THE EFFECT OF NOISE PRODUCED BY HIGH SPEED HANDPIECE ON PREDENTAL ANXIETY AND HEART RATE IN PATIENTS VISITING A DENTAL HOSPITAL IN ATTARKHEL

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ABSTRACT

Dental anxiety is a very common dental health problem in the populations of many countries and the prevalence of dental anxiety has been the subject of many studies. The etiology of this condition may be due to previous traumatic experiences, such as severe pain or discomfort during or after a dental procedure and negative observations by the dentist. Noise produced by high speed handpiece can also cause dental anxiety. This cross sectional study was conducted to assess the effect of noise produced by high speed handpiece on predental anxiety and heart rate. The Modified Dental Anxiety Scale (MDAS) measuring tool was filled before the start of the treatment by the patients to measure their general dental anxiety score. The patients were divided into two groups; experienced and non-experienced. The heart rate was recorded with the help of a pulse oximeter at three different intervals i.e. before, during and after the procedure. Descriptive statistics was calculated along with Chi square test, ANNOVA, Independent t test were used. Anxiety was associated with prior treatment experience and the result was statistically significant. Majority of study participants had low anxiety (59.2%), 10.7% had no anxiety and only 2.4% had extreme anxiety. The relation between heart rate with gender (M: 62.4%, F: 56.6%), age (18-29 years: 55.6%, 30-39 years: 67.6%, 40-50 years: 61.8%) and prior treatment experience (experienced: 67.0%, non-experienced: 51.5%) was statistically insignificant. It was concluded that non-experienced group had more anxiety than the experienced group. The percentage of heart rate was more during the treatment compared to before treatment and after treatment.

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INTRODUCTION

Dental anxiety is a very common dental health problem in the populations of many countries and the prevalence of dental anxiety has been the subject of many studies.[1] It is defined as a state of apprehension, coupled with a sense of losing control, which is linked to a feeling that something dreadful is going to happen concerning the dental treatment.[2] The etiology of this condition may be due to previous traumatic experiences, such as severe pain or discomfort during or after a dental procedure and negative observations by the dentist.[3,4] Dental anxiety can affect the patient's oral health, cause negative thoughts, affect social interactions and job performance and can have an impact on the self-esteem and self-confidence, influencing the overall quality of life. Anxiety is a barrier for dental care because anxious patients tend to miss, delay or cancel appointments, seeking treatment only in acute cases of inflammation or infection.[5]

Noise can also be considered as a factor, which could also be responsible for behavioral changes in humans, as it can generate feelings of fear, surprise, and anxiety among individuals.[6] In our practice, dental equipments such as handpiece, suction tube, and scaler tips used during the different procedures generate noise. The fear which is caused by noise from the dental equipment tends to be a source of patient discomfort which is believed to be among the leading causes for what is referred to in the dental community as "dental drop-out" i.e. patients refusing to undergo dental treatment or ignoring follow up appointments.[7] Studies have identified stress and pain as the main two "fear factors", which prevent people from visiting dental clinics for diagnostic, preventive and therapeutic treatments. It was also suggested by Yousuf *et al*[8] that noise produced by dental equipments which is necessary for dental treatment is a cause of dental fear in patients in Jaipur. The main characteristic of each of these dental devices (handpieces) is the loud sounds they produce which is believed to be strongly related to fear and dental anxiety among UAE population.[7]

The sound in general hospital practice is measured as 66 to 70 decibels (dB) is enough to provoke anxiety and other behavior impacts.[9] In a study it was evaluated, that the sound pressure produced by the high-speed handpiece is 87.3 dB, and in another study it was mentioned to be 102 dB,[10] which is more than enough to bring the state of anxiety in patients, which can be detected through the pulse oximeter because it has been stated in the previous studies that there is a strong association between the psychological and physiological effects as anxiety is considered as psychological stress and it affects the physiological condition of the body i.e. heart rate.[11] The heart rate increases during the state of anxiety and stress.[12]

Some studies state that dental anxiety is a gender issue.[13] Anxiety can be assessed through subjective or objective means. The subjective assessment can be through self-assessment anxiety scales like Dental Fear Survey (DFS), Corah's Dental Anxiety Scale (CDAS), Modified Dental Anxiety Scale (MDAS), Gale's Ranking Questionnaire (RQ) etc.[14] Corah's DAS is popular and widely used among dental researchers. It is a simple, easy to score, validated and reliable test for dental visit-associated anxiety.[15] Humphris *et al*[16] introduced a modified scale from the original Corah's DAS. The Modified DAS was more comprehensive, highly valid and reliable. It was accepted by respondents and has a more consistent answering system. Hence, the Modified DAS was used to measure dental anxiety in the current study. Objective assessment can be carried through the physiological response of the body that occurs due to stress. Studies showed that vital signs changes had a positive correlation with moderate-to-severe dental anxiety.[17] Noise induced anxiety can lead to increase in heart rate. This study was done to identify noise induced anxiety and its effect on heart rate. Dental anxiety should be identified and certain anxiety reduction protocol should be followed, so as to prevent negative impact on our dental care system.

