Received: 24 May 2016 **Accepted: 11 Sep. 2016**

Comparing pain and pain-related behavior in children with invented telescopic dental needles

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Original Article

Abstract

BACKGROUND AND AIM: Pain control is an important part of pediatric dentistry. The purpose of this study was to evaluate pain and behavioral reaction who receive an injection with conventional and telescopic dental needles.

METHODS: A total of 50 healthy children aged 4-8 years were included to this study to get a dental injection with the telescopic or the conventional dental needles. Two observers scored videos of children at the time of injection procedures based on sound, eye, motor (SEM) scale and distress reaction to evaluate the observed pain-related behavior. Children completed a face version of visual analog scale (VAS) after injection. Reliability of observer's opinion evaluated and was established at 96%. Independent t-test and chi-square tests were used for statistical analysis. Statistical significance was defined at $P < 0.0500$.

RESULTS: This study was conducted among 23 girls and 27 boys with mean age 5.3 ± 1.4. The pain scores according to VAS for the telescopic, and the conventional dental needles were 40.20 ± 10.50 and 56.40 ± 14.63, respectively, which was statistically significant between the two groups ($P = 0.0001$). The difference of SEM values for the telescopic and the conventional groups were statistically significant in totals as well as individual parameters ($P = 0.0001$). According to mean distress scores, patients showed less muscle tension, less verbal protest and less movement when receiving the telescopic needles ($P < 0.0500$).

CONCLUSION: Telescopic dental needles with the ability of using topical anesthesia before needle insertion and covering needle sight out of patient's eyes may be a good intervention to reduce pain and anxiety of children during dental injection.

KEYWORDS: Pain; Anxiety; Injection; Dentistry

Citation: Habib-Agahi R, Gandjalikhan-Nassab SA, Hashemipour MA, Saidi AR, Eskandarizadeh A. **Comparing pain and pain-related behavior in children with invented telescopic dental needles.** J Oral Health Oral Epidemiol 2017; 6(1): 33-9.

Dental treatment under anesthesia is usually associated with pain and anxiety. Pain is a multifactorial event.[1] Various physical and psychological factors control the relationship between pain and pain agent.[2,3] It seems that there is a close relation between pain and anxiety during dental injection, anxious patients show more pain perception and duration.[4,5] The previous study on Dutch children showed that 14% of 4-11 years old children were anxious about dental treatment and injection were the most fear factor.[6,7] Milgrom et al.[8] considers general anxiety of injections, including pain and fear of injury, to be the main aspects of dental injection. Fear of needles in 19% of children aged 4-6 years has been found significantly.[9]

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Children's dental anxiety prevents them from dental clinic and causes abnormal behavior of children in the future that may lead to avoidance of treatment and irregular attendance in adulthood.[10-13] Painless injection is effective in reducing pain and anxiety and increase patient cooperation and trust between doctor and patient and lead to comfortable admission of next treatment.[12,13]

Dentists have developed their skills to reach almost painless injections and to deliver more comfortable local anesthesia before starting the dental procedure.[13]

Although treatment under anesthesia scientifically acceptable, it always associated with risk of death[5] also treatment under general anesthesia is not financially affordable for minor dental.[14] New invented telescopic dental needle, based on its special design that covers the needle's appearance out of patient's eyes and the ability of using topical anesthesia at the site of injection, would control pain during various pediatric dental procedures. Therefore, the purpose of this study was to evaluate the effectiveness of telescopic dental needle for the first time in reducing pain and anxiety and compare it with the conventional dental needle during pediatric dental procedures.

$$n = \frac{Z^2 \times P(1-P)}{d^2}$$

Methods

This study was conducted among 50 healthy children aged from 4 to 8 years [n = sample size, = Z value (e.g., 1.96 for 95% confidence level)], P = Percentage picking a choice, expressed as decimal (20% used for this study), d = Confidence interval (CI), expressed as decimal (2% used for this study)], who visited a private Dental Clinic in Kerman, Iran, in a period of 3-month, were included in the randomization process. Parental consent from was taken from patients before treatment. Ethical code was obtained from the Ethics Committee of Kerman University of Medical Sciences, under number of IR.Kmu.rec.1394.312. This clinical study with registration number of Iranian Registry of Clinical Trials (IRCT) IRCT 2015113025300N1 had recorded to IRCT site. Only patients with no previous experience of dental injection were included to the study. They all required dental restorative of posterior maxillary teeth under local anesthesia. Children who could be able to complete the face version of visual analog scale (VAS), no allergy to lidocaine or other anesthetic agents, no suspected or known developmental delay, free from any systemic diseases were included to the study. Extremely anxious children had excluded from the study. Parents of the children were informed that two special anesthetic injection devices were being studied: (1) a conventional syringe with a standard needle and (2) a conventional syringe with a recently new design telescopic coated dental needle (patent number 85929).

