Section A-Research paper

ISSN 2063-5346

ARTICLE CATEGORY: Original Research.

PROGRESSIVE MUSCLE RELAXATION: A TOOL FOR ANXIOLYSIS IN PEDIATRIC DENTISTRY

AUTHOR NAMES – Divya priyal S[a] * Daya Srinivasan [b] Senthil Eagappan A R[c]

[a]. Postgraduate student, Department of Pediatric and preventive dentistry, Chettinad dental college and research institute, Chennai, India, Postcode - 603103; email address – divya.siva05@gmail.com ; ORCid - https://orcid.org/0000-0002-3721-7903 .

[b]. Professor and Head, Department of Pediatric and preventive dentistry, Chettinad dental college and research institute, Chennai, India, Postcode - 603103; email address – dayaswathi@gmail.com ; ORCid - https://orcid.org/0000-0001-5453-4380

[c]. Professor, Department of Pediatric and preventive dentistry, Chettinad dental college and research institute, Chennai, India, Postcode - 603103; email address – dr.eaga_ars@yahoo.com; ORCid - https://orcid.org/0000-0003-2933-6272

*Corresponding Author: divya.siva05@gmail.com

RUNNING TITLE - PROGRESSIVE MUSCLE RELAXATION: A TOOL FOR ANXIOLYSIS IN PEDIATRIC DENTISTRY

We declare that this manuscript is original, has not been published before, and is not currently being considered for publication elsewhere.

ABSTRACT:

Anxiety about dental treatment prevents the patients from receiving adequate dental care. Children feel more anxious about the dental treatment than adults. The change in behaviour of children affects the treatment quality due to compromised cooperation towards dental treatment. Anxiety can be reduced by both pharmacological and non-pharmacological behaviour management techniques. Relaxation techniques are considered to be patient-compliant and cost effective non-pharmacological method for reducing anxiety of the patients. Progressive muscle relaxation [PMR] is a relaxation technique that involves contraction and relaxation of different muscle group in order to reduce stress of the patients. Behaviour, heart rate and oxygen saturation levels are affected with increased anxiety. The present study evaluated the effectiveness of PMR in reduction of anxiety among 6–10-year-old children undergoing pulp therapy under local anesthesia. The anxiety levels and behaviour of the patients were determined based on the modified dental anxiety scale and frankel's behaviour rating respectively. Pulse oximeter was used to determine the heart rate and oxygen saturation levels. The results showed significant decrease in anxiety and heart rate in patients under PMR group. Also, children under PMR group exhibited positive attitude towards treatment than the control group. PMR can be

Section A-Research paper

ISSN 2063-5346

effectively used as a behaviour management technique for anxious children in dental environment.

KEYWORDS: Progressive muscle relaxation, Relaxation techniques, Behaviour management, Dental anxiety, Pulp therapy.

INTRODUCTION:

Dental anxiety is an irrational fear associated with dental settings. Children and adults have varied tolerating capacities, temperaments, and competence to overcome fear. Various behaviour management techniques can manage anxiety induced by dental treatment. The behaviour management techniques are classified into the psychological, physical and pharmacological approach [1]. The psychological approach includes two forms, including prevention and treatment of anxiety. Communication and relaxation techniques aimed at preventing the anxiety of the children [2]. These techniques are considered to be safe, cost-effective, and also readily accepted by both patients and parents [3]. Progressive muscle relaxation [PMR] is a relaxation technique to reduce anxiety proposed by Jacobson in 1938 [4]. Systematic desensitization is a psychological behaviour management technique based on the concept of "Reciprocal Inhibition" developed by Joseph Wolpe in the 1950s. He incorporated PMR in systematic desensitization to reduce fear and anxiety in patients. PMR is effective in reducing anxiety, heart rate, and blood pressure and thereby improving pain control in children undergoing extraction, and exhibited decreased salivary cortisols in periodontal patients [5,6]. PMR gives both psychological and physiological relaxation. The purpose of the present study was to compare the effectiveness of PMR with the control group on anxiety, heart rate, oxygen saturation, and behaviour of pediatric patients who undergo pulp therapy under local anesthesia.

