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Single tooth anaesthesia: a new approach to the paediatric patient. A clinical experimental study

ABSTRACT

Aim The objective of this study is to assess the efficacy of the STA Wand System with respect to pain and fear reduction in paediatric patients and by using the Single Tooth Anaesthesia (STA) technique.

Methods Patients included children and teenagers between 6 and 17 years of age, who required the administration of local anaesthesia prior to expected treatments. Local anaesthesia was performed by means of the electronic STA Wand System (Milestone scientific, Inc.) adopting the Single Tooth Anaesthesia (STA) technique. Pre- and post-anaesthesia, the patients were asked to complete the Wong-Baker faces image scale and the provider filled in the Frankl Scale.

Results All treatments were completed successfully and no collaboration issues were recorded. Frankl's assessment showed that 91% of patients regarded dental experience positively. The efficacy of the computer-assisted anaesthesia was at 100% when treating primary teeth, and 70% for procedures on permanent teeth. Almost the totality of treated patients (94%) gave a positive evaluation after having tried the device with STA technique. Only 6% of the patients assessed the procedure negatively.

Conclusions The STA technique allows for absence of anticipatory anxiety, absence of physical pain, no anaesthetic effects in the perioral tissues and a controllable, lower dosage of the anaesthetic liquid.

Keywords Fear; Single tooth anaesthesia; Pain.

Introduction

The fear of receiving dental care is widespread across the whole population and it concerns all age ranges. However, its very beginning and development can be traced back to the paediatric and adolescent age [Porrirt J et al., 2012; Cianetti et al., 2017]. Epidemiological studies show that around 30-40 million people in the US have dentist phobia and tend to avoid dental treatment. Additionally, about 90% of respondents experience a great degree of anxiety when receiving local anaesthesia [Gibson et al., 2000]. Globally, the so-called odontophobia (i.e. fear of dentistry) can reach figures between 6% and 15% among adults [Scarpelli et al., 2009], whereas in Europe, fear levels in both children and teenagers vary between 3–21%.

With regards to paediatric dentistry, the level of patient cooperation plays a pivotal role for successful treatment. In order to obtain collaboration, it is necessary to gain the patient's trust and become familiar with the child, limiting painful treatments as much as possible and adopting techniques to manage fear and anxiety, feelings which are highly common in young patients [AAPD, 2016]. Local anaesthesia is the most fear-striking and pain-provoking therapeutic phase for adults, even more so for children [Ran et al., 2003]. Fear and pain are strictly interrelated. Indeed, if on one hand the patient is scared of suffering pain, on the other hand, the anticipatory anxiety alters the psychological component of pain, eventually resulting into an increased pain perception [Armfield et al., 2013]. The extent of perceived discomfort is enhanced by the sight of the syringe, as well as the anticipation of the pain which will stem from the injection itself.

The conventional local anaesthesia, which has been commonly used for over 100 years with the aim of removing procedural distress, in actual fact proves painful. The physical pain resulting from the injection is caused by the piercing of the needle itself, but, to a greater extent, by the speed at which the anaesthetic is introduced inside the tissues [Ghaderi, 2016; Hochman et al., 1997; Yenisey et al., 2009; van Wijk et al., 2009; Kudo, 2005].

Several methods have been tested to prevent distress during the administration of conventional local anaesthesia.

- Dental topical anesthetics (spray or gel) are applied to the mucosa 5 minutes before injection; they can

operate on the surface by controlling the sting-related sensation, but do not have any effect on the pressure of the liquid inside the tissues.

- Reduction of injection speed, which can not always be managed, especially with regards to high-resistance tissues, such as the palate and the periodontal ligament [Ram et al., 2003; Allen et al., 2002].
- Distraction techniques [Porritt et al., 2012; Gupta et al., 2014; Zamagni et al., 2008].

While the mentioned options may reduce the levels of pain, they do not solve the root of the issue. In 2006, an electronic controlled release delivering device was introduced in the market with the purpose of delivering an entirely, or almost completely painless local anaesthesia [Hochman, 2007; Elbay et al., 2015]. This device allows for both traditional and innovative anaesthesia techniques (P-ASA, AMSA e STA).

The objective of this study is to assess the efficacy of the device with respect to pain and fear reduction in paediatric patients by means of Single Tooth Anesthesia (STA) technique.

Materials and methods

Selection of patients

The participants were selected among those referring for their first visit at the Pediatric Dentistry Clinic of the Department of Oral and Maxillofacial Surgery of the University of Modena and Reggio Emilia (Modena, Italy).

