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Conventional method versus automatic injection for infiltration anesthesia in the premolar region

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ABSTRACT

Introduction: Pain control by local anesthesia plays a critical role in success of most dental treatments. Due to the unpleasant pain experience related to the use ofthe conventional syringe injection, some computerized techniques have been developed for local anesthetic injection. This study aimed to compare the pain score following infiltration anesthesia of the maxillary premolar teeth administered by the conventional syringe and automatic.

Materials and Methods: This single-bind randomized clinical trial was performed on 35 patients whose average age was 38. Requiring bilateral extraction of maxillary premolars. The patients' dental anxiety was scored and they received infiltration anesthesia with the iCT injection SE (Dentium, South Korea) at one side and conventional syringe at the contralateral side. The pain level was recorded during needle insertion, anesthetic delivery and 5 hours after the injection using visual analog scale (VAS) and the face rating scale (FRS). The data were subjected to Wilcoxon signed-rank test.

Results: Significant differences were found between the automatic and conventional methods regarding pain scores duringneedle insertion ($P<0.01$) and anesthetic delivery ($P<0.0001$) while no significant differences were notedat 5 hours after the injection. Pain scores were significantly lower during supra-periosteal injections in the maxillary premolar region using iCT injection.

Conclusion: Both FRS and VAS in iCT injection showed that frequency of severe pain during needle insertion and anesthetic delivery was noticeably lower than that in conventional injection method but findings revealed that there was no significant difference between these two technics after 5 hours of injection.

Keywords: Pain scores, Automatic injection, Infiltration anesthesia.

Introduction

Pain control by local anesthesia plays a critical role in success of most dental treatments [1]. Dental fear and anxiety is a common finding among patientsand part of this fear and anxiety is related to anesthetic injection. Local anesthesia administration is an important step in provision of dental procedures and plays an important role in success of dental treatments [1].

Mechanical trauma as the result of needle insertion, injection of anesthetic agent into the tissue and extraction of needle often cause pain [2]. The dosage of anesthetic agent should be determined based on the type of treatment and should not be too high to damage the tissue [2].

Infiltration anesthesia is the preferred method of anesthesia for the maxillary teeth. This technique is not associated with any adverse effect due to local anesthetic injection and does not numb the lips or tongue. Moreover, it is easy to performand fast actingand has a localized effect. Both sides of the maxilla can be operated on within one session by administration of infiltration anesthesia. This saves time and greatly decreases the patient's stress and anxiety [3,4].

Automatic injection systems as an alternative to conventional syringe injection are easy to useand decrease the level of pain and anxiety experienced by patients during anesthetic injection [5]. This novel modality has revolutionized dental anesthesia since it greatly decreases dental fear and stress experienced by patients [6]. In this method, microprocessors automatically control the flow rate and volumeof the anesthetic agent to keep itlower than the threshold of stimulation ofthe pain receptors [5,6]. Some previous studies have shown that use of automatic injection systems is easier than the conventional syringe injection andthey have higher efficacy for pain control and decrease the stress and anxiety of patients; whereas, some others did not show any advantage in use of automatic systems and preferred theconventionalsyringe method [7].

The efficacy of local anesthesia for pain control and dental fear and anxiety of patients associated with anesthetic injection are among the everyday challenges faced by clinicians. Several formulations of anesthetic agents, injection techniques and devices have been proposed to enhance local anesthesia administration. Success of local anesthesia depends on administration of safe dosage of anesthetic agent, proper use of injection devices, and decreasing the level of stress experienced by patients during anesthetic injection [8-11]. This study aimed to compare pain control following infiltration anesthesia of maxillary premolar using the conventional syringe and automatic methods.

Materials and Methods

This single blind, split-mouth, randomizedcontrolled clinical trial was performed according to the principles outlined by the Declaration of Helsinki. The study was independently reviewed and approved by the Ethical Board of the Prosthodontics Department of Tehran University of Medical Sciences. All procedures and materials were approved by the local ethical committee of Tehran University of Medical Sciences code IR.TUMS.REC.1394.359. All patients were briefed about the procedure and willingly signed informed consent forms.

Sample size was calculated to be 35 in each group according to a study by Singh et al, [12] assuminga=0.05, b=0.2, standard variation of 15 units and minimum difference of 10 units,using Minitab software. The dropout probability was estimated to be 10%.

