezanu s injekcijom, niti se u navedenim istraživanjima navode najvažnije varijable i tehnike u percepciji boli. Unatoč svemu, trenutačno je uobičajeno mišljenje da se uporabom topikalnog anestetika dvije minute prije injekcije te njegovim polaganim ubrizgavanjem pod malim pritiskom, stvaraju uvjeti za bezbolnu anesteziju poznatu kao *tehnika bezbolne lokalne anestezije* (31).

Još uvijek nisu u cijelosti razjašnjeni važni čimbenici koji utječu na percepciju boli. U ovom istraživanju ciljano se pokušalo odrediti utječe li topikalna primjena otopine lokalnog anestetika na neugodu izazvanu ubodom igle u nepce.

Materijali i metode

Protokol istraživanja bio je u skladu sa smjernicama Helsinške deklaracije iz 1975. godine i odobrilo ga je Etičko povjerenstvo Sveučilišta Yeditepe. Osim toga, svi su sudionici potpisali suglasnost nakon što su im objašnjeni ciljevi.

Ispitanici

Odabrano je 25 odraslih dobrovoljaca u dobi od 20 godina (12 žena, 13 muškaraca) i svaki je tijekom jednog posjeta stomatologu bio uboden dva puta u nasumičnom redoslijedu. Iz studije su bili isključeni maloljetnici (manje od 8 godina), trudnice, osobe koje nisu mogle potpisati suglasnost ili su alergične na amidni lokalni anestetik te one s problemima sa zgrušavanjem krvi i neurološkim tegobama.

Mjesta injiciranja i ubrizgavanje otopine LA

Bilo je provedeno placebo, nasumično, dvostruko *slijepo* istraživanje. Pedodont (OOK: Ozgur Onder Kuscu) obavio je injiciranje prema prije definiranim mjestima ubrizgavanja na temelju kompjutorskog programa (tablica 1.). Mjesta uboda bila su centimetar od ruba gingive prvih maksilarnih premolara sa svake strane nepca, što je standardizirana metoda za dosezanje vrha korijena (slika 1.). Igle debljine 30 i dužine 13 mm stavljene su na plastične štrcaljke (Hayat Tıbbi Aletler®, Istanbul, Turska) koje su sadržavale ili 2-postotni lidokain s 0,125mg/ml epinefrina (Jetokain®, I.E.Ulugay, Istanbul, Turska) ili fiziološku otopinu (slika 2.). Pedodont nije znao što je u kojoj štrcaljki, te je svaki put izvukao kapljicu otopine na vrh igle i prislonio i kapljicu i vrh igle na nepce 20 sekundi (slika 3.). Tom metodom provjeravalo se kontaktno vrijeme otopine (fiziološka ili lidokain) s nepcem od 20 sekundi, ali ne možemo biti sigurni hoće li se to točno tako provoditi i u praksi. Nakon 20 sekundi igla je bila polako uvedena okomito na sluznicu do kontakta s kosti (slika 4.).

jection (14-16), or electronic computerized devices which offer controlled injection speed regardless of tissue density such as the Wand® (later rebranded as CompuDent®, Milestone Scientific, Livingston, NJ, USA (6-9,17-21). Furthermore, some techniques have been suggested and evaluated to ease the discomfort of intra-oral injections, which have required a prolonged injection time, warmed-up anaesthetic solution (22-24), the possible significance of the needle gauge and the sharpness of the bevel (25-30). None of these techniques by themselves have been able to completely manage the pain connected with injections nor do the papers describing them address the question of the most significant variable(s) and technique(s) in pain perception. However, currently it is reported that following a two-minute topical anaesthetic application, slow and low-pressure injections are the key to pain free and comfortable delivery of local anaesthetic and named as "Pain free local anaesthesia technique".(31)

Thus, the significant, influential factor(s) in pain perception has not yet been clearly addressed. The present study, aims to determine if the pre-injection diffusion of local anaesthetic solution influences the discomfort of needle penetration in the palate.

