



Effectiveness of thaumaturgic distraction in alleviation of anxiety in 4–6-year-old children during inferior alveolar nerve block administration: a randomized controlled trial

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Background: Dental anxiety is a matter of serious concern to pediatric dentists as it may impede the efficient delivery of dental care. If not adequately resolved, a persistent negative response pattern may emerge. Thaumaturgy, commonly known as magic trick, has become popular recently. It is a tool that distracts and relaxes the child by using magic trick while the dentist performs necessary treatment. Hence, the aim of this study was to evaluate the effectiveness of Thaumaturgic aid in alleviation of anxiety in 4–6 – year-old children during administration of local anesthesia using the inferior alveolar nerve block (IANB) technique.

Methods: Thirty children aged between 4–6 years with dental anxiety requiring IANB were included in this study. Patients were divided equally into two groups: Group I, thaumaturgic aid group and Group II, conventional non-pharmacological group using randomization. Anxiety was measured before and after using the intervention with Raghavendra Madhuri Sujata-Pictorial scale (RMS-PS), Venham's anxiety rating scale, and pulse rate. All the data were tabulated and compared using statistical analysis.

Results: Children in thaumaturgy group (Group- I) exhibited significantly lower anxiety during IANB in comparison with children in the conventional group (Group- II) and the difference was statistically significant.

Conclusion: Magic tricks are effective in reducing anxiety among young children during IANB; Moreover, it expands the arsenal of behavior guidance techniques for treatment of children with anxiety and plays an important role in shaping the behavior of a child in pediatric dentistry.

Keywords: Children; Distraction; Inferior Alveolar Nerve; Magic Tricks; Nerve Block; Pain.



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INTRODUCTION

A child's co-operation and positive behavior is one of the key factors for improving long term success of any dental treatment. Child's disruptive behavior resulting from dental anxiety and fear negatively restricts the

child's access to quality dental care and can also increase risk of iatrogenic injury. Studies suggests that the prevalence of dental anxiety among children ranges from 23.9% – 52% and it is more prevalent in preschool (36.5%) and school children (25.8%) than in adolescents (13.3%) [1,2]. Dental anxiety not only affects the behavior of the child in the dental setting but also the

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oral health related quality of life [3]. According to various studies, children with dental anxiety are more affected by dental caries than the other children [3-5]. Dental anxiety affects the oral health of the child [6]. Anxiety also affects the pain perception. Fear of pain is a specific anxiety that the child patient frequently displays. A large component of psychological pain perception depends on the sum of attention aimed towards the noxious stimulus modulating the pain [7-10]. Resultantly, strategies for alleviation dental anxiety remains the cornerstone of pediatric dentistry.

According to psycho-behavioral findings, local anesthesia administration is found to be one of the most frightening and anxiety provoking procedure in young children [11]. Ram and Peretz [12] in 2002 stated that local anesthesia and its synergistic effect with dental anxiety leads to negative attitude towards dental care in spite of effective action of local anesthesia. This highlights the importance of alleviation of anxiety during local anesthesia procedure.

Given the need to reduce anxiety in children, many techniques have been explored and used effectively. Distraction technique is one such anxiety reducing strategy that utilizes the limited attention capacity of the child, to divert their attentiveness from unpleasant procedures. Distraction techniques are classified as active or passive. Active techniques ensure direct engagement of the child in the activity, like while playing games and toys. Passive techniques rely on the aids not requiring the child's direct participation [13].

Thaumaturgy, commonly known as magic trick, alleviates the anxiety by reducing the perception of unpleasantness. It was found to be useful in patients with psychological issues to enhance self confidence in the patients [14]. Frankenfield [14] used it to decrease anxiety in pediatric oncology patients while administering injections. It was also used in pediatric wards by Fischer et al. [14] and found it be effective. Magic tricks not only relaxes the child but also builds a friendly rapport between the child and dentist. Moreover, there is an active involvement of a child while using thaumaturgic aids,

such as thumb and light trick, as the child gets involved in the activity by trying to catch the light and keeps on wondering about the reason behind the trick, thus, allowing the dentist to perform the procedure.

Peretz and Gluck [15] were the first to use magic trick as a behavior management technique in pediatric dentistry for taking radiographs and believed that cognitive development plays an important role in effectiveness of thaumaturgic aid. However, there is a dearth of studies on the use of magic trick in reducing anxiety during local anesthesia administration in children. Moreover, there is a scarcity of data evaluating its effectiveness in highly anxious young children.

To the best of our knowledge, no study reporting the association between reduction of anxiety during administration of inferior alveolar nerve block (IANB) in children younger than 6 years and magic tricks exists in literature.

Therefore, the present study was undertaken to evaluate the effectiveness of thaumaturgic aid in 4-6 -year - old children during administration of local anesthesia during IANB administration.