Thirty-fivepatients who were candidates for bilateral extraction of their maxillary premolars were chosen. Patientshad no systemic disease and their average age was 38 years. The patients' anxiety level was also scored using a questionnaire, which contained four 5-point Likert-scale questions. The maximum score was 20 andscores between 9-12 indicated moderate stress, scores 13 and 14 indicated severe stress andscores over 15 indicated very severe stress.

Allocation of infiltration injection technique (iCT or conventional) to the side of maxilla was done by flipping a coin (Fig. 1). Next, pain during injection, pain during anesthetic delivery, and pain at 5 hoursafter the injection was recorded. The patients were blindfolded and a sound proofed instrument was inserted into their ear so that they were not aware of the allocated technique to each side. Bothinjectionswas performed in one session. The gauge of needle used in conventional technique was 27.

The pain intensity was determined using the Heft-Parker visual analogue scale (VAS), which is a 170 cm line. Different signs through the line show different levels of pain intensity (Fig. 2). In the face rating scale (FRS), 6 images were used to express the pain intensity (Fig. 3). Patients were thoroughly instructed on how to express their level of pain using FRS/VAS.

Figure 1. iCT injection system.

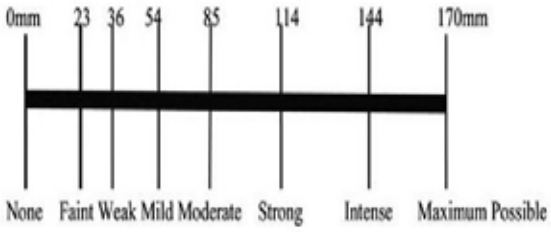

Figure 2: Heft-Parker visual analog scale.

Figure 3. Wong-Baker Faces pain rating scale.

Statistical Analysis

SPSS version 21.0 was used to analyze the data. The number and percentage of patients with different degrees of pain based on both VAS and FRS at the time of needle insertion, anesthetic delivery, and at 5 hours post-injection were reported. Wilcoxon signed-rank test was applied to compare the conventional syringe injection and the iCT system based on FRS-VAS at the three time points (P=0.05).

Results

A total of 18 females (51.4 %) and 17 males (48/6%) participated in this study. Comparison of frequency distribution of pain levels when needle is inserted in the conventional syringe method with iCT method according to FRS and VAS criterion was shown in Chart 1 and 2. Comparison of frequency distribution of pain levels during anesthetic delivery in the conventional syringe method with iCT method according to FRS and VAS criterion was shown in Chart 3 and 4. Comparison of frequency distribution of pain levels 5 hours post anesthetic injection in the conventional syringe method with iCT method according to FRS and VAS criterion was shown in Chart 5 and 6.

Based on the results of Wilcoxon signed-rank test, there was a significant difference in pain scores between the iCT system and the conventional method according to the FRS during needle insertion (P<0.01) and anes the tic delivery (P<0.0001) but no significant difference was noted at 5 hours after the injection (P=0.15). Also, a significant change in level of pain was noted according to the VAS during needle insertion (P<0.03) and anesthetic delivery (P<0.0001) but no significant difference was noted at 5 hours after the injection in the two methods (P=0.57).