Material and Methods

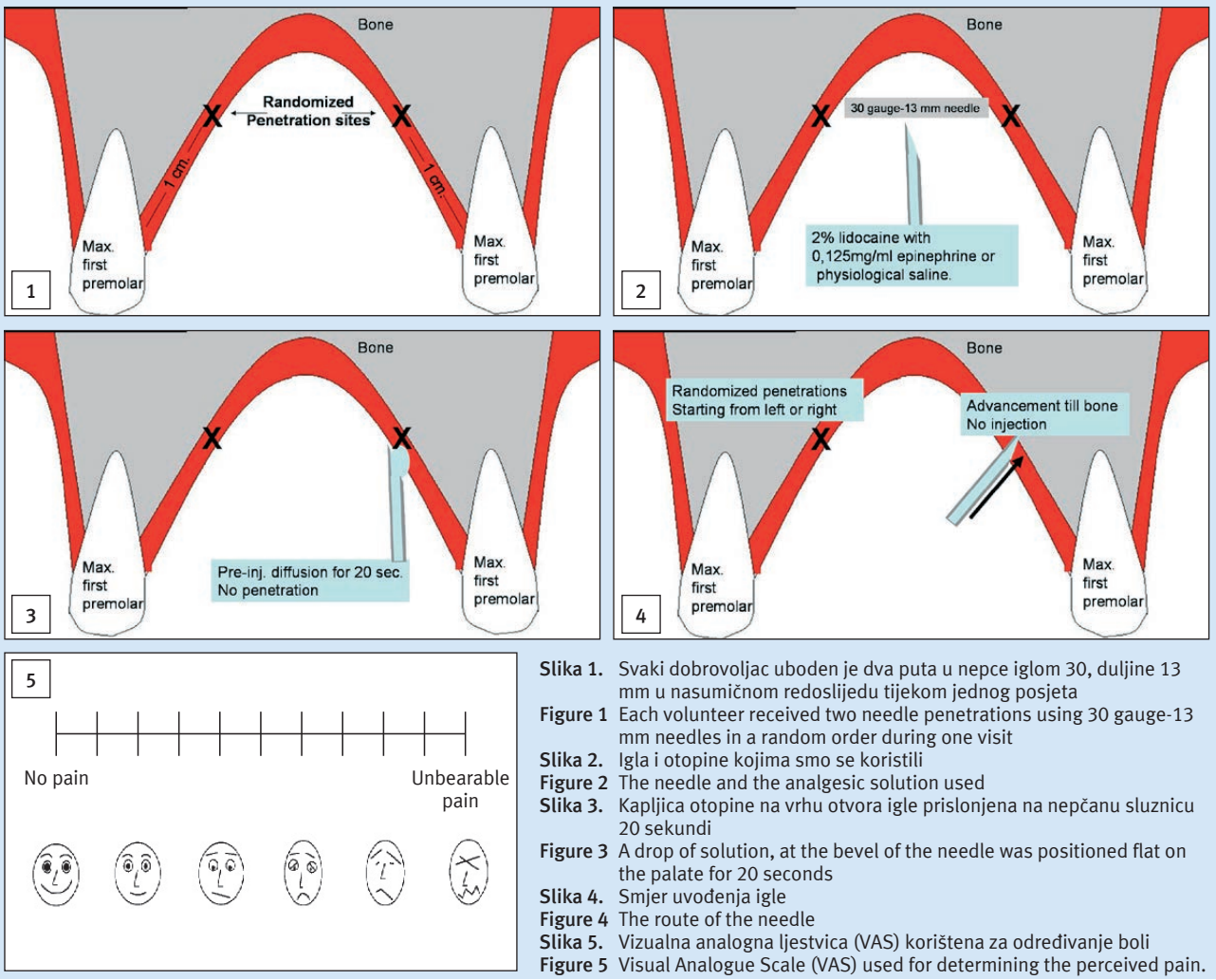
The study protocol was in agreement with the guidelines of the Helsinki Declaration as revised in 1975 and approved by the Ethical Committee of Yeditepe University. Written consent was obtained from all participants after explaining the objectives of the present study.

Participants

Twenty five healthy adult volunteers aged 20 (12 F, 13 M) were recruited and each received two needle penetrations in a random order during one visit. Exclusion criteria included: under 18 years of age, pregnancy, inability to provide written informed consent, allergy to amide local anaesthetic solutions, bleeding disorders and neurological disturbances.