MATERIALS AND METHODS

This analytical, cross-sectional study was performed in the Department of Conservative Dentistry and Endodontics from December 2024 to February 2025 after receiving ethical approval from Nepal Medical College Institutional Review Committee (Ref. No. 30-081/082). The participants were informed about the study and written consent was obtained from those who were willing to participate and had understood the content of the study. Patients undergoing root canal treatment or restoration of the tooth between 18 and 50 years of age were included in the study. Patients who had a medical condition or taking drugs which alter the heart rate and anxiety control pills were excluded. The sample size was calculated using the formula for estimating population proportion:

Sample size (n) = $Z^2 S^2/d^2$

= 1.96x1.96x4.408x4.408/ (0.6315x0.6315)

=188

Where, Z=1.96 at 95% confidence interval S=Standard deviation of MDAS-N score as adopted from a study by Poudel et al[18] =4.40824, d =absolute margin of error to be tolerated (expected difference from true mean) =5% of 12.63.[18] Further assuming the response rate to be 90%, the total sample size is calculated to be 206 (two groups experienced and non-experienced patients). The demographic details were collected in a questionnaire. The demographic data included age, gender and occupation. The patients were divided into two groups: Experienced patients and non-experienced patients. Experienced patients are those who had already undergone a dental procedure before and non-experienced patients are those who had not undergone a dental procedure before.

MDAS measuring tool was filled before the start of the treatment by the patients to measure their general dental anxiety score. This scale relies upon a scoring system. The scores range from 5 to 25, and the patient's level of anxiety was quantified as follows: a total score of 0 to 5 indicates "no anxiety", a score between 6 to 10 corresponds to "low anxiety", a score between 11 to 14 indicates "moderate anxiety", a score between 15 and 18 corresponds to "high anxiety" and a score between 19 to 25 corresponds to "extreme anxiety".[16] The questionnaire was in the Nepali language. The readings of the heart rates were recorded by the researcher during the intervals of the procedure. The patient was seated at the corner most dental chair of the department to minimize the other sound effects, this was standardized for all of the patients who were a part of this study. The anxiety level was measured by using the pulse oximeter, which was placed on the right index finger of the patient. The researcher recorded pulse oximeter readings three times during the procedure. The first reading was recorded before filling out the questionnaire and before the start of the treatment. The second reading was recorded, without removing the pulse oximeter after the first reading, when the dentist held the high-speed handpiece and pressed the paddle outside the mouth for about 5 seconds. A handpiece was placed near the patient so that they could hear the sound. The final reading was taken following the removal of cavities and the crown-cutting process, marking the cessation of handpiece usage (with an approximate time of within five minutes) which was mandatory for both filling and root canal treatments.[6] The high-speed handpiece used was a Pana Air FX, NSK, Japan.

RESULTS

The data were entered in Microsoft Excel and then exported to SPSS-20 for statistical analysis. Data was presented in the form of frequency, percentage, mean and standard deviation. Chi-square test was used to find the association of anxiety between experienced and non-experienced group and between male and female. Independent t-test was used for comparison of heart rate before, during and after treatment according to gender and prior treatment experience. One way ANNOVA was used for comparison of heart rate before during and after treatment according to age. A

Table 1: Sociodemographic characteristics of the study participants

Variables		n (%)
Gender	Female	93 (45.1)
	Male	113 (54.9)
Age group (in years)	18-29	117 (56.8)
	30-39	34 (16.5)
	40-50	55 (26.7)
Prior treatment experience	Experienced	103 (50.0)
	Non experienced	103 (50.0)

Table 2: Distribution of study participants according to levels of anxiety

Levels of anxiety	n (%)
No anxiety	22 (10.7)
Low anxiety	122 (59.2)
Moderate anxiety	42 (20.4)
High anxiety	15 (7.3)
Extreme anxiety	5 (2.4)

Table 3: Descriptive statistics of heart rate among the study participants

Time	Heart rate (beats per minutes)		
	Min	Max	Mean±SD
Before	54	111	77.88±11.09
During	56	109	78.13±11.58
After	48	109	76.79±11.26

total of 206 study participants were included in the study of which the majority were females (113, 54.9%) and of age group 18-29 years (117, 56.8%). There was an equal distribution of study participants with and without prior treatment experience (103, 50.0%) as in Table 1.