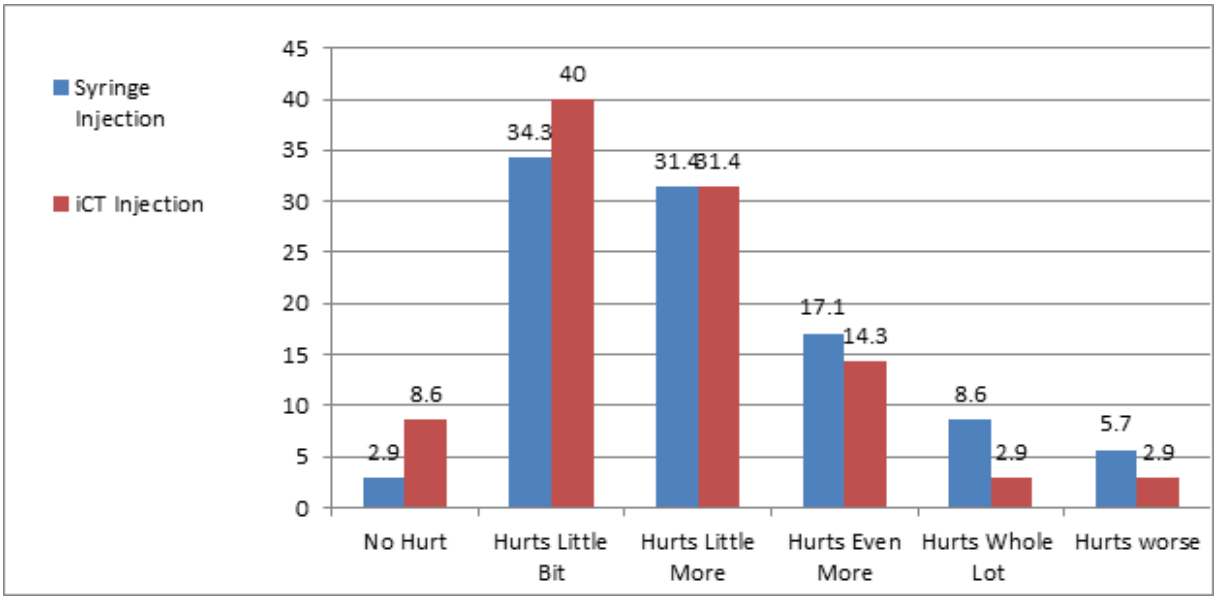

Chart 1. Comparison of frequency distribution of pain levels according to FRS criterion when needle is inserted in the conventionalsyringe method with iCT method.

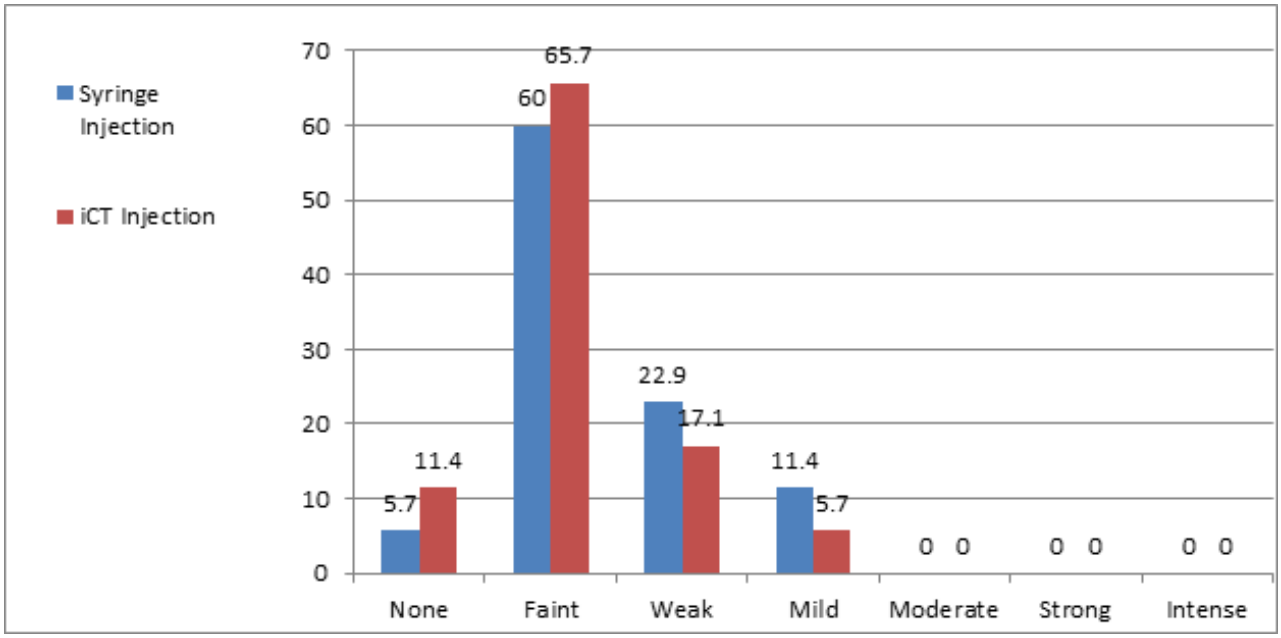

Chart 2. Comparison of frequency distribution of pain levels according to VAS criterion when needle is inserted in the conventionalsyringe method with iCT method.