Dentist explained the anesthesia procedure similarly for both techniques, and the dentist announced local anesthesia as a dental hypnotic juice to all the children. Each child was randomly based on a randomization list assigned to either the telescopic system or the conventional injection condition. The end result was two groups of 25 children each. Each patient participated only once in the study. Both injections were given in essentially the same manner by one experienced dentist, at the same environment regarding light and temperature. In the case of the telescopic coated needles, an anesthetic cartridge was placed in syringe. The telescopic cover tubing was covering the needle (Figure 1). A sterile cotton pellet saturated in topical anesthetic gel (20% benzocaine topical anesthetic gel (Topex™, Sultan, New York, USA), connected to the head of the telescopic cover (Figure 1, a). In the telescopic coated dental needles, injection was initiated by contact of sterile cotton pellet to the soft tissue of injection site for 60 seconds. Once the target area of injection was reached, needle aspiration was performed by the usual thumb backpressure. After negative blood aspiration, injection was applied, and children were

carefully monitored for the signs of adverse sensation. Injection phase was continued for about 60 seconds until depletion of the contents of the anesthetic cartridge. In the telescopic needle group because of its new design dentist had the ability of using topical anesthetic gel with the telescopic cover at the same time of needle insertion, but in the conventional group, topical gel had to use previously and separately before needle insertion. All injections were administered in approximately 90-120 seconds.

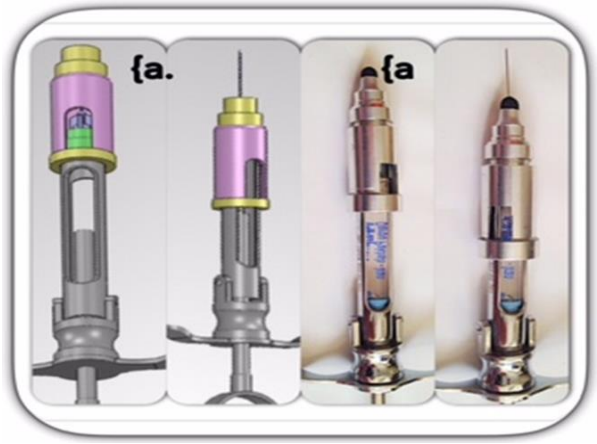

Figure 1. New invented telescopic coated dental needles (a: Topical anesthetic gel place)

The anterior middle superior alveolar injection had used for all children in two groups. 2% lidocaine with 1:100000 epinephrine (Schein, New York, USA), and 27-gauge short dental needles (Monoject, Sherwood Medical, St. Louis, MO, USA) were used in this study.

We used standard video to memorize the injection phases of treatment. The videotaped of injection period was analyzed by two independent observers (a psychologist and a last year dental student), who were trained to analyze video of children who were not included in the study. Intra-rater reliability was established at 96%. Children's reaction during injection evaluated according to the: Sound, eye, motor (SEM) scale: which were evaluated patient's pain, anxiety, and pain-related behavior. Each category scored ranged from 0 (comfort) to 3 (sever discomfort). Total score was range from 0 to 9. A lower score indicates less and higher score indicates more severe physical reaction to the injection (Table 1). Two independent observers analyzed children's reaction based on their videotape during injection period.

VAS: After the dental injection, the child was asked to point out on the face version of VAS according to his or her level of pain. Six faces, presenting different levels of pain/distress, were presented parallel to the scale. The scale included of 11 points on a scale of 0 (pain-free) to 10 (unbearable pain) (Figure 2).