MATERIALS AND METHODS:

This Randomized control trial was conducted from November 2021 to January 2022 on twenty 6–10-year-old children who required pulpal treatment in their primary molar teeth under local anesthesia for subsequent three appointments. The sample size was calculated using G power software version 3.1 with an anticipated 10% loss to follow-up, 5% alpha error, and 20% beta error for the two groups to be 20. The study proposal was approved by CARE IHEC-II with Reference No. IHEC-I/0209/21 on 18.11.2021.

Children with anxiety scores above two as per the modified dental anxiety scale were identified and randomly allocated to two groups [Group A and Group B] using the toss of coin technique. In group A, the children were intervened with a progressive muscle relaxation technique. In group B, verbal communication was established.

Children aged 6 – 10 years who required pulpal treatment in their primary molar teeth under local anesthesia for consecutive three appointments were included in the study. Patients, after getting voluntary consent were included in the study. Patients who were allergic to local anesthesia and those with uncooperative behaviour were excluded from the study. Patients

ISSN 2063-5346

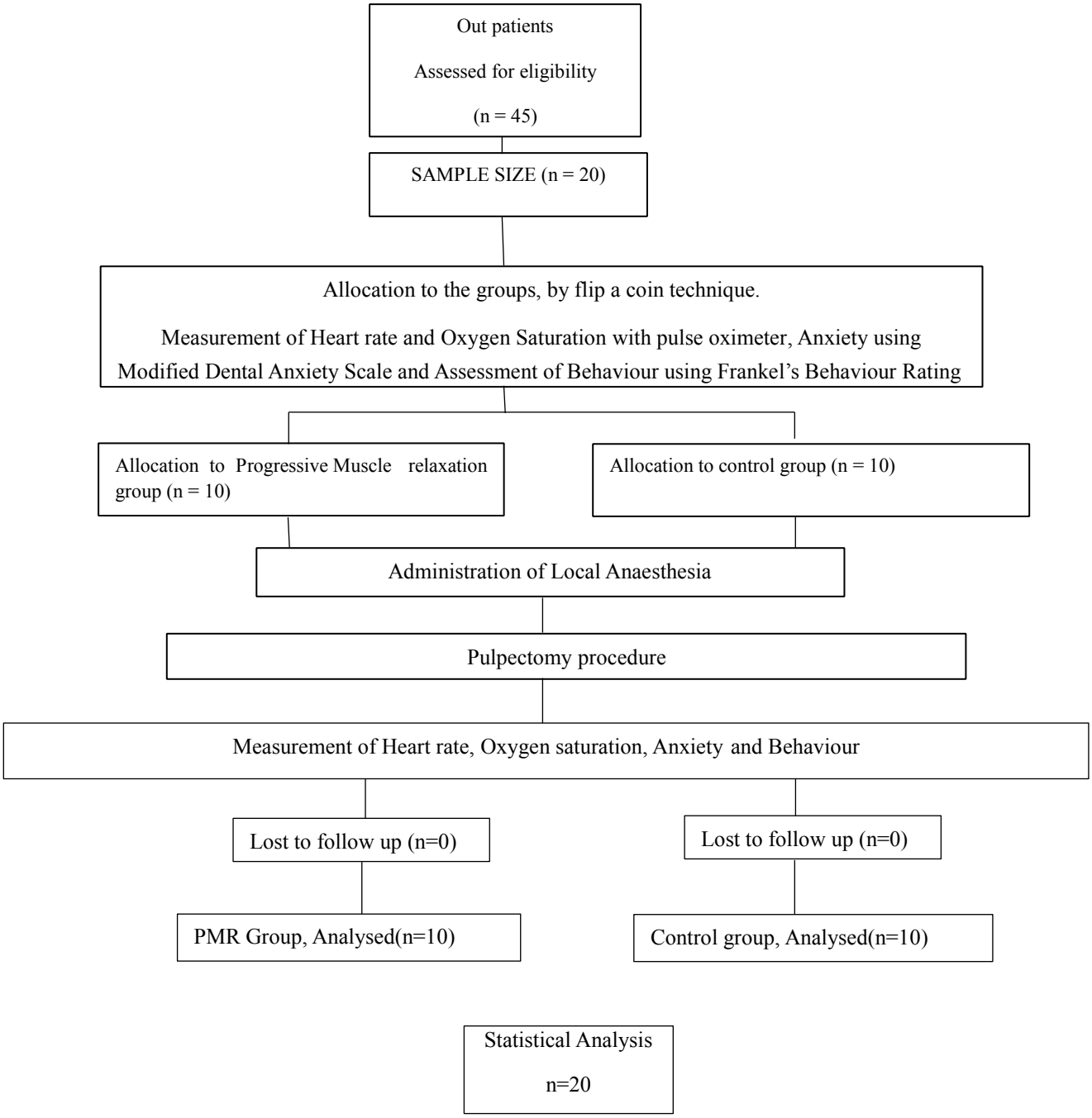
who required pulp therapy in the anterior teeth and those with any systemic disease were also excluded from the study.