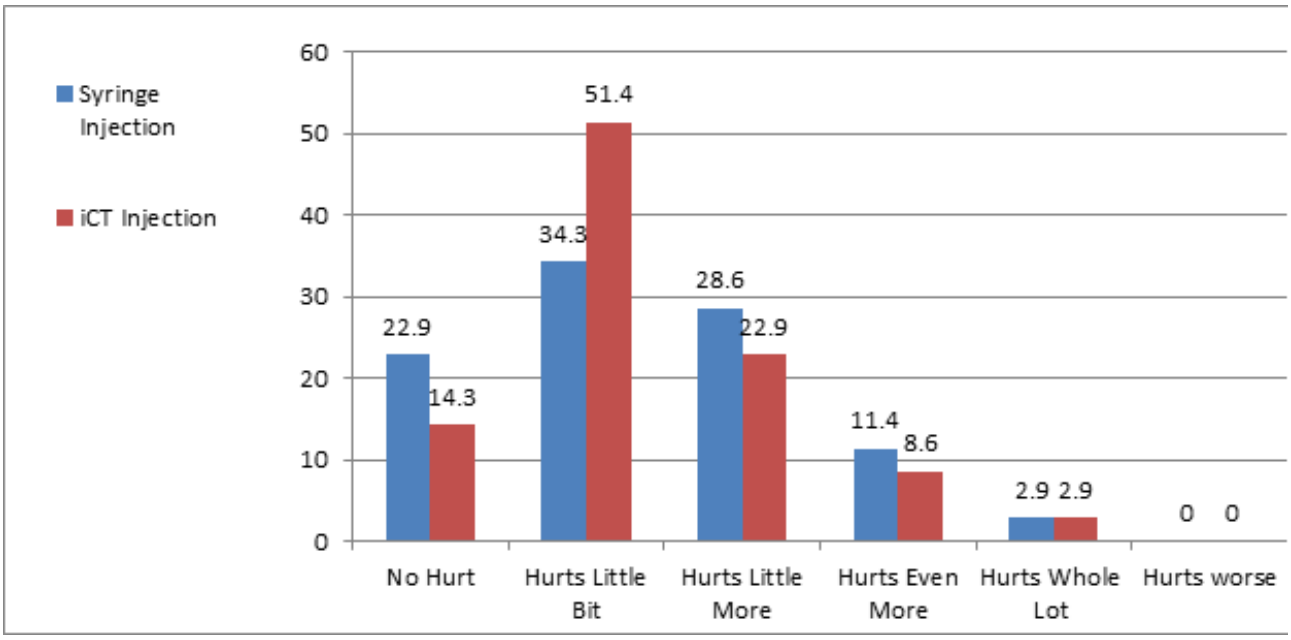

Chart 3. Comparison of frequency distribution of pain levels according to FRS criterion during anesthetic delivery in the conventionalsyringe method with iCT method.