Distress: Because the behavioral response of children in dentistry is a mixture of anxiety and pain, and these two concepts are difficult to separate, distress behavior was evaluated as well. Distress behavior can be defined as an occurrence of emotions felt or behavior displayed, during dental treatment, which is caused by factors like pain and anxiety. The distress behavior was measured using Venham's anxiety and cooperative behavior during three phases of injection (anticipation, first 30 seconds interval, and second 30 seconds interval). The scale consists of 6 points: [1] 1: relaxed, 2: uneasy, 3: tense, 4: reluctant, 5: resistant, and 6: out of contact or untreatable.

Table 1. Sound, eye, motor (SEM) scale for assessment of children behavior

Parameter	0	1	2	3
	Comfort	Mild discomfort	Moderate discomfort	Severe discomfort
Sound	No sound	Nonspecific sound	Verbal complaint, raise voice	Verbal complaint, shouting, crying
Eye	No sign	Eyes wide, show of concern, no tears	Tears, sudden eye movements	Crying, tears covering the face
Motor	Relaxed body and hand status	Hands show some distress, muscular tension	Sudden body and hand movements	Hand movement for defense, pulling head away

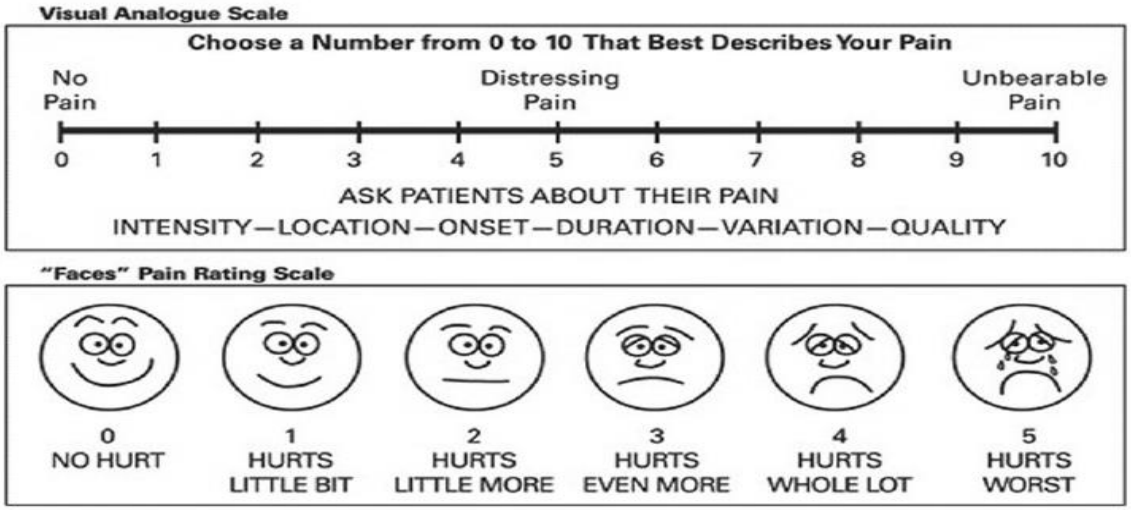

Figure 2. Visual analog scale (VAS) for assessment of children's pain perception

The treatment procedures summarized step by step in flow diagram of the study (Figure 3). T-test was used for self-reported pain (VAS) and the different pain-related behaviors based on SEM scale. Distress scores on the Venham rating scale for the anticipation phase, and for the first and the second interval, were analyzed using a multivariate general linear model. Statistical significance was defined at $P < 0.0500$.

