The effect of transcoutaneous electrical nerve stimulation on pain control during dental procedure in children 9-14 years old

Cebalo, Nina; Bašić Kes, Vanja; Urlić, Iris; Karlović, Zoran; Negovetić Vranić, Dubravka

Source / Izvornik: **Psychiatria Danubina, 2021, 33, 1316 - 1319**

Journal article, Published version
Rad u časopisu, Objavljena verzija rada (izdavačev PDF)

Permanent link / Trajna poveznica: https://urn.nsk.hr/urn:nbn:hr:220:518758

Psychiatria Danubina, 2021; Vol. 33, Suppl. 4 (part IV), pp 1316-1319
Conference paper

Original article

THE EFFECT OF TRANSCOUTANEOUS ELECTRICAL NERVE STIMULATION ON PAIN CONTROL DURING DENTAL PROCEDURE IN CHILDREN 9-14 YEARS OLD

Nina Cebalo[1], Vanja Bašić Kes[2], Iris Urlić[3], Zoran Karlović[4] & Dubravka Negovetić Vranić[5]

[1]Community Health Center Zagreb-West, Postgraduate studies student, School of Dental Medicine, University of Zagreb, Zagreb, Croatia
[2]Department of Neurology, Sisters of Charity Hospital, School of Dental Medicine, University of Zagreb, Zagreb, Croatia
[3]Department of Ophthalmology, Clinical Hospital Dubrava, Zagreb, Croatia
[4]Department of Endodontics and Restorative Dentistry, School of Dental Medicine, University of Zagreb, Zagreb, Croatia
[5]Department of Pediatric and Preventive Dentistry, School of Dental Medicine, University of Zagreb, Zagreb, Croatia

SUMMARY

Introduction: *Transcutaneous electrical nerve stimulation (TENS) is a non-pharmacological method widely used by medical specialists to manage acute and chronic pain in different circumstances. It can be used to manage pain during many dental procedures, as well as pain due to various conditions affecting the maxillofacial region. The aim of this study was to provide insight into the clinical research evidence for the analgetic application of TENS in pediatric patients. The hypothesis was that TENS device will achieve analgetic effect on teeth during dental procedure.*

Methods: *This study included 125 patients treated at the School of Dental Medicine, University of Zagreb clinic during two-year period. After diagnosis of caries and need for restorative treatment, patients were randomly selected in three groups. Group 1 received local anesthesia, group 2 had no anesthesia and group 3 used TENS device. Level of pain was measured with Visual Analogue Scale (VAS). Research was conducted by one therapist that was calibrated.*

Results: *We found no statistically significant difference between TENS group and group without anesthesia($p>0.05$).*

Conclusion: *TENS device is not as efficient in achieving analgetic impact during dental procedure as local anesthesia.*

Key words: *TENS device - dental pain – analgesia - anesthesia*

* * * * *

INTRODUCTION

Dental pain is a distressing feeling often caused by intense or damaging stimuli. Drilling the tooth is the most common cause of pain during restorative treatment (Dorri et al. 2017). Local anesthesia is temporary painlessness induced by chemical agents to certain areas that lasts long enough to carry out the required action. Unlike general anesthesia, during which the patient sleeps, local anesthesia has no effect on alertness and awareness. Analgesia is achieved by injecting a small amount of chemical substance that affects neural structures and prevents transmission of painful stimulus. The sense of touch and pressure remains partially preserved, so that the patient during the procedure feels something is happening while not feeling pain. Depending on the type of local anesthetic and technique of application, duration of analgesia may be very different in a time span of about 30 minutes up to six hours. For routine procedures, such as fillings or extraction, anesthetics are used that last up to two hours (Ogle & Mahjoubi 2012). Transcutaneous electrical nerve stimulation (TENS) is a method of pain relief involving the use of a mild electrical current. TENS is typically done with a TENS unit, a small battery-operated device. The device can be hooked to a belt and is connected to two electrodes. The electrodes carry an electric current from the TENS machine to the skin and at or near nerves. TENS therapy blocks or changes the perception of pain (Wright 2012).