to non-experienced study participants. There was a statistically significant association of prior treatment experience with levels of anxiety (p-value 0.012). In case of age , majority of no anxiety was seen (18.2%) in the age group of 40-50 years but the result was statistically

Table 4: Association of level of anxiety with age groups, gender and prior treatment experience						
Variables	**No anxiety n (%)**	**Low anxiety n (%)**	**Moderate anxiety n (%)**	**High anxiety n (%)**	**Extreme anxiety n (%)**	**p-value**
Age group (in years)						
18-29	8 (6.8)	66 (55.6)	30 (25.6)	11 (9.4)	3 (2.6)	0.203
30-39	4 (11.8)	23 (67.6)	4 (11.8)	2 (5.9)	1 (2.9)	
40-50	10 (18.2)	34 (61.8)	8 (14.5)	2 (3.7)	1 (1.8)	
Gender						
Male	14 (15.1)	58 (62.4)	14 (15.1)	5 (5.4)	2 (2.2)	0.160
Female	8 (7.1)	64 (56.6)	28 (24.8)	10 (8.8)	3 (2.7)	
Prior treatment experience						
Experienced	14 (13.6)	69 (67.0)	15 (14.6)	3 (2.9)	2 (1.9)	0.012*
Non experienced	8 (7.8)	53 (51.5)	27 (26.2)	12 (11.7)	3 (2.9)	
Total	**22 (10.7)**	**122 (59.2)**	**42 (20.4)**	**15 (7.3)**	**5 (2.4)**	

*Chi square test, p-value<0.05 statistically significant**

Table 5: Comparison of mean heart rates according to gender			
Time	**Male Mean±SD**	**Female Mean±SD**	**p-value**
Before treatment	76.78±11.47	78.79±10.73	0.198
During treatment	77.41±12.04	78.73±11.20	0.418
After treatment	75.87±12.14	77.54±10.47	0.291

Independent t test, p-value<0.05 statistically significant

The prevalence of anxiety was found to be 89.3% among the study participants. Among those with anxiety, majority (122, 59.2%) had low level of anxiety followed by moderate anxiety (42, 20.4%), no anxiety (22, 10.7%), high anxiety (15, 7.3%) and minority had extreme anxiety (5, 2.4%) as in Table 2.

The maximum heart rate seen before the procedure was 111 beats per minute and the minimum was 54 beats per minute. The same maximum heart rate was seen during and after the procedure which was 109 beats per minute and the minimum heart rate seen during and after the procedure was 56 and 48 beats per minute as in Table 3.

Higher proportion of experienced study participants had no anxiety (13.6%) as compared

insignificant (p-value 0.203). Whereas in gender, higher percentage of male had no anxiety (15.1%) as compared to females but the result was statistically insignificant (p-value 0.16) as in Table 4.

There was no statistically significant difference in mean heart rates between male and female before treatment (p-value 0.198), during treatment (p-value 0.418) and after treatment (p-value 0.291) as in Table 5. Females had a higher mean heart rate during treatment 78.73±11.20 compared to before and after treatment than males.

There was no statistically significant difference in mean heart rates between experienced and non-experienced study participants before treatment (p-value 0.960), during treatment

Table 6: Comparison of heart rates according to prior treatment experience			
Time	Experienced Mean±SD	Non Experienced Mean±SD	p-value
Before treatment	77.84±11.11	77.92±11.12	0.960
During treatment	77.60±10.88	78.66±12.27	0.513
After treatment	75.94±10.99	77.64±11.52	0.282

Independent t test, p-value<0.05 statistically significant

Table 7: Comparison of heart rates according to age groups				
Time	18-29 years Mean±SD	30-39 years Mean±SD	40-50 years Mean±SD	p-value
Before treatment	77.82±12.14	79.24±8.72	77.18±10.08	0.696
During treatment	78.44±12.62	77.35±9.79	77.96±10.38	0.885
After treatment	76.60±12.28	75.74±9.19	77.82±10.23	0.676

One way ANOVA, p-value<0.05 statistically significant*

(p-value 0.513) and after treatment (p-value 0.282) as in Table 6. The heart rate of non-experienced group during treatment was higher 78.66±12.27 than before and after treatment than the experienced group.

There was no statistically significant difference in mean heart rates among different age groups before treatment (p-value 0.696), during treatment (p-value 0.885) and after treatment (p-value 0.676) as in Table 7.