Injection Sites and Injection of LA Solution

A placebo-controlled, randomised, double-blind split-mouth investigation was conducted. A pediatric dentist (OOK: Ozgur Onder Kuscu) gave the injections according to the previously defined injection sites formulated randomly by a computer programme (Table 1). The penetration sites were one centimetre from the gingival margin of the maxillary first premolars on each side of the mouth which is standardized to reach the apex of the tooth (Figure 1). 30 gauge-13 mm needles which were attached to traditional plastic injectors (Hayat Tıbbi Aletler®, Istanbul, Turkey) that contained either 2% lidocaine with 0.125mg/ml epinephrine (Jetokain®, I.E.Ulugay, Istanbul, Turkey) or physiological saline were used (Figure 2). For each penetration the same operator who was blinded to the solution in the syringe encouraged a drop of solution to appear at the end of the needle and placed this drop with the bevel of the needle flat on the palate for 20 seconds (Figure 3). In the study method, the contact time of the solution (saline or Lidocaine) can be verified, since we cannot be sure if this 20 seconds of contact



Slika 1. Svaki dobrovoljac uboden je dva puta u nepce iglom 30, duljine 13 mm u nasumičnom redoslijedu tijekom jednog posjeta
Figure 1 Each volunteer received two needle penetrations using 30 gauge-13 mm needles in a random order during one visit
Slika 2. Igla i otopine kojima smo se koristili
Figure 2 The needle and the analgesic solution used
Slika 3. Kapljica otopine na vrhu otvora igle prislonjena na nepčanu sluznicu 20 sekundi
Figure 3 A drop of solution, at the bevel of the needle was positioned flat on the palate for 20 seconds
Slika 4. Smjer uvođenja igle
Figure 4 The route of the needle
Slika 5. Vizualna analogna ljestvica (VAS) korištena za određivanje boli
Figure 5 Visual Analogue Scale (VAS) used for determining the perceived pain.

Procjena boli i tjeskobe

Neugoda nakon uboda bilježila se na 100-milimetarskoj vizualnoj analognoj ljestvici (VAS) s krajnjim vrijednostima označenima *bez boli* i *nepodnošljiva bol* (slika 5.). Nakon svake injekcije ispitanici su na ljestvici označili razinu boli.

Statistička analiza

Podatci su obrađeni programom GraphPad Prisma V.3 i Paired t testom. Statistički značajnima smatrane su sve p vrijednosti manje od 0,05.

Rezultati

Nije bilo velike razlike u neugodi nakon uboda iglom u testiranoj i kontrolnoj skupini (prosječna vrijednost VAS-a = 26,80 ± 19,36 mm za lidokain i 26,20 ± 18,39 mm za fiziološku otopinu)($p > 0,05$). Unatoč tomu, drugi je ubod bio znatno neugodniji negoli prvi, ako se ocjenjuje ugoda tijekom uboda (prosječna vrijednost VAS-a = 22,00 ± 16,65 mm i 31,00 ± 19,84 mm, t = 2,89; $p = 0,008$) (tablica 2.).

time would happen in clinical practice. After that, the needle was gently advanced perpendicularly to the tissue until the bone was contacted (Figure 4).

Assessment of pain and anxiety

The discomfort of each penetration was noted on a 100 mm visual analogue scale (VAS) with end points marked "No pain" and "Unbearable pain" (Figure 5). At the end of the first and second injection, the subjects were asked to point out the VAS pain score.

Statistical Analysis

The data were processed with the GraphPad Prisma V.3 programme using Paired t test. A *p*-value less than 0.05 was considered statistically significant.

Results

There was no significant difference in penetration discomfort between the test and control solutions (mean VAS = 26.80±19.36mm for lidocaine and 26.20±18.39mm for saline)($p > 0.05$). Regarding penetration comfort, however, the second penetration was significantly more uncomfortable than the first (mean VAS = 22.00±16.65 mm and 31.00±19.84 mm respectively, t = 2.89; $p = 0.008$) (Table 2).