METHODS

Protocol and Registration: The study received ethical committee approved from an appropriate institutional review board (registration number DYPDCH/IEC/164/153/20). Although the study is not a randomized controlled trial, we have applied for provisional registration in Clinical trial registry India (CTRI) REF/2022/12/061533.

Study design and population: This in-vivo comparative study was conducted in the out-patient department of a tertiary care hospital setting. Children aged 4-6 years without any past dental treatment experience requiring dental treatment under IANB were provisionally enrolled in the study. The study was carried out for a period of 12 months (2021 to 2022). Children with underlying medical condition, extreme disruptive behavior, and any



Fig. 1. Thumb sleeves with batteries

acute pain or swelling were excluded from the study. Child's baseline fear and anxiety was recorded using Children's Fear Survey Schedule -Dental Subscale scale (CFSS-DS). Children with a score of 38 and above (anxious children) were finally included in the study [16]. Considering power as 80%, 0.6 as a standard deviation, and 0.5 as error, the sample size was calculated to be 30. Patients enrolled in the study were sequentially numbered based on their outpatient number and were randomly equally divided into following two groups using randomizer software: Group I, thaumaturgic aid group (Fig. 1 & 2) and Group II, conventional non-pharmacological group (communicative management with euphemisms).

Study Parameters: Raghavendra, Madhuri, Sujata Pictorial Scale (RMS-PS) -is a subjective scale developed as a modification of facial image scale for Indian population (Fig. 3). This scale was used for evaluation of all children by asking each patient to point out to the face they related the most with themselves at that moment [17]. Venham's anxiety and behavior rating scale -was recorded by a trained operator, who was blinded to the type of intervention used. This scale assesses a child's anxiety and uncooperative behavior in the dental setting. It consists of five behavioral categories scored from 0 to 5, where higher score indicates greater level of anxiety or lack of cooperation [18]. Pulse rate was used as a physiological parameter and measured in all patients using pulse oximeter [19].

Data Collection: During the first appointment, a thorough



Fig. 2. Inferior alveolar nerve block with thaumaturgic aid

clinical and radiographic evaluation was performed. Patients fulfilling the inclusion criteria were provisionally enrolled for the study. Parents were informed about the purpose of the study and those willing to participate were finally included in the study. The included patients were randomly divided into two groups Group I: Thaumaturgic aid group and Group II: Conventional non-pharmacological group. In the second appointment anxiety was measured prior to beginning the procedure using the study parameters i.e., RMS-PS scale, Venham's anxiety rating scale, and pulse rate. Thaumaturgic aid consisted of two skin colored thumb sleeves with an internal battery operated lightening device. Thumb and light trick along with conventional non-pharmacological behavior management techniques were performed for the study group using these sleeves by trained first and second operator. Various creative hand movements were performed with the help of thumb sleeves, which was worn on the thumb of the operator and could be activated and deactivated at the operator's will. Both the operators manipulated the light by passing it from



Fig. 3. Raghavendra Madhuri Sujata pictorial scale

one hand to the other by releasing the pressure from the batteries of the left thumb and applying it to that of the right thumb. Along with this the operators also created an illusion of manipulation of light in the patient's oral cavity. When second operator was distracting the child with the magic trick, the first operator applied topical anesthesia (20% Benzocaine Mucopain[®]) on the injection site and administered local anesthesia with Conventional Halstead IANB technique. All the operator procedure was done by the same person. In the control group, conventional non-pharmacological behavior management techniques were used without thaumaturgic aid and local anesthesia was administered using conventional technique. Subjective symptoms in the lower lip were checked to verify the success of the administered IANB. In case of failure in achieving anesthesia IANB was re-administered. The anxiety was measured again using RMS-PS scale, Venham's anxiety rating scale, and measuring pulse rate after local anesthesia administration. All data were recorded and tabulated and results were statistically analyzed using paired t test and unpaired t test in IBM SPSS software

2021. e P-values less than 0.05 were considered statistically significant.

RESULTS

A total of 30 children were included in the study, 15 were girls and 15 were boys. Evaluation of the baseline data i.e., before using the intervention revealed a non-significant mean difference of 1.9 (t: -1.323 and P-value: 0.196) between the pulse rate between Groups I and II. Moreover, the mean difference between Venham's anxiety rating scale and RMS-PS scale between both the groups was -0.1 (t: -0.224 and P-value: 0.825) and -0.3 (t: -1.213 and p-value: 0.235), respectively. In Group I the mean difference in the pulse rate, Venham's anxiety rating scale and RMS-PS scale at baseline and after administration of IANB, was 17.9 (t: 9.183 and p-value: < 0.001), 1.8 (t: 10.311 and P-value: < 0.001), 2.3 (t: 14.642 and P-value: < 0.001), respectively. Thus, the results showed a statistically

