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Pain management during needle insertion with low level laser

ABSTRACT

Aim *To date, there is no safe, effective, and rapid method to eliminate the pain associated with needle insertion. It is noticed that using a low-energy laser before intradermal and intramuscular injection would help rapid local anaesthesia with a lidocaine product. However, there is no valuable data on the effect of the concomitant use of laser and benzocaine as a pre-treatment option, compared to local application of benzocaine products alone before needle insertion.*

Materials and methods *A prospective single-blind clinical trial was designed to assess pain perception during needle insertion into mucosa in 66 healthy volunteer dental students. They received a topical anaesthetic agent on one side (control) applied for one minute and a topical anaesthetic agent plus low-power laser on the other side (experimental) prior to needle insertion. The first pre-treatment method was chosen based on block randomisation table. A dentist recorded the subjects' reaction based on the visual analogue scale (VAS) during insertion of needle in the two groups. SPSS version 15 was used for data analysis. The statistical significant level was defined at P-value< 0.01.*

Result *The mean scores of VAS for the experimental and control groups was 21± and 19± 2.70 respectively, with a statistically significant higher VAS score in the experimental group, although it was not clinically significant.*

Conclusion *Simultaneous application of laser with local anaesthetic products containing benzocaine in the buccal mucosa before dental needle insertion does not reduce pain perception.*

Keywords *Benzocaine; Dental injection; Local anaesthesia; Low level laser; Pain perception.*

Introduction

Injection of local anaesthetics is one of the most feared and anxiety-producing stimuli in the dental practice [Shapiro et al., 2002]. The needle is a phobia for some [McDonnell-Boudra et al., 2014] and a powerful negative symbol for many children. Eliminating the pain due to needle insertion is extremely important for patients [Kuscu and Akyuz, 2008]. Many methods have been introduced to reduce the pain during injection of the local anaesthetics [Ram and Peretz, 2003; Kreider et al., 2001; Taddio et al., 1994]. Different factors such as needle gauge, anaesthetic temperature, pH of the injection site and type of anaesthetic solution influence the pain perception [Kreider et al., 2001; Kaufman et al., 2005; Ursell and Spalton, 1996].

Some studies supported that the cooling of the injection site might decrease the injection pain [Aminabadi and Farahani, 2009; Ghaderi et al., 2013].

Despite their limited penetration, topical anaesthetics have been shown to reduce the pain in both subcutaneous and intramuscular injections [Taddio et al., 1994]. Attempting to develop better topical anaesthetics for use in dental office settings, these agents should be safe and inexpensive, and have rapid onset of action (10 minutes) [Shapiro et al., 2002; Keating et al., 2012]. It was suggested that Eutectic Mixture of Local Anesthetics EMLA is effective in reducing the pain of both subcutaneous and intramuscular injections [Keating et al., 2012]. In dentistry, it was shown that benzocaine 20% and lidocaine 5% could significantly reduce the pain during needle insertion [Kreider et al., 2001]. However, to achieve a desirable topical anaesthesia, the EMLA cream should cover the skin for approximately one hour, which is impractical [Keating et al., 2012]. Recent studies have reported the effect of different low-level lasers on reduction of pain perception in intradermal

and intramuscular injections [Shapiro et al., 2002; Yun et al., 2002]. Some studies weighted the efficacy of laser in the oral cavity as a method of analgesia and also in emphasising the effect of anaesthesia [Bicakci et al., 2012; de Carvalho et al., 2010]. There have been claims that successful analgesia following oral surgery can be achieved with all major low-level laser therapy (LLLT) wavelengths from 632 nm to 904 nm [Mier y Teran Armida, 1989]. However there is controversy on this issue [de Carvalho et al., 2010; Cunha et al., 2013]. Svensson et al. reported the efficacy of laser argon analgesia on pain reduction [Svensson et al., 1993; Svensson et al., 1992]. However the sample size of their study was too small to be valuable for documentation as an evidence-based result [Svensson et al., 1992].

To date, there is not valuable data on the effect of the simultaneous use of laser and benzocaine on pain perception during injection in oral mucosa. The present study was designed to evaluate the effect of low-power laser on the pain perception of intraoral needle insertion (dental local anaesthesia).

Materials and methods

A total of 66 volunteers (30 female and 36 male) with the mean age of 23.34± 2.16 years, recruited among dental students, participated in a single-blind, clinical trial study employing laser as pretreatment method for the mucobuccal fold for injection above the maxillary canine. After explaining the study procedure, a written informed consent was obtained from all participants before the commencement of the trial. The Committee of Research and Ethics of Shiraz Medical Sciences University approved all the aspects and steps of this research protocol.

Administration of local anaesthetics

The main purpose of the split-mouth design chosen for the study was to remove all issues related to the variances between subjects [Bicakci et al., 2012]. Each subject received both pre-injection techniques – topical anaesthetic gel plus laser on one side (experimental side) and only topical anaesthetic gel on the other side (control side). Half of the participants were randomly assigned to receive topical anaesthetic gel plus laser on one side, and later, only anaesthetic gel on the other side. Others received only anaesthetic gel first, then anaesthetic gel and laser on the other side. The first pre-treatment method was chosen based on block randomization table. On the control side, the buccal mucosa of the maxillary canine area was dried with a cotton roll for 30 sec. and then a topical anaesthetic, Benzocaine gel (Hurricane, Beutlich, USA) was applied for 1 min. The procedure was immediately followed by application of laser device in the off mode for 1 min to simulate a placebo situation, then a short 27-gauge needle (Terumo, Japan) was inserted by a dentist.