Baseline anxiety in both groups was assessed, using the Modified Dental Anxiety Scale, 1995 [7]. Heart rate, Oxygen Saturation, and behaviour were assessed for all the patients using a pulse oximeter and Frankel's behaviour rating scale respectively before intervention [8]. After assessment of the parameters, PMR was initiated in Group A children as given by Children's Anxiety Institute, 2018 [9]. In the control group, the treatment was started with verbal communication. After the intervention, pulp therapy under local anesthesia was initiated. The anxiety levels, Behaviour, Heart rate, and Oxygen Saturation was assessed for all the participant in both groups after treatment. The study procedure was given as per Modified CONSORT criteria [10].

Modified CONSORT flow diagram for individual randomized controlled trials of nonpharmacologic treatments.

Section A-Research paper

ISSN 2063-5346



PROGRESSIVE MUSCLE RELAXATION:

The technique of PMR used is based on protocols proposed by Children Anxiety Institute, 2018. Before starting the relaxation technique, the children were explained about the procedure and were asked to recognize the hand, facial and toe muscles. Initially, the child was asked to close his/her eyes followed by inhalation and exhalation for ten times. This was followed by another set of instructions on how to tense and relax the target muscle groups from count 1-5 and count

ISSN 2063-5346

10-1 respectively. Prolonged expiration results in relaxation as per previous study [11]. In this study, the child was asked to pretend having a rubber ball in his/her hand, and try to squeeze it tightly and relax during the 1-5 and 10-1 count respectively. After this, the child was asked to produce several wrinkles on the face by smiling to a maximum extent and then relax for the counts. Finally, the toe muscles were contracted, and relaxed. All these contraction and relaxation techniques must be carried out simultaneously when the children were breathing in and out.

RESULTS:

In this study, 20 children were randomly allocated to the PMR and control group. The parameters recorded for each of the patients were anxiety, behaviour, oxygen saturation, and heart rate. All these variables were recorded for all three appointments before intervention and at the end of the procedure.

Table 1 depicts the difference in anxiety levels before and after treatment both in PMR and control groups. A decrease in anxiety levels was seen in the PMR group during the third appointment with p-values of 0.039 and 0.011 before and after intervention respectively. Table 2 depicts the inter-group comparison of behaviour between the PMR group and control group using Mann- Whitney U test. Positive behaviour was noted in the PMR group during third appointment before and after treatment with p values 0.005 and 0.005

Table 3 denotes the difference in the heart rate of the intervention and control groups. Heart rate has been reduced significantly in the intervention group with p values 0.019 and 0.002 in the second and third visits after treatment. Table 4 gives the oxygen saturation values. There is no difference between the PMR and control group. The preintervention and post-intervention values on all four parameters are observed in table 5. Heart rate was reduced significantly in all three appointments in group A. Anxiety and behaviour also showed improvement in group A in two appointments.

TABLE 1: Inter-group variation in anxiety scores pre-intervention and post-intervention at all three visits

Variable	Visit	Time	Group	N	Mean Rank	*P* value
Anxiety	I	Before	PMR	10	11.40	0.494
			Control	10	9.60	
		After	PMR	10	11.65	0.382
			Control	10	9.35	
	II	Before	PMR	10	10.85	0.786
			Control	10	10.15	

ISSN 2063-5346

		After	PMR	10	7.90	**0.048***
			Control	10	13.10	
	III	Before	PMR	10	7.80	**0.039***
			Control	10	13.20	
		After	PMR	10	7.20	**0.011***
			Control	10	13.80	

* - Significant at $p \leq 0.05$ level

TABLE 2: Depicting behaviour change in both the groups before and after intervention at all three visits.