Tablica 1. Mjesta uboda za nasumično odabrane pacijente
Table 1 Injection site table used for random allocation of the subjects

Reg.no	Ime • Name	1. Ubod desno bukalno • 1. Penetration Right buccal	2. Ubod lijevo bukalno • 2. Penetration Left buccal
1		Lidokain • Lidocaine	Fiziološka • Saline
2		Lidokain • Lidocaine	Fiziološka • Saline
3		Fiziološka • Saline	Lidokain • Lidocaine
4		Lidokain • Lidocaine	Fiziološka • Saline
5		Lidokain • Lidocaine	Fiziološka • Saline
6		Lidokain • Lidocaine	Fiziološka • Saline
7		Fiziološka • Saline	Lidokain • Lidocaine
8		Lidokain • Lidocaine	Fiziološka • Saline
9		Fiziološka • Saline	Lidokain • Lidocaine
10		Lidokain • Lidocaine	Fiziološka • Saline
11		Fiziološka • Saline	Lidokain • Lidocaine
12		Fiziološka • Saline	Lidokain • Lidocaine
13		Lidokain • Lidocaine	Fiziološka • Saline
14		Fiziološka • Saline	Lidokain • Lidocaine
15		Lidokain • Lidocaine	Fiziološka • Saline
16		Fiziološka • Saline	Lidokain • Lidocaine
17		Lidokain • Lidocaine	Fiziološka • Saline
18		Fiziološka • Saline	Lidokain • Lidocaine
19		Fiziološka • Saline	Lidokain • Lidocaine
20		Lidokain • Lidocaine	Fiziološka • Saline
21		Fiziološka • Saline	Lidokain • Lidocaine
22		Lidokain • Lidocaine	Fiziološka • Saline
23		Fiziološka • Saline	Lidokain • Lidocaine
24		Fiziološka • Saline	Lidokain • Lidocaine
25		Fiziološka • Saline	Lidokain • Lidocaine

Tablica 2. Percepcija boli i prosječna vrijednost VAS-a (Vizualna analogna ljestvica) boli ± SD
Table 2 Pain perception and related mean VAS (Visual Analog Scale) pain scores ± SD

	Lidokain • Lidocaine	Fiziološka • Saline	1. ubod • 1. penetration	2. ubod • 2. penetration
Prosjek vrijednosti boli prema VAS-u ± S.D srednja vrijednost • Mean VAS pain scores ± S.D median	26.80±19.36mm 20	26.20±18.39mm 20	22.00±16.65 mm* 10	31.00±19.84 mm* 30

Paired t test * p = 0.008

Rasprava

Lokalna anestezija dio je cjelokupnog stomatološkog zahvata koji uzrokuje najveći stupanj tjeskobe (32). Anesteziranje pacijenta potiče određenu nelagodu i kod stomatologa. Tako su u svojem istraživanju Simon i suradnici (33) zabilježili da 19 posto stomatologa pod stresom daje lokalni anestetik, a šest posto stomatologa izjavilo je da je to ozbiljan problem. Samo dva posto stomatologa reklo je da nisu svjedočili negativnim posljedicama lokalnog anestetika.

Danas se može postići bolja suradnja i opuštenost pacijenta, bezbolan tretman te, posljedično, bolje stomatološke usluge, ako se pravilno uporabi lokalni anestetik. Imajući to na umu, svaki stomatolog trebao bi svladati vještinu davanja bezbolnih injekcija lokalnog anestetika (18), pa bi nove generacije dentalnih liječnika morale dobro poznavati te tehnike (34). Nekoliko čimbenika utječe na pojavu boli tijekom davanja lokalnog anestetika. Kontrolom stanja prije injekcije LA, odnosno uklanjanjem neugode zbog uboda iglom, može se izbjeći niz čimbenika koji uzrokuju tjeskobu.

Discussion

An aspect of dental treatment that produces anxiety in patients is local anaesthesia (32). The delivery of LA injections also produces anxiety among dentists. Simon et al. (33) recorded that 19% of dentists in their study reported that the administration of local anaesthesia caused them distress; 6% considered this problem was serious. Only 2% of the respondents in that study reported no negative reaction to the administration of local anaesthesia.

Today, patient comfort and co-operation, a pain free treatment, and better performance of the dental practitioner can be achieved by proper administration of dental injections. Within this perspective, every practitioner should strive to master delivering relatively painless injections (18) and a new generation of dentists should be educated properly (34). A number of factors may influence injection pain during the administration of dental LA. Controlling pre-injection diffusion of LA as a means of reducing needle penetration discomfort might be helpful in eliminating related confounding factors.