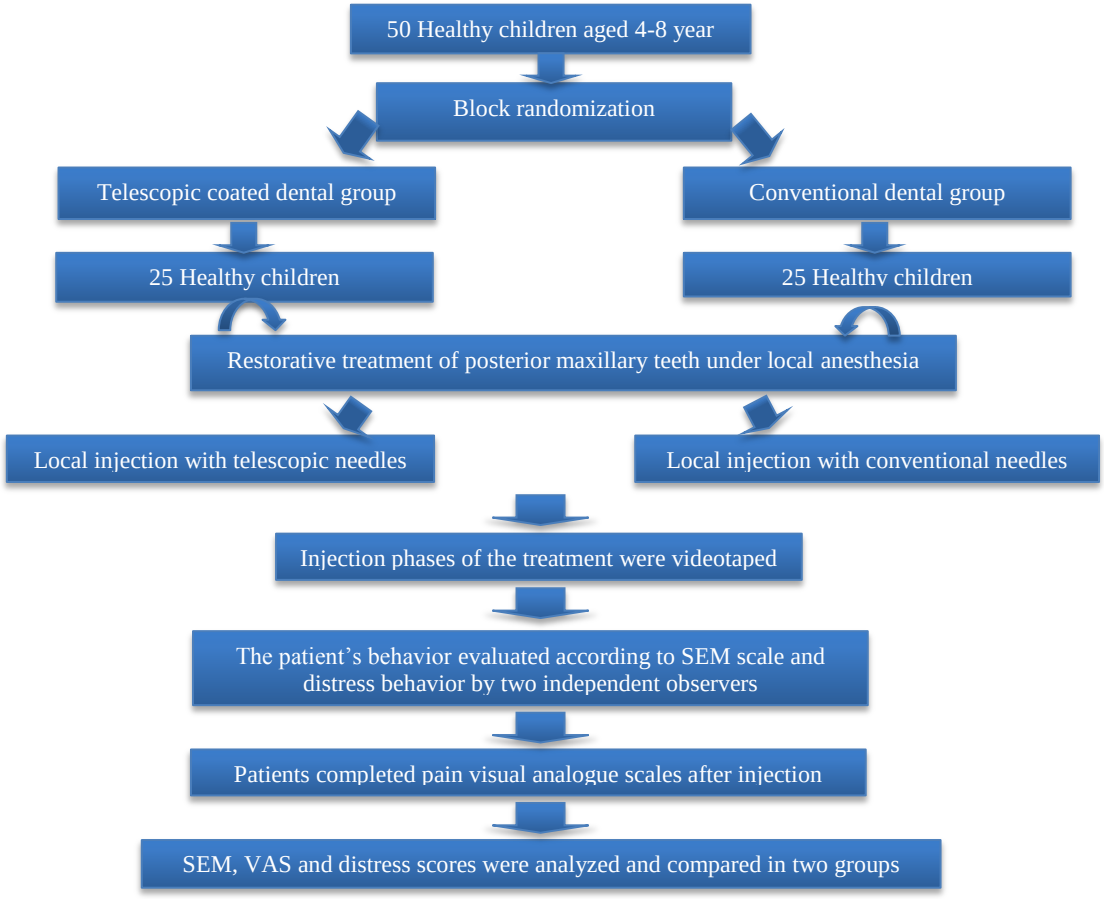

Figure 3. Flow diagram of the study

SEM: Sound, eye, motor; VAS: Visual analog scale

Table 2. Sound, eye, motor (SEM) scores among two injection methods

Parameter	Conventional (mean ± SD)	Telescopic (mean ± SD)	P*
Sound	1.80 ± 0.75	1.40 ± 0.61	< 0.0010
Eye	1.75 ± 0.65	1.31 ± 0.48	< 0.0010
Movement	1.73 ± 0.66	1.24 ± 0.58	< 0.0010
Total	5.40 ± 1.72	4.05 ± 1.34	< 0.0010

*Significant difference between the two groups (P < 0.0500), SD: Standard deviation

Results

This study was conducted among 50 children (23 girls and the rest of them were boys) aged 4-8 years (mean age 5.3 ± 1.4). The two experimental groups were equal regarding age and gender. Children did not have any previous dental experiences. Table 2 indicated the SEM scores for the telescopic and the conventional needle injections. The means of SEM values for the telescopic, and the conventional groups were significantly different in totals as well as sound, eye and motor parameters individually (P = 0.0001).

The VAS mean value for the telescopic needle was 40.20 ± 10.50 (range: 0-100) and for the conventional needle was 56.40 ± 14.63 (range: 0-100), respectively, with statistically significant lower VAS scores in the telescopic group (P = 0.0001).

Significant differences were found relating to the distress response of the children between the different injection techniques during three injection phases (Table 3).