Variable	Visit	Time	Group	N	Mean Rank	*P* value
Behaviour	I	Before	PMR	10	10.80	0.811
			Control	10	10.20	
		After	PMR	10	11.60	0.389
			Control	10	9.40	
	II	Before	PMR	10	11.60	0.389
			Control	10	9.40	
		After	PMR	10	12.95	**0.053***
			Control	10	8.05	
	III	Before	PMR	10	14.00	**0.005***
			Control	10	7.00	
		After	PMR	10	14.00	**0.005***
			Control	10	7.00	

* - Significant at $p \leq 0.05$ level

ISSN 2063-5346

TABLE 3: Differences in the heart rate between PMR and control group pre and postintervention for three visits

Variable	Visit	Time	Group	N	Mean	SD	*P* value
Heart Rate	I	Before	PMR	10	103.30	9.044	0.935
			Control	10	103.60	7.121	
		After	PMR	10	98.30	8.460	0.072
			Control	10	106.20	9.931	
	II	Before	PMR	10	103.40	9.324	0.920
			Control	10	103.80	8.217	
		After	PMR	10	97.20	8.025	**0.019***
			Control	10	106.90	8.800	
	III	Before	PMR	10	101.00	10.349	0.813
			Control	10	102.00	8.124	
		After	PMR	10	93.00	6.880	**0.002***
			Control	10	105.30	8.381	

* -Significant at $p \leq 0.05$ level

TABLE 4: The table shows the comparison of oxygen saturation levels between both groups in three visits before and after the intervention.

Variable	Visit	Time	Group	Mean	N	SD	P value
Oxygen	**I**	**Before**	**PMR**	10	96.3400	1.84101	0.972
			Control	10	96.3700	1.86789	
		After	**PMR**	10	96.2200	1.32229	0.640
			Control	10	96.5500	1.74944	
	II	**Before**	**PMR**	10	96.9900	1.24940	0.583
			Control	10	96.6300	1.60973	
		After	**PMR**	10	96.7400	1.50422	0.989

ISSN 2063-5346

			Control	10	96.7300	1.57201	
	III	**Before**	**PMR**	10	96.8600	2.00510	1.000
			Control	10	96.8600	1.85005	
		After	**PMR**	10	96.7600	1.49161	0.989
			Control	10	96.7500	1.82893	

* - Significant at $p \leq 0.05$ level

TABLE 5: Depicts intra-group comparison of all the parameters for the PMR group and control group separately for three visits.

Group	Visit	Time	Anxiety[a]	Behaviour[a]	HR	SPO_2
PMR	First	Before	0.865	**0.046***	**0.011***	0.749
		After				
	Second	Before	**0.005***	**0.025***	**0.015***	0.248
		After				
	Third	Before	**0.041***	1.000	**0.001***	0.618
		After				
Control	First	Before	0.564	0.705	0.278	0.393
		After				
	Second	Before	0.102	1.000	**0.048***	0.670
		After				
	Third	Before	0.102	0.157	0.090	0.367
		After				

* -Significant at $p \leq 0.05$ level.

DISCUSSION:

Child cooperation is an essential element in delivering quality dental care. Dental fear and anxiety affect the cooperative ability of children. Dental fear (DF) is an unpleasant response specifically to dental stimuli [12]. Anxiety is an emotional state that occurs before the actual encounter with the threatening condition and is sometimes undetectable [13]. It is the major reason for patients to avoid dental treatment [14]. It must be recognised and considered in a

ISSN 2063-5346

modern treatment strategy based on patient behaviour and oral health. [15]. In an Indian study population of 5- to 10-year-old children, the estimated prevalence of dental anxiety was 6.3% [16]. Intensity of pain is accelerated in anxious patients [17]. The fear of pain during root canal treatment may prevent the patient from seeking dental treatment [18]. Relaxed children during Local anesthesia administration is imperative [19].