The main aim of study was to prove if transcutaneous electical nerve stimulation can be effective in pain reduction as local anesthesia.

METHODS

Transcutaneous electrical nerve stimulation is an FDA approved method of pain alleviation since 1972. The mechanism of action of TENS device is explained with Gate control theory of pain (Mendell 2014, Moayedi & Davis 2013, Melzack & Wall 1965) and endogenous opioid theory (Kimmey et al. 2020, Reynolds 1969, Sluka et al. 1999). TENS equipment is made of the main TENS unit, electrodes, and lead wires. The TENS unit is an electric pulse generator, lead wires establish electrical connection by connecting electrodes to the TENS unit and electrodes convert electric flow from the TENS unit into an ionic current flow in the tissue. Electrodes were placed extra orally on the place where mandibular or maxillary nerve are positioned depending on which tooth was restored (Quarnstrom 1992). Conventional TENS mode with high frequency

between 100 and 200 pps was used which produces segmental analgesia with a rapid onset (<30 minutes) and a rapid offset (<30 minutes). This study included 125 patients aged 9-14 years old treated at the School of Dental Medicine in Zagreb, Croatia during 2-year period. On the first visit selection of patients who have an indication for grade I filling on the first permanent molar, clinical examination was performed. Based on the diagnosis of dental caries the selection of patients who need restorative therapy on a permanent molar, patients were randomly grouped into three groups. Group 1, which has 41 children on whom no anesthesia was applied, group 2 of 42 children on whom the TENS device was applied and group 3 of 42 children to whom classic local anesthesia injection was administered. All patients in TENS group self-administered the amount of electricity. The research was conducted by one therapist who was calibrated. All patients had to fill out the Visual Analogue Scale (VAS) after the treatment to rate the amount of pain felt during the procedure. The pain Visual Analogue Scale is a unidimensional measure of pain intensity, which has been widely used in diverse adult and children patients. It has a categorization of none, mild, moderate and severe pain rated on scale from 1-10. The patient marks on the line the point that they feel represents their perception of their pain (Sung & Wu 2018).

RESULTS

The study included 85 girls (68%) and 40 boys (32%) treated during 2-year period (Figure 1, 2). The arithmetic mean (average) age of patients was 11.53 years (range of age 9-14 years), with standard deviation of 1.78 years and Pearson`s asymmetry coefficient (α) 0.03 (the results are evenly distributed around the arithmetic mean) (Table 1). Statistical indicators of the VAS scale of 3 groups of respondents after treatments show that highest levels of pain were when patients were treated without any anesthesia (arithmetic mean 7.34 and standard deviation 1.26), followed by patients treated with TENS (arithmetic mean 6.67 and standard deviation 1.36) and the lowest levels of pain were shown when patients were treated with local anesthesia (arithmetic mean 2.10 and standard deviation 1.19). Analysis of variance indicated that the three observed groups of subjects differed statistically significantly in the estimated severity of pain ($p<0.01$) (Table 2). The Post-hoc Scheffe test further found that the "local anesthesia" group felt statistically significantly ($p<0.01$) less pain than the TENS and "no anesthesia" subjects. Even though patients treated with TENS showed slightly lower pain results, there was no significant statistical difference between no anesthesia and TENS group patients ($p>0.05$) (Figure 3). Correlation analysis (Pearson's linear correlation coefficient) has found statistically significant correlation ($r=0.82$; $p<0.01$) between age of subjects and electricity intensity of TENS device. Older subjects choose a stronger current.

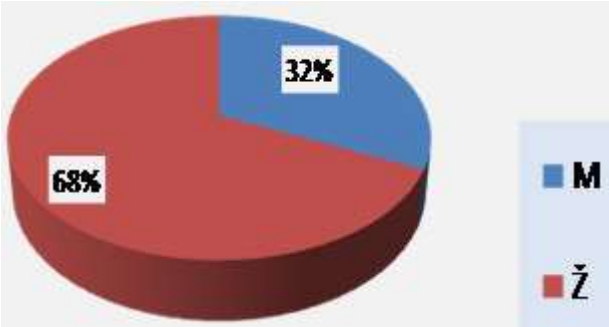

Figure 1. Structure of all respondents by gender

Table 1. Statistical indicators of the age of the respondents

N	MIN	MAX	M	SD	α
125	9	14	11.53	1.78	0.03

MIN – minimum; MAX – maximum; M - Arithmetic mean (average); SD - standard deviation; α - Pearson's asymmetry coefficient

