

Relationship between the patient's dental noise recognition level and response

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[Abstract]

The purpose of this study is to present basic data to provide a comfortable treatment environment by analyzing the relation between the degree of recognition of dental noise and responses. For 205 dental patients in Seoul and Gyeonggi Province, the differences in the cognitive level, physiological response, and psychological response of dental noise according to general characteristics and dental experience were analyzed by t-test, one way ANOVA, and correlation analysis. As a result of the study, the cognitive degree, physiological response, and psychological response of dental noise showed significant differences according to age and occupation, and significant results were found in the cognitive degree, physiological response, and psychological response of dental noise according to the contents of treatment and the period of visit. In this study, a positive correlation was confirmed between the cognitive degree of dental noise and the psychological and physiological response. For continuous research and essential improvement to reduce noise in dentistry, it is necessary to pay attention to the noise-generating environment and make efforts to prevent hearing loss.

▶ **Key words:** Dentistry, Noise, Degree of recognition, Psychological Response, Physiological Responses

[요약]

본 연구의 목적은 치과 소음 인지정도 및 반응 관련성을 분석하여 편안한 진료 환경을 제공하기 위한 기초자료로 제시하고자 한다. 서울 및 경기지역 치과 내원 환자 205명을 대상으로 일반적 특성 및 치과경험에 따른 치과 소음의 인지정도, 생리적 반응, 심리적 반응의 차이는 t-test, one way ANOVA 분석하였다. 치과 소음의 인지정도, 생리적 반응, 심리적 반응과의 관련성을 확인하기 위해 correlation analysis를 이용하였다. 연구 결과, 나이와 직업에 따라 치과 소음의 인지정도, 생리적 반응, 심리적 반응이 유의한 차이를 보였으며, 진료내용, 내원기간에 따라 치과소음의 인지정도, 생리적 반응, 심리적 반응에서 유의한 결과를 보였다. 본 연구로 치과 소음 인지정도 및 심리적·생리적 반응은 양의 상관관계를 확인하였다. 치과 내 소음저감을 위한 지속적인 연구와 본질적인 개선을 위해 소음 발생 환경에 관심을 갖고, 청력 손실을 예방하고자 하는 노력이 필요하다.

▶ **주제어:** 치과, 소음, 소음 인지정도, 심리적 반응, 생리적 반응

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 - Received: 2024. 08. 26, Revised: 2024. 10. 17, Accepted: 2024. 10. 24.

I. Introduction

Noise is defined as "unwanted sound generated by the use of machinery, facilities, etc." In dental practice, inevitable noise made by various equipment such as handpieces, intraoral aspirators, and ultrasonic scalers exists which negatively affects both patients and medical staff[1]. Noise generated during dental treatment is perceived as loud and irritating compared to general hospitals, which can affect the tendency to avoid visiting dental hospitals. The noise of medical devices generated in dental hospitals causes high discomfort to most visitors and poses a risk of hearing impairment when repeatedly exposed. In addition, noise is psychologically and physiologically damaging, and irritating noise increases body stress and causes hearing loss, sleep deprivation, and reproductive problems[2]. In particular, noise within a hospital environment can affect health recovery. Noise in a hospital environment is very diverse, such as the footsteps of doctors and various machines, which can be a factor that creates psychological or physiological problems of patients[3-4]. In order to solve the problem caused by such exposure to noise in dentistry, the importance of measures to establish noise reduction is increasing day by day[2].

According to previous studies, noise generated by dental equipment does not meet the criteria for recognizing noise-induced hearing loss, but caution is needed because it has the characteristics of high noise above 70(dB) and high frequency above 4 KHz[3]. Another study found that sharp mechanical sounds generated from devices operated during treatment in dental hospitals cause fear for people suffering from dental diseases, regardless of age or sex. Dental noise causes dental phobia, which makes people reluctant to visit hospitals or tolerate tooth pain, exacerbating the disease, and requiring time and more expensive treatment[4]. Most dental noise occurs during treatment, and dental noise sources can be largely divided into noises of dental

treatment and noises of dental medical equipment used for treatment [3]. In a study of 'Activation of the human amygdala by dental treatment sources', when we visualized auditory stimulation arising from ultrasound scaling and inhalation equipment and cerebral cortical stimulation in dental patients, we demonstrated that hateful auditory stimulation in subjects causes discomfort[5].

In order to reduce the psychological and physiological problems of patients, it is necessary to understand the noise status of medical devices generated in dental hospitals, manage the working environment to improve quality by establishing appropriate noise reduction measures[2]. Several studies have been conducted in the past to measure the level of noise generated in dentistry or to check the hearing damage of dental staff, but papers on patients' subjective perceptions and psychological and physiological responses to noise generated in dental offices are insufficient. Therefore, this study aims to find out the factors and degree of noise generated in dentistry and to present it as basic data to provide a better patient's safety and treatment environment by grasping the patient's psychological and physiological responses to noises.

II. Study Methods

1. Subject of study

We collected data only for patients visiting dentistry who agreed on the purpose of the study from May 6, 2024 to August 18, 2024 in Seoul and Gyeonggi-do. The survey data used a self-written questionnaire, and the number of study subjects was set to effect size=0.25, significance level α =0.05, and power $1-\beta$ =0.80 in ANOVA analysis using Cohen's Power analysis, and the weighted average value was calculated, and the number of study subjects was set to G*power 3.1.9.6, and the minimum number of 159 subjects was required, but a total of 205 copies were finally analyzed in

consideration of maximum sampling error and sample bias.