Dentists rely on behaviour management techniques for uncooperative and anxious children and children with special health needs. The goal of these techniques is to inculcate positive behaviour in children, reduce anxiety and deliver adequate dental care. Behaviour management techniques are classified into pharmacological and non-pharmacological techniques. Pharmacological behaviour management techniques include use of benzodiazepines, conscious sedation, and general anesthesia [20]. Non–pharmacological behaviour interventions, can be grouped into communication skills, psychotherapeutic behaviour management, and technological advancements [13]. Systemic desensitization is one of the psychotherapeutic behaviour management techniques. The main aim of this technique is to analyse anxious patients and perceive the fear-producing stimuli making them anxious. In this technique a hierarchy of stimuli is established and the individual is initially exposed to the stimulus posing the least menace [21].

Progressive muscle relaxation (PMR) comes under systemic desensitization. PMR was first developed by Edmund Jacobson during his research at Harvard university in the 1920s [22]. He proposed that relaxation of muscle fibers as a contradiction to tension and can be considered as an option for anxiety management [23]. Joseph Wolpe continued the work of Edmund Jacobson and introduced the concept of “Reciprocal inhibition”. In PMR, a Hierarchy was created based on patient’s anxiety and then the patient was made to relax by imagining the items in the hierarchy [24].

In the present study, PMR is used to reduce anxiety of the patients undergoing pulp therapy under local anesthesia. Children aged six to ten years were selected for the study. Anxiety tends to decrease in children with age [25]. Anxiety levels, behaviour rating, oxygen saturation, and heart rate were the parameters measured before and after the intervention. These parameters aid in the assessment of anxiety. Studies have shown that children aged two to five years showed increased heart rates during the first three dental visits [26]. Stress is based on three factors such as physiological, behavioral, and cognitive response [27]. Behaviour is one of the determinants of anxiety.

According to Benson et al, all the relaxation techniques could be used as a tool to reduce anxiety and have been identified to evoke a non-specific relaxation response of reduced sympathetic arousal [28]. In general, PMR involves learning to tense and relax several groups of muscles including hands, arms, neck, head, and shoulders [29]. Anxious patients learn relaxation techniques in about 10 to 20 minutes. These relaxation techniques have been proven advantageous in both learning and recalling the technique [30].

ISSN 2063-5346

PMR demonstrated a reduction in salivary cortisol levels as a result of attenuation of the Hypothalamic-Pituitary-Adrenal axis [31].

The present study showed significant improvement in the anxiety level of the children during every appointment after intervention than in the control group. The intervention group showed a better reduction in anxiety when compared with the control group. These results were consistent with the findings of other studies on reducing anxiety. PMR effectively reduced anxiety and depression among leprosy patients. It was easier to learn and did not require any trained professional [32]. On assessing the patient's anxiety and sleep quality using Spielberger State-Trait Anxiety Inventory (STAI) and St Mary's Hospital Sleep Quality Questionnaire (SMHSQ), Jacobson's relaxation technique showed a decrease in their anxiety level and improvement in sleep quality [33]. By all these findings, a steady decline was seen in depression and anxiety for the patients before and after the application of the PMR Technique [32 ,34, 35,36].

In this study, improvement in behaviour was observed in the second and third appointments. Patients here were accommodated to the relaxation method given to them every visit [37]. This change in the behaviour of the children is in accordance with a study, where elementary school children with emotional or Behaviour disorders support PMR as an effective short-term aggression reduction [38]. Muscle relaxation calmed the subjects and resulted in a 14.7% decrease in the occurrence of violent behaviour in the intervention group. [39]. The findings of the present study are in contrast a study where there was an increase in oxygen saturation levels prior to and immediately following intervention with a PMR technique [40]. The results of the current study showed no significant difference in oxygen saturation levels in all three appointments.

The pre-and post-intervention difference in the heart rate in the intervention group shows a significant difference in all three appointments, unlike the control group. After PMR training, there was a decrease in resting blood pressure, pulse, and perception of stress levels[41]. The PMR group has been proven to increase Heart rate variability in healthy individuals in a pilot study in 2021 [42].

This study used fewer samples, which limits the accuracy of results. The determinants of anxiety used were not physiological indicators of stress like blood pressure and salivary cortisol levels. The local anesthetic technique was not the same for all the participants. Future research is recommended with an increased sample size to determine the effects of PMR.