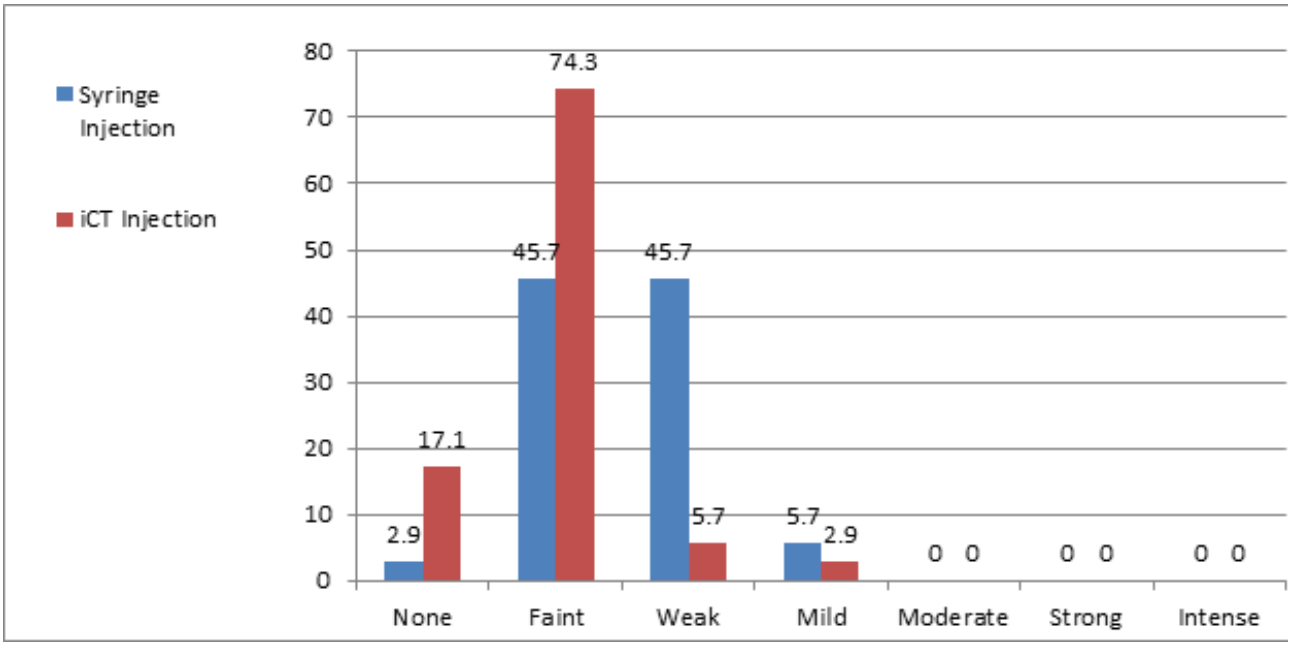

Chart 4. Comparison of frequency distribution of pain levels according to VAS criterion during anesthetic delivery in the conventional syringe method with iCT method.

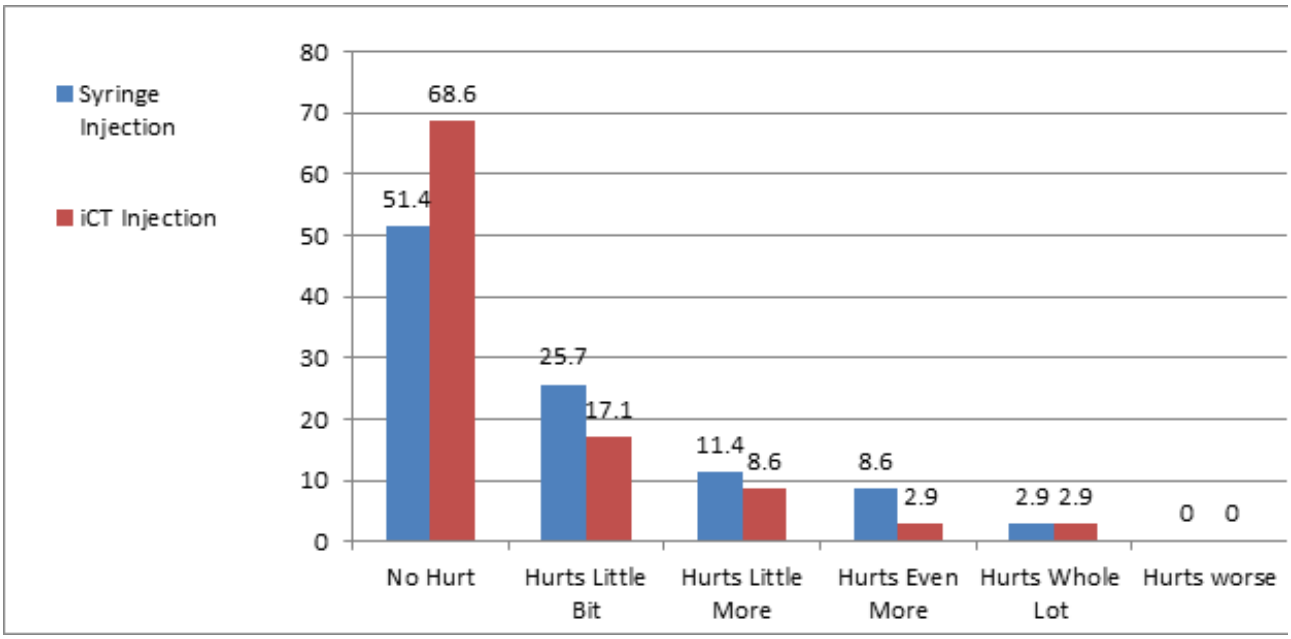

Chart 5. Comparison of frequency distribution of pain levels according to FRS criterion 5 hours post anesthetic injection in the conventional syringe method with iCT method.

Discussion

Based on the results of this study, the frequency of severe pain according to both FRS and VAS in iCT injection system during needle insertion and anesthetic delivery was significantly lower than that in the conventional injection method but no significant difference was noted between the two methods at 5 hours after the injection. According to this finding, patients experience lower level of pain in use of iCT injection system. The Wand injection system has also been evaluated in some previous studies but researchers found no significant difference between the conventional syringe injection and Wand automatic system [13,14].

Instudies by Asarchetal, in 1999 [13] and Koyuturketal, in 2009 [14], no significant difference was noted between the computerized and the traditional method. However, their methodology was different from ours since our study had a split-mouth design and thus, we controlled forthe effects of most confounders on the results. Langth asaet al, in 2012 [15] reported significantly less pain in the computerized method compared to the conventional method. Their study also had a split-mouth design and they determined the level of pain using FRS and VAS, which was similar to our methodology.