DISCUSSION

Dental anxiety is the major reason that patients delay dental treatment which has a negative effect on dental health care. In the present study, the prevalence of dental anxiety was 89.3%. This was higher than the anxiety scores of some other countries around the world like in Dammam and Jeddah (22.7%, 31.9%, respectively) of Saudi Arabia, 19.5% in Belfast; United Kingdom.[19] This score was similar to a study done by Doe et al[20] in which 83.1% reported anxiety. Dental anxiety results in an avoidance behavior that can only be assessed in compulsory check-ups. Avoidance of dental treatment is highly correlated with increased caries morbidity as well as the level of anxiety and DMFS scores.[21]

In our study, among those with anxiety majority of the study participants 59.2% had low anxiety. This percentage was higher than in some studies done in Nepal by Poudel et al[18] and Giri et al[22] where 30.1% and 26% had low anxiety. Minority of the study participants had extreme anxiety ie.2.4%. Similar levels of dental anxiety have been reported in studies conducted in Nepal, India and Finland.[22-24] However, there are studies which have reported higher prevalence of extreme dental anxiety or dental phobia.[25,26] This low prevalence of extreme dental anxiety among Nepali samples compared to other countries could be attributed to ethnic differences.

Some authors[1,13] have shown an association with gender and dental anxiety. In studies done by Manoela et al[13] and Arslan et al[1] showed that females had more anxiety than males. This female predominance wasn't not reported by others.[20,27] Such differences in the literature could be attributed to personal and socioeconomic differences as well as methodological differences such as study design, analysis methods, type of measurement of dental anxiety, and sample size.[28] However, in our study there was no association between gender related to dental anxiety. This was in agreement with the findings of Kanegane et al.[27]

In our study dental anxiety isn't associated with age. In many studies it has been seen to be correlated with age. Younger the patient more anxiety has been seen in studies done by Maneola et al,[13] and Vinikangas et al.[29] Similar findings were seen in a study done by Kanegane et al.[27] This may be due to uneven distribution of the study participants according to age. Older people might have come for dental treatment before which can lead to less anxiety. We can also see in our study that the percentage of no anxiety increases with age and high anxiety decreases with increase in age.

A correlation was seen in patients with prior treatment experience. Non-experienced patients had more dental anxiety than experienced patients. This finding is supported by a study conducted by Ghaffer *et al*[6] and Oktay *et al*[30] which showed that the first dental visit or the previous traumatic experience does affect the anxiety level of the patient, which means that patients are more anxious when they are visiting the clinic for the first time. This observation is not in agreement with the findings of Stabholtz *et al*[31] who state that prior dental experience doesn't affect dental anxiety.

Dental anxiety was reported to increase the sympathetic and parasympathetic nervous system activities.[32] Overstimulation of sympathetic nerves leads to an increase in noradrenaline secretion which causes an increase in blood pressure, heart rate, and muscle contractility.[32] It was reported by Salih *et al*[33] that rather than pain anxiety was responsible for increase in heart rate.

In this study, anxiety causes increase in heart rate. Noise produced by the highspeed handpiece is also a provoking factor that can cause anxiety and increase in heart rate. Yousuf *et al*[8] stated that higher noise levels result in higher fear levels. However, in another study, the number of respondents who feared hearing the sound of a dental drill and feeling a drill were almost equal.[34] The mean heart rate was a bit higher during the procedure i.e, immediately hearing the sound of handpiece compared to before and after the procedure. This finding is consistent with the results of some other studies, where the heart rate is seen to be increased during the procedure.[35,36]

The mean heart rates for female patients were more during treatment compared to before treatment and after treatment. This result is similar to another study, where females had more heart rate compared to males.[6] The mean heart rate of experienced patients was seen to be remarkably reduced after the cessation of the use of the hand piece compared to non-experienced patients. This result is similar to study conducted by Gaffer *et al*[6] who has stated that even after proper counseling and instructions non-experienced patients seemed nervous about what the machine is going to do to their teeth and what they would feel after that.

We can conclude that dental anxiety is a major reason why patients delay their visit to the dental clinic and can lead to oral health problems. Prior treatment experience affects dental anxiety. Experienced patients have less anxiety compared to non-experienced patients. Noise from the high speed handpiece can cause anxiety which can lead to increase in heart rate. Noise produced from the handpiece is seen to increase heart rate during treatment rather than after treatment or before the use of handpiece in females and non-experienced patients. To minimize noise-induced anxiety, we can make certain changes while treating patients like using music therapy, counseling the patient properly before doing the procedure. In such a way that we can minimize the negative impact on dental healthcare system.

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