Kritični dio cijelog postupka anesteziranja jest ubod iglom kroz tkivo sluznice i injiciranje nekoliko kapi LA bez ikakvog pritiska. Tako nastaje analgezija u okolnom tkivu koja dopušta daljnje brže ubrizgavanje otopine LA. U jednom od navedenih istraživanja opisana je tehnika topikalne anestezije i njezin potencijal da smanji bol uzrokovanu ubodom igle ako se otopina ostavi na sluznici dvije, pet, ili deset minuta, ali pokazalo se da nema kliničke koristi ako je doista riječ o injekciju anestetika (35). Nedavno su praktičari zaključili da igle šireg promjera, kao na primjer 27 ili 30, uzrokuju manje neugode (1). U svim dosadašnjim istraživanjima upozoreno je na činjenicu da promjer igle ne utječe na pojavu boli tijekom uboda (26 – 27). U našem istraživanju difuzija LA na mjestu uboda prije injiciranja nije utjecala na smanjivanje boli. Unatoč tomu, druga aplikacija otopine bila je mnogo neugodnija negoli prva.

U našem istraživanju koristili smo se ljestvicom VAS koja se vrlo često primjenjuje u sličnim istraživanjima kada se vrjednuje stupanj boli. U istraživanjima Revilla (36) i McCormacka (37) ističe se da je ta ljestvica instrument kojim se liječnik može koristiti u reprodukciji rezultata. Seymour (38) je u kliničkom istraživanju postoperativne dentalne boli zabilježio da je VAS osjetljiviji od ostalih ljestvica kojima se vrjednuje stupanj boli te da se njime mogu vrlo uspješno razlikovati male razlike u intenzitetu boli. Većina ispitanika u istraživanju vrlo se vješto koristila ljestvicom nakon što im je objašnjeno što trebaju učiniti te nisu zahtijevali daljnju pomoć.

Ovo istraživanje prvo pokazuje da nema potrebe držati LA topikalno na mjestu uboda kako bi se smanjile nelagoda i bol uzrokovane ubodom igle. U zaključku možemo reći da topikalna difuzija lokalnog anestetika nije smanjila nelagodu uzrokovanu ubodom igle u nepce.

Zahvale

Zahvaljujemo našim dobrovoljcima na njihovu doprinosu.

Sukob interesa

Nije bilo sukoba interesa.

The critical part in dental injections is at the beginning when the target tissue is first punctured by the needle and a few drops of solution are injected slowly, without any pressure; then the analgesia spreads in the tissue which permits a relatively faster injection. A recent study showed that topical anaesthetic reduced the pain of needle insertion if left on the palatal mucosa for 2, 5, or 10 minutes, but had no clinical benefit for the actual anaesthetic injection (35). Recently it was concluded that higher gauge needles such as 27 and 30 are sometimes used in the belief that they cause less discomfort of intraoral needle penetrations (1). Studies carried out on the subject all point to the fact that needle gauge did not affect pain upon insertion (26-27). In the present study, pre-injection diffusion of LA itself did not affect pain. However, the second application of pre-injection was significantly more uncomfortable than the first.

The present study used the VAS, which is the most commonly used pain-measuring tool. The studies by Revill (36) and McCormack (37) found the VAS to be a reproducible method for measuring pain. Seymour (38), in a clinical trial on postoperative dental pain, found the VAS to be more sensitive than other pain scales and one that could discriminate between small changes in pain intensity. Most of the subjects in the study were comfortable in its use after receiving instructions and did not need any further directions.

The present study is the first study to show that there is no benefit in keeping LA while pre-injecting as a topical anaesthetic to reduce the pain of needle insertion. In conclusion, pre-injection diffusion of local anaesthetic solution did not influence the discomfort of needle penetration in the palate.

Acknowledgements

We would like to thank our volunteers for their contribution.

Conflict of Interest

They have no conflict of interest.

Abstract

Aim: To determine if pre-injection diffusion of local anaesthetic solution influences the discomfort of needle penetration in the palate. **Methods:** A placebo-controlled, randomised, double-blind split-mouth investigation was conducted. 25 healthy adult volunteers were recruited and each received two needle penetrations in a random order during one visit. The penetration sites were 1 cm from the gingival margin of the first maxillary premolars on each side of the mouth. 30 gauge-13 mm needles which were attached to syringes that contained either 2% lidocaine with 0.125mg/ml epinephrine or physiological saline were used. For each penetration an operator encouraged a drop of solution to appear at the end of the needle and placed this drop with the bevel of the needle flat on the palate for 20 seconds. The discomfort was noted on a 100 mm visual analogue scale with end points marked "No pain" and "Unbearable pain". **Results:** There was no significant difference in penetration discomfort between solutions, (mean VAS = 26.80±19.36mm for lidocaine and 26.20±18.39mm for saline) however the 2nd penetration was significantly more uncomfortable than the first (mean VAS = 31.00±19.84 mm and 22.00±16.65 mm respectively). **Conclusion:** Pre-injection diffusion of local anaesthetic solution did not influence the discomfort of needle penetration in the palate.