CONCLUSION:

Thus, the present study concludes that the PMR technique plays a significant role in reducing anxiety, and heart rate in children who are anxious about dental treatment. It can also be used to modify the child's behaviour before dental treatment.

Section A-Research paper

ISSN 2063-5346

REFERENCES:

1. Marwah N. Textbook of pediatric dentistry. JP Medical Ltd; 2018 Oct 31.
2. Folayan M, Ufomata D, Adekoya-Sofowora C, Otuyemi O, Idehen E. The effect of psychological management on dental anxiety in children. Journal of Clinical Pediatric Dentistry. 2003 Jul 1;27(4):365-70.
3. McLeod, S. A. *Systematic desensitization as a counter conditioning process*. Simply Psychology.2015
4. Progressive relaxation.Chicago: University of Chicago Press,1938;2nd edition.
5. Sabherwal P, Kalra N, Tyagi R, Khatri A, Srivastava S. Hypnosis and progressive muscle relaxation for anxiolysis and pain control during extraction procedure in 8–12-year-old children: a randomized control trial. Eur Arch Paediatr Dent. 2021;22(5):823–32.
6. Park ES, Yim HW, Lee KS. Progressive muscle relaxation therapy to relieve dental anxiety: a randomized controlled trial. Eur J Oral Sci. 2019;127(1):45–51.
7. Humphris GM, Morrison T, Lindsay SJ. The Modified Dental Anxiety Scale: validation and United Kingdom norms. Community Dent Health.1995;12(3):143-50.PMID: 7584581.
8. Frankle SN. Should the parent remain with the child in the dental operatory? J Dent Child.1962;29:150-63.
9. Children's Anxiety Institute. How to teach children progressive muscle relaxation.2018. http://childrenwithanxiety.com/how-to-teachchildren-progressive-muscle-relaxation.
10. Boutron I, Altman DG, Moher D, Schulz KF, Ravaud P. CONSORT Statement for Randomized Trials of Nonpharmacologic Treatments: A 2017 Update and a CONSORT Extension for Nonpharmacologic Trial Abstracts. Annals of Internal Medicine. 2017;167(1):40–7.
11. Komori T.The relaxation effect of prolonged expiratory breathing.Mental illness.2018;10:7669.
12. Klingberg G. Dental anxiety and behaviour management problems in paediatric dentistry—a review of background factors and diagnostics. European Archives of Paediatric Dentistry.2008;9(1):11-5.
13. Appukuttan DP. Strategies to manage patients with dental anxiety and dental phobia: literature review.Clin Cosmet Investig Dent.2016;8:35-50.
14. Beaudette JR, Fritz PC, Sullivan PJ, Ward WE. Oral Health, Nutritional Choices, and Dental Fear and Anxiety. Dent J (Basel).2017;5(1):8.
15. Eitner S, Wichmann M, Paulsen A, Holst S. Dental anxiety--an epidemiological study on its clinical correlation and effects on oral health. J Oral Rehabil.2006;33(8):588-93.