Patients included children and teenagers between 6 and 17 years, who required the administration of local anaesthesia prior to dental treatment (restorative or endodontic therapies or extractions). From the sample of patients, subjects with serious systemic diseases or under treatment with medications that could have altered the pain assessment were excluded.

Procedure

The parents of each participant were informed beforehand about the methodology and procedure and signed an informed consent form before taking part in the clinical study.

Local anaesthesia was performed by means of the electronic STA Wand System (Milestone scientific., Inc.), adopting the Single Tooth Anesthesia (STA) technique, following the manufacturer's suggested protocol, without applying any kind of topical anaesthetic or sedation.

The STA technique utilises an extra-short, 30 gauge needle. The dull bevel of the needle is placed towards the tooth and is inserted in the gingival sulcus, parallel to the long axis of the tooth. There is one distal point of insertion for single-rooted teeth, whereas multiple-rooted teeth allow for two points, distal and mesial, through vestibular anaesthesia (upper teeth) or in the lingual area (lower teeth). If necessary, a third area of injection is possible for multi-rooted teeth and is located at the center of labial



FIG. 1 The Wong-Baker Faces Image Scale.

face for the lower teeth, and in the palate central portion for the upper teeth.

Mepivacaine 1.8 ml vials with 1:100.000 adrenalin were used for each injection: specifically, 1/8 of the vial was used for deciduous teeth, and 1/4 of the vial was injected in the case of permanent teeth.

In order to achieve effective outcomes a good level of anaesthesia, the needle has to be pushed through the tissue until the periodontal ligament is reached. This depth is indicated by the yellow/green led lights on the device [Hochman, 2007; Lackey et al., 1998]. After anaesthesia, the planned treatment was performed.

Only one dentist administered both anaesthesia and treatment.

Assessment method

Pre- and post-anaesthesia the patients were asked their current mood and feelings by using the Wong-Baker Faces Image Scale Wong, 1998], indicating which image was the most representative. This scale enlists 6 facial expressions associated with a numeric value (Fig. 1):

- 0 very good,
- 2 good,
- 4 quite good,
- 6 quite bad,
- 8 bad,
- 10 very bad.

After anaesthesia administration, the provider filled in the Frankl Scale [Frankl et al., 1962] in order to assess the level of patients' collaboration.

The Frankl Scale comprises 4 items (from 1 to 4) which correspond to a description of the patient's behaviour.

1. The patient shows a definitely negative attitude, refuses treatment, cries and is scared.
2. Negative attitude: the patient does not collaborate, struggles to accept the treatment and shows signs of sudden withdrawal.
3. The patients present a positive behaviour, he/she accepts the treatment and follows the instructions cooperatively.
4. The patient shows a definite positive behaviour: he/she has a good interaction with the operator, is interested in the procedure and amused by the situation.

Data collection and analysis

Data were collected in an Excel file and analysed: personal data of participants (name, age, gender), type

of treatment, area in which anaesthesia was performed, pre- and post- anaesthesia FIS assessments, Frankl Scale evaluations and participants' record of past administrations of anaesthesia.

Results

The study sample was composed by 66 paediatric patients (Table 1), including 36 males and 30 females aged between 6 and 17 years.

A total of 46 deciduous teeth (16 upper and 30 lower) and 20 permanent ones (6 upper e 14 lower) were treated: 24 conservative treatments were implemented (12 for deciduous teeth and 12 for permanent teeth), as well as 6 endodontic treatments (4 on deciduous teeth, 2 in permanent ones); finally, 36 extractions were performed (30 deciduous, 6 permanent teeth).

All treatments were completed successfully and no collaboration issues were recorded. The efficacy of the computer-assisted anaesthesia was 100% for deciduous teeth, and at 70% for permanent teeth.

In 6 cases, it was necessary an additional infiltration or nerve block through the electrical device, due to patients' pain sensitivity during the procedure. In any case, effectiveness of the device was not related to the type of treatment performed. As a matter of fact, the 6 unsuccessful cases regarded both restorative and endodontic therapy, as well as one extraction.

The FIS assessments (pre- and post-anaesthesia) were related to several variables: gender, tooth (i.e. primary, permanent), type of treatment (restorative, endodontic, extraction) and history of anaesthetic experiences (no past experiences, past STA or conventional anaesthesia).