Received: March 10, 2013
Accepted: May 13, 2014

Address for correspondence
Assist Prof Dr Ozgur Onder Kuscu
Yeditepe University
School of Dentistry
Department of Pediatric Dentistry
Bagdat cad 238, Goztepe 34728 Istanbul
Turkey
Phone : + 90 216 3636044/6432
Fax : +90 216 3636211
Self-phone : +90 532 7690065
ookuscu@yahoo.com

Key words
Anesthesia, Dental; Needles; Pain; Anesthetics, Local

References

1. Meechan JG, Howlett PC, Smith BD. Factors influencing the discomfort of intraoral needle penetration. Anesth Prog. 2005 Fall;52(3):91-4.
2. Okawa K, Ichinohe T, Kaneko Y. Anxiety may enhance pain during dental treatment. Bull Tokyo Dent Coll. 2005 Aug;46(3):51-8.
3. Ram D, Peretz B. Administering local anaesthesia to paediatric dental patients -Current status and prospects for the future. Int J Paediatr Dent. 2002 Mar;12(2):80-9.
4. Wilson S. Nonpharmacologic Issues in Pain Perception and Control. In: Pinkham, Casamassimo, Fields, Mc Tigue, Novak - editors. Pediatric Dentistry, Infancy Through Adolescence. Pennsylvania: Saunders Company; 1999. p.74-83.
5. Kuscu OO. Thesis. Examination of children's pain and anxiety by psychometric, physiologic and observational methods during dental treatment and local anaesthesia by two different dental injectors. Istanbul: Marmara University, Institute of Health Sciences; 2006.
6. Kuscu OO, Akyuz S. Children's preferences concerning the physical appearance of dental injectors. J Dent Child. 2006 May-Aug;73(2):116-21.
7. Kaufman E, Epstein JB, Naveh E, Gorsky M, Gross A, Cohen G. A survey of pain, pressure, and discomfort induced by commonly used oral local anesthesia injections. Anesth Prog. 2005 Winter;52(4):122-7.
8. Asarch T, Allen K, Petersen B, Beiraghi S. Efficacy of a computerized local anesthesia device in pediatric dentistry. Pediatr Dent. 1999 Nov-Dec;21(7):421-4.
9. Kuscu OO, Akyuz S. Is it the injection device or the anxiety experienced that causes pain during dental local anaesthesia? Int J Paediatr Dent. 2008 Mar;18(2):139-45.
10. Kuscu OO, Sandalli N, Caglar E. Çocuklarda ağrısız lokal anestezi teknikleri. Yeditepe U Dis Hek Fak Derg. 2008;4:7-13.
11. Kuscu OO, Çaglar E, Sandalli N. Local analgesia - a contemporary approach: What are the techniques that provide pain-free local analgesia for children? In: Spilieth CH, editor. Revolutions in Pediatric Dentistry. Berlin: Quintessence Publishing; 2011. p 135-50.
12. Kuscu OO, Çaglar E, Sandalli N. Parents' assessments on the effectiveness of non-aversive behaviour management techniques: a pilot study. J Dental Sci. 2013;7. In press.
13. Çaglar E, Kuscu OO, Aytan ES, Sandalli N. Reflections of learning on perspective behaviour management strategies during dental treatments of pediatric patients. Pediatr Croat. 2012;56:293-296.
14. Primosch RE, Rolland-Asensi G. Comparison of topical EMLA 5% oral adhesive to benzocaine 20% on the pain experienced during palatal anesthetic infiltration in children. Pediatr Dent. 2001 Jan-Feb;23(1):11-4.
15. Quarnstrom F, Libed NE. Electronic anesthesia versustopical anesthesia for the control of injections pain. Quintessence Int. 1994 Oct;25(10):713-6.
16. Abu Al-Melh M, Andersson L, Behbehani E. Reduction of pain from needle stick in the oral mucosa by topical anesthetics: a comparative study between lidocaine/prilocaine and benzocaine. J Clin Dent. 2005;16(2):53-6.