In a study by San Martin-Lopez et al, in 2005, the level of pain was compared in the conventional and Wand system using the same scales and they reported results similar to ours. Their study was conducted on children and also had a split-mouth design [16]. Palm et al, in 2004 reported that the inferior alveolar nerve block via the automatic system was less painful in comparison with the manual method [17]. Their study similar to ourshad asplit-mouth design and VAS was used to assess the level of pain. Their results were also in agreement with ours. Sumer et al, in 2006 measured the pain level in the conventional and Wand system using VAS and reportedless pain in the automatic system [18]. Yesilyurt et al, in 2008 used automatic Wand system for inferior alveolar nerve block and reported that this system caused less pain and yielded higher patient satisfaction; thus, they suggested the automatic system for dental anesthesia [19]. Tahmassebi et al, in 2009 found no significant difference in stress or pain levelsbetween the automatic and manual systems, which was in contrast to the results of the current study. This difference in the results may be due to the inaccurate monitoring of pain or stress levels by the researchers [20]. On the other hand, Shah et al, in 2012 used the same methodology on a smaller sample size and reported the same results as ours; although they compared the Wand system with the conventional syringe method [21].

Singh and Gargin 2013 compared the conventional syringe injection and automatic system for upper periosteal injections. They used Anaeject automatic system and reported that this system caused less pain during needle insertion. Their results regarding the level of pain during distribution of anes the tic agent were in line with ours. Similarly, they used VAS (Heft Parker) for assessment of level of pain and their study had a split-mouth design as ours. Their sample size was larger than ours (about 90 patients) [22].

During administration of local anesthesia, pain is felt first upon needle insertion. This pain is sharp and short. Next, the sensory receptors of painare stimulated upon release of anesthetic agent (chemical stimulation) and traumatization of the adjacent tissues; this pain lasts longer [23]. It has been reported that gentle insertion of needle and slow release of anesthetic agent decrease the level of pain experienced [4]. Prioschand Brooks in 2002 reported that slow distribution of anesthetic agent decreased the level of pain experienced by patients [24].

Automatic injection systems including the iCT injection systemslowly distribute the anesthetic agent in a controlled manner. Thus, the pain experienced by patients is often less. The iCT injection system has different features such as 3 different flow rates for controlled release of anesthetic agent (250,120 and 50 in 1.8 mm), anaudio warning alarm system and a display monitor for injection status and control of flow rate. On the other hand, several factors affect the level of pain experienced during injection such as fear, stress and previous painful experiences of injection [25]. Since previous painful injection experiences cause stress, pain evaluation would be harder in these patients. The DAS questionnaire designed by Corahin 1969 [26] was used in our study to assess the level of stress in patients. In this study, the stress of patients was divided into two categories of actual and sensationalized stress.

Pain perception is a subjective matter and a lot of physical and psychological factors can affect pain perception. Thus, the stress level of patients should be assessed before the anesthetic injection. According to Corah, low level of stress clinically was correlated to less pain and vice versa. Also, reporting of the level of pain is difficult and may be associated with some errors. Providing patients with detailed and thorough information about the VAS can increase the reliability

of this method for pain evaluation [26,27]. In the present study, the Heft Parker VAS was used to increase the reliability of results reported by patients [28]. On the other hand, in FRS some images are shown to patients so that they can express their level of pain. This method was introduced in 1984 for dental purposes and has an acceptably high reliability. It contains 6 images starting with a very smiley face to a crying face. In the current study, both FRS and VAS were used to increase the accuracy of results. Since some patients may misinterpret theimages, use of both methods can increase the reliability of results [29].

The iCT automatic injection system has some drawbacks such are high cost. Grace et al, in 2003 [3] reported that both the conventional and automated systems gained the same level of acceptance among patients and clinicians. Thus, dentists are free to use either method and may prefer the conventional method considering the high cost of the automatic system. Use ofautomatic iCT injection SE system significantly decreased the level of pain in patients who were candidates for extraction of maxillary premolar teeth in our study. Also, there were no reports of severe or highly severe pain in the iCT method based on the VAS evaluation system.

Conclusion

Controlling pain by local anesthesia is very important in success of most dental treatments. some computerized techniques have been developed for local anesthetic injection in order to reduce the pain experienced by patients. Both FRS and VAS in iCT injection showed that frequency of severe pain during needle insertion and anesthetic delivery was noticeably lower than that in conventional injection method but findings revealed that there was no significant difference between these two technics after 5 hours of injection.

Conflict of Interest

There is no conflict of Interest to declare.

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