Table 1. Table showing the mean difference between the pulse rate, Venham's anxiety rating scale, and Raghavendra Madhuri Sujata-Pictorial scale (RMS-PS) scale at baseline

	Group	Mean	Std. Deviation	Mean Difference	t	P value
Pulse rate	1.00	119.9	4.4	-1.9	-1.3	0.2
	2.00	121.8	3.6			
Venham's anxiety rating scale	1.00	2	0.8	-0.1	-0.2	0.8
	2.00	2	0.8			
RMS-PS Scale	1.00	3.7	0.8	-0.3	-1.2	0.2
	2.00	4	0.7			

Table 2. Table showing the mean difference between the pulse rate, Venham's anxiety rating scale, and Raghavendra Madhuri Sujata-Pictorial scale (RMS-PS) scale before and after the administration of inferior alveolar nerve block in Group I

		Mean	Standard. Deviation	Mean Difference	t	P value
Pair 1	Pulse rate at baseline	121.8	3.6	17.9	9.2	< 0.001
	Pulse rate after the intervention	103.9	9.4			
Pair 2	Venham's anxiety rating scale at baseline	2.1	0.8	1.8	10.3	< 0.001
	Venham's anxiety rating scale after the intervention	0.3	0.5			
Pair 3	RMS- PS Scale at baseline	4.1	0.7	2.3	14.6	< 0.001
	RMS- PS Scale after intervention	1.7	0.7			

Table 3. Table showing the mean difference between the pulse rate, Venham's anxiety rating scale and Raghavendra Madhuri Sujata-Pictorial scale (RMS-PS) scale before and after the administration of inferior alveolar nerve block in Group II

		Mean	SD	Mean Difference	t	P value
Pair 1	Pulse rate at baseline	119.9	4.4	7.3	4.1	0.001
	Pulse rate after the intervention	112.6	9.8			
Pair 2	Venham's anxiety rating scale at baseline	2.1	0.8	0.5	1.9	0.072
	Venham's anxiety rating scale after Intervention	1.5	1.4			
Pair 3	RMS-PS Scale at baseline	3.7	0.8	0.7	2.6	0.019
	RMS-PS Scale after Intervention	3.1	1.3			

significant decrease in anxiety levels in Group I. In Group II the mean difference between the pulse rate, Venham's anxiety rating scale, and RMS-PS scale before and after IANB was 7.3 (t: 4.084 and p-value: 0.001), 0.5 (t: 1.948 and P-value: 0.72), 0.7 (t: 2.646 and p-value: 0.019), respectively. There was statistically significant decrease in anxiety levels in the control group with regards to the pulse rate and RMS-PS scale while the difference with regards to Venham's anxiety rating scale was non-significant. On intergroup comparison after the administration of IANB, the mean difference between the pulse rate, Venham's anxiety rating scale, and RMS-PS scale was 8.7 (t: 2.482 and p-value: 0.019), 1.2 (t: 3.225 and p-value: 0.03), 1.3 (t: 3.536 and P-value: 0.01), respectively. Anxiety reduction in group I during IANB

administration was found to be more when compared with group II and the mean difference on intergroup comparison was found to be statistically significant (Table 1-4).

DISCUSSION

Behavior guidance tools help to alleviate dental anxiety and instill a positive attitude towards dental treatment in children. It also provides children with appropriate coping strategies, which in turn improves the behavior of the child in dental setting. According to a review done by Smari [20] in 2018, children are more anxious because of the fear of unknown people, different olfactory stimuli

Table 4. Table showing the comparison of mean difference between the pulse rate, Venham's anxiety rating scale, and Raghavendra Madhuri Sujata-Pictorial scale (RMS-PS) scale after the administration of inferior alveolar nerve block (IANB)

	Group	Mean	Standard Deviation	Mean Difference	t	P value
Pulse rate	1.00	112.6	9.8	8.7	2.5	0.019
	2.00	103.9	9.4			
Venham's anxiety rating scale	1.00	1.5	1.4	1.2	3.2	0.003
	2.00	0.3	0.5			
RMS-PS Scale	1.00	3.1	1.3	1.3	3.5	0.001
	2.00	1.7	0.7			

encountered in dental clinics, dental instruments and their noises and the fear and anxiety in children is more pronounced with procedures requiring injections. Thus, achieving local anesthesia in anxious children comes under critical aspect of dental care as it not only affects behavior but also the outcome of dental treatment. Moreover, administration of local anesthesia in young anxious children poses a greater challenge for a pediatric dentist.