17. Allen KD, Kotil D, Larzelere RE, Hutfless S, Beiraghi S. Comparison of a computerized anaesthesia device with a traditional syringe in preschool children. Pediatr Dent. 2002 Jul-Aug;24(4):315-20.
18. Gibson RS, Allen K, Hutfless S, Beiraghi S. The Wand vs. traditional injection: a comparison of pain related behaviors. Pediatr Dent. 2000 Nov-Dec;22(6):458-62.
19. Sumer M, Misir F, Koyuturk AE. Comparison of the Wand with a conventional technique. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2006 Jun;101(6):e106-9.
20. Goodell GG, Gallagher FJ, Nicoll BK.Comparison of a controlled injection pressure system with a conventional technique. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2000 Jul;90(1):88-94.
21. Oztaş N, Ulusu T, Bodur H, Doğan C. The Wand in pulp therapy: an alternative to inferior alveolar nerve block. Quintessence Int. 2005 Jul-Aug;36(7-8):559-64.
22. Ram D, Hennida L, Peretz B. A comparison of warmed and room-temperature anesthetic for local anesthesia in children. Pediatr Dent. 2002 Jul-Aug;24(4):333-6.
23. Rogers KB, Allen FF, Markiewicz SW. The effect of warming local anesthetic solutions prior to injection. Gen Dent. 1989 Nov-Dec;37(6):496-9.
24. Oikarinen VJ, Ylipaavalniemi P, Evers H. Pain and tem-perature sensations related to local anesthesia. Int J Oral Surg. 1975 Sep;4(4):151-6.
25. Farsakian LR, Weine FS. The significance of needle gauge in dental injections. Compendium. 1991 Apr;12(4):262, 264-8.
26. Fuller NP, Menke RA, Meyers WJ. Perception of pain to three different intraoral penetrations of needles. J Am Dent Assoc. 1979 Nov;99(5):822-4.
27. Mollen AJ, Ficara AJ, Provant DR. Needles 25 gauge versus 27 gauge—can patients really tell ? Gen Dent. 1981 Sep-Oct;29(5):417-8.
28. Brownbill JW, Walker PO, Bouncy BD, Keenan KM. Comparison of inferior dental nerve block injection in child patients using 30-gauge and 25 gauge short needles. Anesth Prog. 1987 Nov-Dec;34(6):215-9.
29. Forrest JO. A survey of the equipment of local anesthesia. Br Dent J. 1968 Apr 2;124(7):303-9.
30. Lehtinen R. Penetration of 27-and 30-gauge dental needles. Int J Oral Surg. 1983 Dec;12(6):444-5.
31. Welbury RR. Paediatric Dentistry. Management of Pain and Anxiety. NewYork: Oxford University Pres; 2001. p.51-75.
32. Fiset L, Milgrom P, Weinstein P, et al. Psychophysiological responses to dental injections. J Am Dent Assoc. 1985 Oct;111(4):578-83.
33. Simon JF, Peltier B, Chambers D, Dower J. Dentists troubled by the administration of anesthetic injections: long term stresses and effects. Quintessence Int. 1994 Sep;25(9):641-6.
34. Kuscu OO, Caglar E, Kucuktepe C, Cildir SK, Hacinlioglu N, Sandallı N. Role of "Student- to- Student Local Analgesia Administration" on Undergraduate students' opinions regarding "Pain Free Local Analgesia Technique" in Children. Eur J Dent Educ. 2013 Aug;17(3):185-9.
35. Bhalla J, Meechan JG, Lawrence HP, Grad HA, Haas DA. Effect of Time on Clinical Efficacy of Topical Anesthesia. Anesth Prog. 2009 Summer;56(2):36-41.
36. Revill SI, Robinson JO, Rosen M, Hogg MI. The reliability of a linear analogue for evaluating pain. Anaesthesia. 1976 Nov;31(9):1191-8.
37. McCormack HM, Horne DJL, Sheather S. Clinical applications of visual analogue scales: a critical review. Psychol Med. 1988 Nov;18(4):1007-19.
38. Seymour RA. The use of pain scales in assessing the efficacy of analgesics in post-operative dental pain. Eur J Clin Pharmacol. 1982;23(5):441-4.