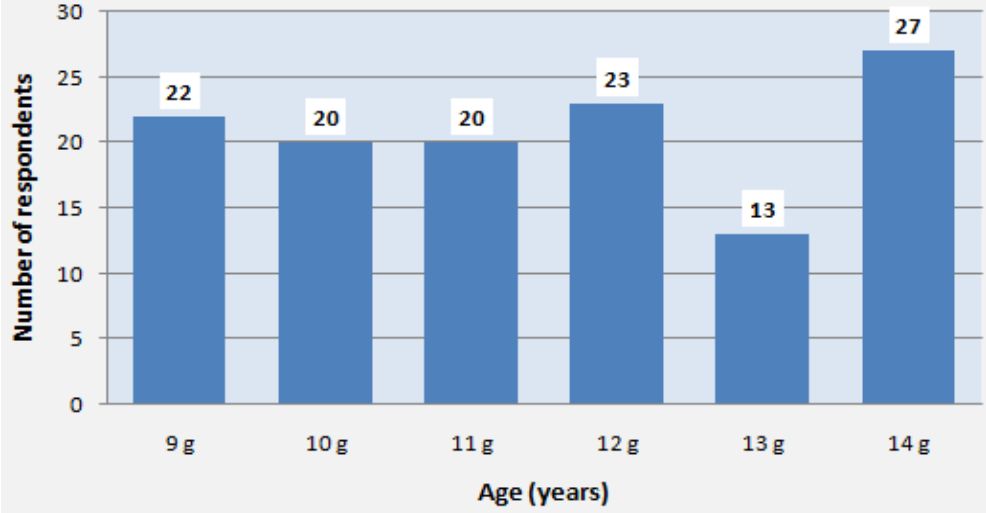

Figure 2. Distribution of all respondents by age

Table 2. Analysis of pain variance after treatment of three groups of subjects

Anova: Single Factor SUMMARY Groups	Count	Sum	Average	Variance		
TENS	42	280	*6.67*	1.84		
Local anesthesia	42	88	*2.10*	1.41		
Without anesthesia	41	301	*7.34*	1.58		
ANOVA Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	680.34	2	340.17	211.55	*0.0000*	3.07
Within Groups	196.17	122	1.61			
Total	876.51	124				