Discussion

New invented telescopic dental needles showed lower pain and anxiety during injection and children felt more comfortable when telescopic dental needle was used. Pain control is an essential part of dental treatment.[15,16] The objective anxiety of children association to needle prick have a wide range, from seeing needle to the pain of needle insertion.[17] We had used VAS which is a reliable factor to analyze the pain of injection.[18] Children's behavioral reaction is a mixture of anxiety and pain specially during dental treatment and because these two concepts are difficult to separate and[19] it was also decided to use valid and reliable method of distress behavior.[21,29] SEM scale was used to evaluate patient's pain, anxiety, and pain-related behavior.[22] We used SEM scale and distress behavior next to the VAS, since based on the previous study in some 4-5 years old children the cognitive level is not yet sufficiently developed to understand the pain VAS scale.[19]

Dental injection is the only part of dental procedures that pedodontist cannot use tell, show, do technique about it.[23] In the conventional technique, the dentist covered children's eyes so they did not see the needle during injection. Seeing the needle during injection conditions creates fear in children and may change his/her reaction to the covering children's eyes caused the reaction of children and provoked their anxiety.[2] In the telescopic needle, because of its new design that covers the needle's appearance, dentist had the opportunity to show the syringe which was similar to marker and explained to the children that we are going to color your teeth, so there was no need to cover the children's eyes, and that caused more cooperation of children.

The pain response of children receiving a local anesthesia injection with the telescopic

Table 3. Mean distress scores for the conventional and the telescopic methods of injection

Injection phase	Injection method		
	Conventional [mean (95% CI)]	Telescopic [mean (95% CI)]	P*
Anticipation	1.15 (0.85-1.45)	0.60 (0.30-0.90)	0.0400
First 30 seconds interval	1.54 (1.23-1.85)	0.85 (0.55-1.15)	0.0030
Second 30 seconds interval	1.56 (1.25-1.86)	0.91 (0.63-1.20)	0.0020

*Significant difference between the two groups (P < 0.0500), CI: Confidence interval

coated injection in comparison with the conventional method was more positive, as they showed less body movement, less muscle tension, and less verbal protest. One reason was due to the ability of using topical anesthetic gel with telescopic needles. Local anesthetic gel blocks terminal fiber of sensory neurons, so could change pain realization and pain response of a patient.[24-27] Since we had used topical anesthetic gel in both groups, so the reason of lower injection pain in the telescopic groups could be related to lower patient's anxiety in the telescopic groups due to its new design that covers the needle from patient's eyes during injection time and also duration of injection period. The injection time with the telescopic needles was a little bit longer than of the conventional method, which was due to the use of topical anesthetic gel at the same time of injection period in the telescopic group. In the conventional technique, we had used topical anesthetic gel previously before needle insertion, so dentist had to speed up the injection time in some anxious patients to finish the injection period as soon as possible.[28] The telescopic coated dental needles by providing less stress and anxiety in patients, it gave the dentist the ability to deliver the solution slowly, and it would be anticipated that they provide a comfortable injection.

Telescopic needle has got certain limitations as well: Some highly anxious children are already highly sensitive and distressed when entering the treatment room and it seems that the pain related behavior is not influenced by the type of injection method.[29] To positively change the anxiety threshold of these highly anxious children during the anticipatory part of the treatment, more treatment sessions or treatment under hypnotic situation are probably needed.[30] Since the telescopic system had larger size than conventional syringe, in some children who had smaller mouth, dentist had problem to fit the telescopic needle in children's mouth, which need to work on product procedures to be able to make it in compact size to be more convenience for patients and dentist. The long-term benefit may involve reduction of dental anxiety, admission to future treatments and development of proper behavior toward oral health.[31]

Conclusion

However, not all children seem to benefit equally from the use of the telescopic system, it seems that low-anxious and even some high-anxious children with no previous dental experience have the most positive reaction, which makes the telescopic needle a useful system in normal practice instead of expensive and high-risk procedures like general anesthesia. Further studies are required for the telescopic needles with an improved structure more suitable for dentist and patient's application and also use of this new invention in another site of the mouth and different anesthesia techniques other than buccal infiltration before its routine use in dentistry.

Conflict of Interests

Authors have no conflict of interest.

Acknowledgments

Authors would like to acknowledge Kerman Dental and Oral Diseases Research Center, Kerman University of Medical Sciences, for their financial support and also our appreciation goes to Mr.Hamed Mirzazadeh and Dr. Pouya Azari for their cooperation during this study.

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