ISSN 2063-5346

16. Chhabra N, Chhabra A, Walia G. Prevalence of dental anxiety and fear among five- to ten-year-old children: a behaviour based cross sectional study. Minerva Stomatol.2012;61(3):83-9.
17. van Wijk AJ, Hoogstraten J.Experience with dental pain and fear of dental pain. J Dent Res.2005;84:947-50.
18. Rousseau WH, Clark SJ, Newcomb BE, Walker ED, Eleazer PD, Scheetz JP. A comparison of pain levels during pulpectomy, extractions, and restorative procedures. Journal of endodontics.2002;28(2):108-10.
19. Ram D, Peretz B. Administering local anaesthesia to paediatric dental patients–current status and prospects for the future. International journal of paediatric dentistry.2002;12(2):80-9.
20. Cianetti S, Paglia L, Gatto R, Montedori A, Lupatelli E. Evidence of pharmacological and non-pharmacological interventions for the management of dental fear in paediatric dentistry: a systematic review protocol. BMJ open.2017;7(8):e016043.
21. Levitt J, McGoldrick P, Evans D. The management of severe dental phobia in an adolescent boy: a case report. Int J Paediatr Dent 2000;10:348-53
22. Jacobsen E. Progressive relaxation.1929.
23. Martha S. McCallie BSW, Claire M. Blum RN & Charlaine J. Hood.Progressive Muscle Relaxation.Journal of Human Behavior in the Social Environment.2006;13(3):51-66
24. Lieberman S. Psychotherapy by reciprocal inhibition: Joseph Wolpe. The British Journal of Psychiatry.1986;149(4):518-9.
25. Chapman HR, Kirby NC. Dental fear in children: a proposed model. British Dental Journal 1999;187(8):408-12.
26. Venham L, Bengston D, Cipes M. Children's response to sequential dental visits. J Dent Res 1977;56:454-9.
27. Nicolas E, Bessadet M, Collado V, Carrasco P, Rogerleroi V, Hennequin M. Factors affecting dental fear in French children aged 5–12 years. International Journal of Paediatric Dentistry.2010;20(5):366-73.
28. Benson H, Greenwood MM, Klemchuk H. The relaxation response: psychophysiological aspects and clinical applications. The International Journal of Psychiatry in Medicine.1975;6(1-2):87-98.
29. Hainsworth JM, Moss H, Fairbrother KJ. Relaxation and complementary therapies: an alternative approach to managing dental anxiety in clinical practice. Dental update.2005;32(2):90-6.
30. Straughan JH, Dufort WH. Task difficulty, relaxation, and anxiety level during verbal learning and recall. Journal of Abnormal Psychology.1969;74(5):621.
31. Chellew K, Evans P, Fornes-Vives J, Pérez G, Garcia-Banda G. The effect of progressive muscle relaxation on daily cortisol secretion. Stress.2015;18(5):538-44.

ISSN 2063-5346

32. Ramasamy S, Panneerselvam S, Govindharaj P, Kumar A, Nayak R. Progressive muscle relaxation technique on anxiety and depression among persons affected by leprosy. J Exerc Rehabil.2018;14(3):375-81.
33. Harorani M, Davodabady F, Masmouei B, Barati N. The effect of progressive muscle relaxation on anxiety and sleep quality in burn patients: A randomized clinical trial. Burns.2020;46(5):1107-13.
34. Dahlander A, Soares F, Grindefjord M, Dahllöf G. Factors associated with dental fear and anxiety in children aged 7 to 9 years. Dentistry journal.2019;7(3):68.
35. Singh VP, Rao V, RC S. Comparison of the effectiveness of music and progressive muscle relaxation for anxiety in COPD—a randomized controlled pilot study. Chronic respiratory disease.2009;6(4):209-16.
36. Carver ML, O'Malley M. Progressive muscle relaxation to decrease anxiety in clinical simulations. Teaching and Learning in Nursing.2015;10(2):57-62.
37. Vancampfort D, Correll CU, Scheewe TW, Probst M, De Herdt A, Knapen J, De Hert M. Progressive muscle relaxation in persons with schizophrenia: a systematic review of randomized controlled trials. Clin Rehabil.2013;27(4):291-8.
38. Lopata C. Progressive muscle relaxation and aggression among elementary students with emotional or behavioral disorders. Behavioral Disorders.2003;28(2):162-72.
39. MY, Chan S. Evaluating the effectiveness of progressive muscle relaxation in reducing the aggressive behaviors of mentally handicapped patients. Archives of Psychiatric Nursing.2000;14(1):39-46.
40. Cahyati A, Herliana L, Februanti S. Progressive Muscle Relaxation (PMR) Enhances Oxygen Saturation in Patients of Coronary Heart Disease.Journal of Physics: Conference Series.2020;1477(6):062018.
41. Chaudhuri A, Ray M, Saldanha D, Bandopadhyay A. Effect of progressive muscle relaxation in female health care professionals. Ann Med Health Sci Res.2014;4(5):791-5.
42. Groß D, Kohlmann CW. Increasing Heart Rate Variability through Progressive Muscle Relaxation and Breathing: A 77-Day Pilot Study with Daily Ambulatory Assessment. International Journal of Environmental Research and Public Health.2021;18(21):11357.