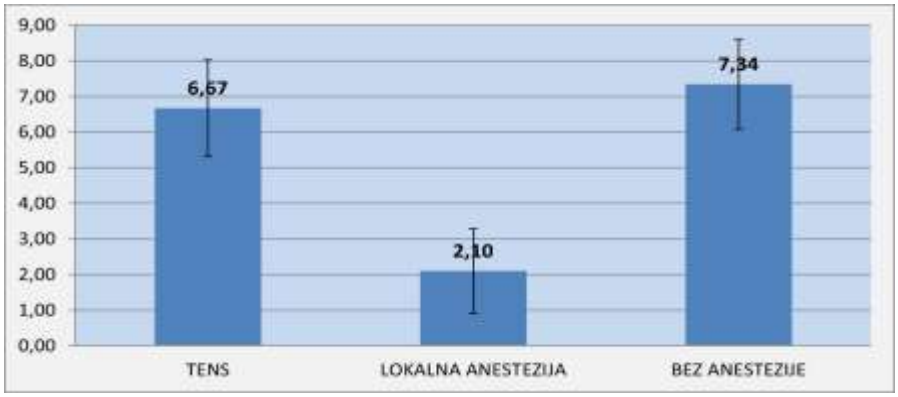

Figure 3. The intensity of pain of three groups of subjects after treatment

DISCUSSION

Treatment options and applications in dentistry for TENS are various, from dental procedures to chronic pain in maxillofacial region such as Trigeminal Neuralgia, Post-herpetic Neuralgia and TMJ syndrome, Xerostomia and Sjörgen`s syndrome up to acute orofacial pain. Saranaya et al. (2019) in 2019. compared TENS and Microcurrent Nerve Stimulation (MENS) in the Management of Masticatory Muscle Pain on 60 patients. Patients with were randomly divided into two groups (A and B) and two subgroups (A1, A2 and B3, B4), based on their VAS scale. Group A patients were given TENS for 20 minutes and group B patients were given MENS for 20 minutes. Each patient was recalled for five days for the treatment, and the same intensity and frequency through the treatment period was maintained. The study showed that both TENS and MENS are equally effective in improving the functional mouth opening, although MENS showed better and immediate effect on pain relief. The side effects such as tingling sensation and paresthesia that occur in some patients using TENS are absent while using microcurrent. Hansson and Ekblom (1983) studied use of TENS on acute orofacial pain in 62 patients using high frequencies (100Hz), low frequencies (2Hz) and placebo TENS. The study included patients who suffered pain for 1-4 days. 38% of patients who received either form of TENS showed over 50% decrease of pain and 10% of patients who received placebo showed more than 50% decrease of pain. Steller et al. (1988) tried to determine whether battery-operated electrical stimulation applied to hard palate and tongue could start salivary flow stimulation on 29 patients with Sjörgen syndrome in a double-blind study. They used the device for 4 weeks, 3 times a days for 3 minutes. The conclusion was that TENS stimulation was successful only in patients with some residual present salivary flow. In post-herpetic neuralgia normal presynaptic inhibition of C fibers doesn`t occur because of the destruction of most of the larger myelinated afferent nerve fibers (Melzack & Wall 1965). That causes pain and abnormal skin sensitivity. The usage of TENS would increase the activity of remaining fibers and reintroduce normal inhibition (Nathan & Wall 1974). Mittal et al. (1998) treated 10 patients who suffered from post-herpetic neuralgia. They used TENS (70Hz) 20 minutes a day for 10 days. The study showed successful results reducing 50% of pain in 60% patients. They concluded that patients who respond better to therapy are patients who had a shorter duration of post-herpetic neuralgia. Most negative behavior in pediatric patients is fear towards needles used in local anesthesia (Stoltz & Manworren 2017, Fiorillo 2019). TENS can be helpful in reducing the fear of syringes. Studies show us that 53-78% children preferred TENS over local anesthesia (Quarnstrom & Libed 1994). Dhinsa et al. (2011) used TENS in comparison to 2% lignocaine in 180 children to reduce pain during pulpotomy, pulpectomy, cavity preparation and extractions. They used Lickert scale, VAS and VPS (Verbal pain scale) to compare effectiveness of TENS and local anesthesia. There was no significant

difference (p>0.05) between TENS and 2% lignocaine although TENS had a positive effect on comfort during the procedure as was reported by patients themselves. Varadharaja et al. (2014) compared TENS to local anesthesia in children undergoing restorative dental procedures in a clinical study. On the right (experiment) side they used TENS and, on the left, (control) side they used local anesthesia. The level of pain and discomfort was measured by VAS scale and heart rate. The results showed that usage of TENS caused less increase in heart rate (0.78%) than local anesthesia (11.78%) and VAS scale showed that minimum pain was felt with TENS but was closely followed by local anesthesia. Conclusion was that TENS can be used as a substitute for local anesthesia in children because of its psychological advantages.

CONCLUSION

TENS can be used as an anxiolytic and mild analgetic during various dental procedures even though it can`t fully replace local anesthesia. It can also be useful for the placebo effect as self administration of the electrical current can cause distraction from procedure being done on the tooth. The assumption is that the amount of electricity self administered by children is not high enough to cause analgesia without causing discomfort to the child.

Acknowledgements: None.

Conflict of interest: None to declare.

Contribution of individual authors:

All authors contributed to writing of this paper equally.