No significant differences based on gender were found during the FIS assessment (pre- and post- anaesthesia).

The best results from the FIS assessments (pre- and post-anaesthesia) were achieved with extraction of deciduous teeth. Overall, 94% of patients gave a post-anaesthesia FIS scoring between 0 and 4 (where 0 corresponds to Very good, 2 = Good, and 4 = Quite good). Only 6% of the respondents selected ranges between 6 and 8 (6 = Quite bad, 8 = Bad). No respondent gave a score of 10, which corresponds to "Very bad" (Table 2).

When compared to the post-anaesthesia FIS evaluation, the pre-anaesthesia outcomes showed 48% positive scorings, 21% equal ??? and 30% negative.

Frankl's assessment showed that 91% of patients experienced the dental treatment positively, 67% scored it 3 while 24% scored it 4; only 9% had negative experience (Table 3).

Discussion

Since the computer-assisted anesthetic device was introduced in the market, not many studies on paediatric

patients have been undertaken and/or published. Among these cases, only few tested the device by using the STA technique.

Ram e Peretz [2003] studied the STA compared to the conventional infiltration, vestibular and palatal anaesthesia in patients aged 2 to 4 years. The outcomes of their studies show an increased collaboration thanks to STA, and proved that STA is as effective as traditional anaesthesia.

Ashkenazi et al. [2005] experimented STA, and obtained an efficient anaesthesia with no increased post-operative pain.

Ashkenazi et al. [2006] tested the Wand device by using both the STA techniques and the palatal, and vestibular infiltration anaesthesia. They reported a 86% efficacy, no differences between the first and second molar teeth, and low levels of pain and discomfort.

Ram e Kassirer [2006] analysed both the STA and P-ASA techniques in comparison to the conventional infiltration

Variables	Total patients	STA efficacy %	SUM of fis assessments Pre-STA	SUM of fis assessments Post-STA
Gender				
Male	36	94%	92	60
Female	30	87%	72	40
Type of tooth				
Deciduous	46	100%	108	52
Permanent	20	70%	56	44
Type of treatment				
Conservative	24	92%	52	52
Endodontic	6	67%	8	16
Extractions	36	94%	104	32
History of previous anaesthesia administration				
Conventional anaesthesia	34		84	48
No history of dental anaesthesia	26		64	52
STA	6		8	0

TABLE 1

	FIS (Wong-Baker Faces Image Scale)		
	Score 0-4	Score 6-8	Score 10
Pre-STA assessments	88%	12%	0%
Post-STA assessments	94%	6%	0%

TABLE 2

FRANKL			
Score 1	Score 2	Score 3	Score 4
0	6	44	16
0%	9%	67%	24%

TABLE 3

anesthesia for paediatric patients aged 1-2 years. For both techniques, they did not detect any stress signals which are common with the infiltration anesthesia. Additionally, their study showed that the great efficacy of the Wand was comparable with conventional anesthesia.

Versloot [2005] tested the STA technique and the conventional nerve block anaesthesia in the mandible and observed that less anxious children showed an improved behaviour, whereas there were no significant differences among anxious patients.

As explained, this study as well as past cases on the use of the computer-assisted device in paediatric patients employed various anaesthesia techniques and different assessment methods. However, all cases demonstrated highly positive results. All therapies were completed successfully with no collaboration issues.

Almost all the treated patients (94%) gave a positive evaluation after having tried the device with the STA technique. Only 6% described the procedure negatively.

The best results were obtained for extraction of deciduous teeth. This can be due to the fact that the anticipatory anxiety is greater in younger patients (who have deciduous teeth) and in the case of more traumatic treatments (i.e. extractions).

Conclusion

In brief, the advantages of the STA techniques are the following.

- Absence of anticipatory anxiety, thanks to the needle support design, which is similar to a pen and can be easily hidden in the operator's fingers.
- Absence of pain, due to the injection speed which is below patients' pain threshold.
- Overall efficacy of the anesthesia, which is comparable with the conventional local anaesthesia.
- No anesthetic effects in the perioral tissues (lips, tongue, cheeks) which eliminate the issues related to biting and temporary alterations of the facial mimic.
- Controllable, lower dosage of the anaesthetic liquid.
- No damages to the crown of permanent teeth, which are below deciduous teeth.

The results achieved by this experimental case study were highly positive and we maintain that further detailed studies should be undertaken on the matter

It would be interesting to continue this line of research by comparing this anaesthesiological technique with other innovative techniques.

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