Sex	Pre-treatment method Before needle insertion	Mean± SD
Female	Control	19 ±1.53
	Experimental	23± 3.10*
Male	Control	19± 0.98
	Experimental	20±0.88

Data are means ± SD (range) obtained in 30 female and 36 male after needle insertion in both case and control groups. VAS =Visual Analog Scale. * $p < 0.01$

TABLE 1 Mean results of VAS Scale in both groups .

On the experimental side, the buccal mucosa of the maxillary canine area was prepared with the same topical anaesthetic gel followed by laser radiation (Aluminum gallium arsenide; AZERO K2, Russia) for 1 min (energy density of 4 J/cm2, power 100 mil W, continuous wave, wavelength 960 nm) before needle insertion. The dentist recorded the pain perception upon insertion of the needle in both groups based on a 100-mm Visual Analogue Scale (VAS). The VAS scale is broadly employed as a tool for pain perception measurement [Javadinejad et al., 2011; Price et al., 1983; Lee, 2001].

Statistical analysis

Data was analysed using SPSS version 11. Pair t- test, was applied for comparison of the means. Statistical significance was defined at $P<0.01$.

Results

The research comprised 66 dental students.

The mean VAS scores for the experimental and control groups were 21± 2.90 and 19± 2.70 respectively, with a statistically significant higher VAS score in the experimental group, but it was not clinically significant.

The mean VAS score in females was statistically significantly higher in the experimental group more than in the control group (Table 1), but it was not clinically significant.

There was no statistically and clinically significant difference in the VAS score between experimental and control groups in males (Table 1).

Discussion

The results of the current study did not show a positive effect of laser pretreatment on reduction of pain perception upon needle insertion. Many researches, evaluating the laser effect on pain perception, found some improvement in pain control using low level laser

therapy [Aras et al., 2010; Dogan et al., 2010].

Carvalho indicated that the application of laser was not statistically effective on pain reduction due to herpes labial ulcer despite its efficacy on reducing the dimensions of herpes lesions [de Carvalho et al., 2010].

Our study found that laser pretreatment did not decrease pain perception but it actually increased it. Pain perception might be affected by different factors such as gender [Girard-Tremblay et al., 2014; Wiesenfeld-Hallin, 2005], so we evaluated the effect of intervention based on the gender of samples. Data analysis showed that there were statistically significant differences in the effect of laser application on pain perception according to gender. The difference on pain perception reported by males was not statistically significant between the experimental and the control group (power=0.76). which seems satisfactory, though the sample size of this study was determined to assess the laser effects and not the gender effects. However, in females pain perception was much higher in the experimental group, than in the control group, which influenced the final result of the whole experimental group. However data analysis showed that the experimental group reported more pain than controls, the difference was not clinically important (laser pretreatment does not induce more pain than conventional method) (<5 scores) [Lee, 2001]. Different studies reported a range of at least 13-30 mm decrement in VAS score as clinically significant [Lee et al., 2003; Gallagher et al. 2001].

The results show that the female samples affected the overall results more than the male ones. The use of a new medical device may cause anxiety in girls, since it is reported that females have a different attitude in accepting a new medical treatment [van Bon et al., 2010]. The results were affected adversely because the pain experienced by patients is a result of the interaction between emotional experience and other factors. Although small changes in the VAS scale were statistically significant between the control and the study group (based on gender), clinically they were not meaningful as previously described [Lee et al., 2003].

Various studies found laser therapy as an effective method for pain control in many cases [Shapiro et al., 2002; Yun et al., 2002; Emanet et al., 2010; Ide, 2014]. Some studies reported the benefit of applying Er: YAG laser in pain reduction caused by subcutaneous as well as intramuscular needle insertion [Shapiro et al., 2002; Yun et al., 2002]. The differences resulted in the above mentioned studies compared with the present study may be related to a different kind of laser used. It seems that gallium-arsenide (GaAs) and gallium-aluminum-arsenide lasers reduce pain and improve the health status in chronic joint disorders when they are employed repeatedly and continuously [Ide, 2014; Dogan et al., 2010; Emanet et al., 2010; Gur et al., 2004]. Sousa et al. [2003] reported a positive effect of the gallium-arsenide laser on healing of pathologic alterations induced by Bothrops moojeni snake venom in mice [Aranha de Sousa et al., 2013]. The effects of gallium-aluminum-arsenide are not completely clear [Yun et al., 2002]. Some researchers reported that LLLT reduces the pain or improves the healing process of the tissue [Cavalcanti et al., 2011; Shapiro et al., 2002]. LLLT decreases the pain of intradermal injection due to its ability to remove the stratum corneum; hence, it is used topically and can penetrate the skin very fast [Shapiro et al., 2002; Cavalcanti et al., 2011]. This energy in the oral mucosa may adversely affect the outer layer; so the higher VAS score reported in the laser group in our study may be due to the lack of the stratum corneum in the oral mucosa.

The literature often provides conflicting results and treatment protocols are not always comparable since there are a large number of parameters in the application of LLLT including treatment dosage, wavelength, irradiance, contact or noncontact application, exposure time, tissue type, physiological condition and optical properties of the tissue [Aras et al., 2010; Verma et al., 2012; He et al., 2014; Dogan et al., 2010] .

Conclusion

The current study showed that the gallium-aluminum-arsenide laser was not effective in decreasing pain perception due to needle insertion into the maxillary buccal mucosa. Assessment of different kinds of lasers as pretreatment method before oral injection is recommended for future studies.

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