References

1. *Dhindsa A, Pandit IK, Srivastav N, Gugnani N: Comparative evaluation of the effectiveness of electronic dental anaesthesia with 2% lignocaine in various minor pediatric dental procedures: a clinical study. Contemp Clin Dent 2011; 2:27–30*
2. *Dorri M, Martinez-Zapata MJ, Walsh T, Marinho VC, Sheiham Deceased A, Zaror C: Atraumatic restorative treatment versus conventional restorative treatment for managing dental caries. Cochrane Database Syst Rev 2017; 12:CD008072*
3. *Fiorillo L: Conscious Sedation in Dentistry. Medicina (Kaunas) 2019; 55:778*
4. *Hansson P, Ekblom A: Transcutaneous electrical nerve stimulation (TENS) as compared to placebo TENS for the relief of acute oro-facial pain. Pain 1983; 15:157–65*
5. *Kimmey BA, McCall NM, Wooldridge LM, Satterthwaite TD, Corder G: Engaging endogenous opioid circuits in pain affective processes. J Neurosci Res 2020. 10.1002/jnr.24762*
6. *Melzack R, Wall PD: Pain mechanism: a new theory. Science 1965; 150:971–9*
7. *Mendell LM: Constructing and deconstructing the gate theory of pain. Pain 2014; 155:210-216*
8. *Mittal A, Masuria B L, Bajaj P: Transcutaneous electrical nerve stimulation in treatment of post herpetic neuralgia. Indian J Dermatol Venereol Leprol 1998; 64:45–7*
9. *Moayedi M, Davis KD: Theories of pain: from specificity to gate control. J Neurophysiol 2013; 109:5-12*
10. *Nathan PW, Wall PD: Treatment of post-herpetic neuralgia by prolonged electrical stimulation. Br Med J 1974; 3:645–7*
11. *Ogle OE, Mahjoubi G: Local anesthesia: agents, techniques, and complications. Dent Clin North Am 2012; 56:133-48*
12. *Quarnstrom F, Libed EN: Electronic anesthesia versus topical anesthesia for the control of injection pain. Quintessence Int 1994; 25:713–6*
13. *Quarnstrom F: Electronic dental anesthesia. Anesth Prog 1992; 39:162-77*
14. *Reynolds DV: Surgery in the rat during electrical analgesia induced by focal electrical stimulation. Science 1969; 164:444–5*
15. *Saranya B, Ahmed J, Shenoy N, Ongole R, Sujir N, Natarajan S: Comparison of Transcutaneous Electric Nerve Stimulation (TENS) and Microcurrent Nerve Stimulation (MENS) in the Management of Masticatory Muscle Pain: A Comparative Study. Pain Res Manag 2019; 2019:8291624*
16. *Sluka KA, Deacon M, Stibal A, Strissel S, Terpstra A: Spinal blockade of opioid receptors prevents the analgesia produced by TENS in arthritic rats. J Pharmacol Exp Ther 1999; 289:840–6*
17. *Steller M, Chou L, Daniels TE: Electrical stimulation of salivary flow in patients with Sjögren's syndrome. J Dent Res 1988; 67:1334–7*
18. *Stoltz P, Manworren RCB: Comparison of Children's Venipuncture Fear and Pain: Randomized Controlled Trial of EMLA and J-Tip Needleless Injection System. J Pediatr Nurs 2017; 37:91-96*
19. *Sung YT, Wu JS: The Visual Analogue Scale for Rating, Ranking and Paired-Comparison (VAS-RRP): A new technique for psychological measurement. Behav Res Methods 2018; 50:1694-1715*
20. *Varadharaja M, Udhya J, Srinivasan I, Kumar Sivakumar JS, Karthik RS, Manivanan M: Comparative clinical evaluation of transcutaneous electrical nerve stimulator over conventional local anesthesia in children seeking dental procedures: A clinical study. J Pharm Bioallied Sci 2014; 6(Suppl 1):S113-7*
21. *Wright A: Exploring the evidence for using TENS to relieve pain. Nurs Times 2012; 108:20-3*

Correspondence:
Prof. Zoran Karlović, MD
Department of Endodontics and Restorative Dentistry,
School of Dental Medicine, University of Zagreb
Gundulićeva 5, 10 000 Zagreb, Croatia
E-mail: karlovic@sfzg.hr