Undoubtedly, IANB administration is one of the most painful injections for young children due to multiple factors, such as young age of the child, fear of needles, and anatomical differences in the location for injection of IANB in comparison to adult counterparts. Distraction is one of the most efficient methods in managing anxiety in young children. Thaumaturgy as a distraction method has been shown to decrease anxiety during dental related procedures in children. Studies have evaluated the use of magic tricks in managing anxiety in children during less invasive dental procedures.

One study has evaluated the use of magic trick in reduction of anxiety related to local anesthesia administration in children aged 2–13 years [15,21-22]. The results of this study showed that there was significant decrease in anxiety during administration of IANB with use of thumb light trick in anxious 4-6 – year- old children when compared to those in the control group. CFSS-DS parental version was used in the present study to categorize anxious children. Previous research have concluded that this scale is an accurate and reliable method of predicting dental fear and anxiety in children. Anxious children with CFSS-DS score more than 38 were included in the present study [16]. This also eliminated

the bias occurring in the results due to different preoperative anxiety levels among children.

Similarly in a study by Peretz and Gluck, magic tricks appeared to be superior to tell-show-do in strong willed children. Magic- trick facilitated the movement of the child into the dental chair and allowed the dentist take radiographs more easily in the magic book trick group than the tell-show-do group [15]. Konde et al. [20] in 2020 evaluated different magic tricks like thumb and light trick, book trick, and item elimination trick in different age groups between 2-13 years. They found that thumb and light and book tricks were effective in reducing anxiety in 2–6-year-olds during local anesthesia while book and item elimination trick was effective in children above 6 years of age.

These results were in accordance with that of our study, which showed that thumb and light trick significantly reduced anxiety in 4–6-year-old children. This group belongs to pre-operational stage of cognitive development. In this age group logical thinking is not completely developed; hence, children cannot recognize the mechanism behind the trick. Instead, they consider the appearing and disappearing of light as a magical phenomenon and keep wondering about the trick, which distracts them from the needle penetration and administration of local anesthesia.

Magic tricks directly works on the right hemisphere of the brain, which is attributed to non-verbal skills, such as art, music, emotions and most importantly imagination. This imagination and lack of logical thinking in young children plays a major role during the use of thaumaturgic techniques. A reason for this could be that the right hemisphere of the brain is more developed in children

of this age group. Hence, this trick instills a cooperative behavior in the children and reduced anxiety among 4-6 year old children. In the study performed by Ashokan et al. [21] in 2020, by evaluating the readiness to sit on the dental chair they found that magic tricks and tell-show-do were equally effective as mobile games in reducing the anxiety levels before oral prophylaxis in children in the age group of 4-5 years.

In the present study we evaluated anxiety using psychometric and physiological methods, unlike the previous studies. Psychometric methods included in this study were subjective as well as objective. Pre-operative and postoperative anxiety were measured using RMS-PS scale subjectively. This scale was considered better than Facial index scale and Venham's pictorial test by Shetty et al. [17] (2015) as children could identify themselves better with original color photographs when compared to black and white and cartoon figures used in other scales. Moreover, this scale has separate photographs for girls and boys in order to expand its acceptability among both the sexes.

For the objective method of anxiety assessment we used Venham's anxiety and behavior rating scale. This scale is not dependent on child's perception of his/her own anxiety level. Instead, a blind operator can assess the anxiety levels according to criteria given in the scale. Hence, the reliability of this scale is found to be better [18]. In the present study, we used pulse rate as a physiological tool for assessing anxiety as it is affected by the nervous system, especially the autonomic nervous system that expresses negative emotions in terms of increase in heart rate [19].

The use of magic trick facilitates a positive bond between the operator and the child unlike in the audio-visual distractions such as mobile game apps. In today's era children are already excessively exposed to digital screen. Additionally, lack of social interaction because of limitation on outdoor activities aids in increasing the fear of unknown people. In such situation it is important for a dentist to develop a friendly rapport and communication with a child, which can be achieved

by live magic tricks instead of the videos or mobile games. This makes magic trick, an alternative digital screen and limits the use of screen in dental set up.

We have specifically included children in the age groups 4-6 years to include patients which fall in the pre-operative intuitive stage in psychological theories. The child in this age group has a high imaginary capacity, which can be redirected for successful distraction especially with the use of magic tricks as a modality.

The only limitation of our study was the small sample size; however, the sample size was calculated from the data acquired from previous studies. More studies with children in diverse age with increased sample size can improve the generalizability of the findings.

In conclusion, within the limitations of our study, we found that the use of magic tricks was effective in reducing anxiety associated with IANB in young children. Using magic or thaumaturgy as a distraction modality in children, especially in invasive dental procedures, reduces the amount of perceived distress resulting in anxiety related behavior in young children. The magnitude of the benefit may vary from child to child. Thus, magic distraction is a low-cost intervention that has no risk to the patient and has a measurable benefit.

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