2. Method of research

The survey tool for this study referred to Shon [2]'s study of in-hospital noise and inpatient response. A total of 58 questions consist of general characteristics of 3 questions, 4 questions of dental experience, and 7 questions such as conversations between medical staff, sounds from patients next to them, and footsteps, 6 questions such as suction and air syringe, and 7 questions such as environmental noise, 14 questions for psychological responses and 17 questions for physiological responses. Noise recognition, psychological response, and physiological response are on a Likert 5-point scale, indicating that the higher the score, the higher the noise recognition, psychological and physiological response. The Cronbach's α coefficient of the study was $\alpha=.95$ on noise perception, $\alpha=.97$ on physiological response, and $\alpha=.94$ on psychological response.

3. Data analysis

We used the SPSS 20.0 program(Statistical Package for the Social Science for Windows) for the data collected in this study, and the significance level was tested at 0.05. Frequency analysis and descriptive statistical analysis were performed on

the general characteristics of the subject, the degree of recognition of dental noise, physiological response, and psychological response. The differences in cognitive level, physiological response, and psychological response of dental noise according to general characteristics were analyzed by t-test and one way ANOVA, and post-test of Scheffe test. Correlation analysis was used to confirm the relationship between the recognition degree, physiological response, and psychological response of dental noise.

III. Results

1. Awareness of Dental Noise according to General Characteristics

Table 1. shows the results of analyzing the recognition level of voice noise, dental machine sound noise, and environmental noise, which are sub-factors of the recognition level of dental noise according to general characteristics. There were statistically significant differences in age and occupation in all dental noise.

As for the age in the voice noises, the '40 to 49-year-old' group had the highest score of 3.74 points, and the '20 to 29-year-old' group had the lowest score of 2.32. As for the job in the voice noises, the 'office worker' group had the highest

Table 1. Awareness of Dental Noise according to General Characteristics

N=205

Division		n	Awareness of dental noise					
			voice noise		machine noise		environment noise	
			M±SD	t/F(p)	M±SD	t/F(p)	M±SD	t/F(p)
Sex	Female	112	2.63±1.37	0.60 (.723)	3.69±1.03	-0.72 (.469)	2.69±1.47	-0.29 (.775)
	Male	93	2.75±1.34		3.74±1.29		2.68±1.40	
Age	≤ 19	25	2.50±1.54 ^{ab}	10.54 ($<.001$)	3.33±1.08 ^a	3.94 (.005)	2.66±1.39 ^a	7.88 ($<.001$)
	20s	37	2.32±0.92 ^a		3.51±0.79 ^a		2.15±0.64 ^a	
	30s	45	2.77±1.30 ^{ab}		3.68±1.06 ^{ab}		2.83±1.03 ^a	
	40s	50	3.74±1.38 ^c		4.26±1.34 ^b		3.60±1.49 ^b	
	≥ 50s	48	3.11±1.03 ^{bc}		3.78±1.19 ^{ab}		2.75±1.51 ^a	
Job	Student	34	2.39±1.17 ^a	4.68 ($<.001$)	3.51±1.10 ^a	2.73 (.036)	2.35±1.15 ^a	4.98 ($<.001$)
	Service worker	53	3.11±1.46 ^{ab}		3.79±1.25 ^{ab}		3.12±1.59 ^{ab}	
	Office worker	47	3.46±1.59 ^b		4.28±1.03 ^b		3.40±1.61 ^b	
	Specialized worker	38	3.09±1.53 ^{ab}		3.72±1.43 ^{ab}		2.99±1.60 ^{ab}	
	Other	33	2.74±1.51 ^{ab}		3.80±1.01 ^{ab}		2.68±1.35 ^{ab}	

** The data were analyzed by t-test, one way ANOVA(*^{a,b,c} scheffe post-hoc)

score of 3.46 points, and the 'student' group had the lowest score of 2.39 points($p<.001$). As a result of post-mortem analysis, those in their 20s were significantly lower than those in their teens and 30s, and those in their 40s were statistically higher than those in their 50s.

As for awareness of the dental machine noise, it was the highest at 4.26 points in the '40 to 49 year old' group ($p<.01$) and the lowest at 3.33 points in the 'under 19 year old' group. It was the highest at 4.28 points in the 'office worker' group and the lowest at 3.51 points in the 'student' group($p<.05$). As a result of post-mortem analysis of voice noise and dental machine sound noise, those in their 40s were statistically significantly higher than those in their 20s. Office workers were statistically higher than students.

As for awareness of the environment noise, it was the highest at 3.60 points in the '40 to 49 year old' group. It was the lowest at 2.15 points in the '20 to 29 year old group. It was the highest at 3.40 points in the 'office worker' group, and the lowest at 2.35 points in the 'student' group($p<.001$). As a result of post-mortem analysis, those in their 40s were significantly higher than those of other ages, and students were statistically lower than those of office workers.

2. Psychological or physiological responses of patients according to general characteristics

Table 2. shows the results of analyzing the difference in the degree of psychological or physiological response according to general characteristics, both psychological and physiological responses showed statistically significant differences in age and occupation. The results of the survey on the degree of psychological response are as follows. As for the age, the 40 to 49-year-old group had the highest score at 4.11 points, and the 20 to 29-year-old group had the lowest score at 2.23 points. As a result of post-mortem analysis, those in their 40s were statistically significantly higher than those in their 20s. As for the job, the highest score was 3.71 in the office worker group, and the student group had the lowest score at 2.48 points.

The results of the survey on the degree of psychological response are as follows. As for the age, the 40 to 49-year-old group had the highest score at 3.98 points, and the 20 to 29-year-old group had the lowest score at 2.10. As for the job, the office worker group had the highest score at 3.45 points, and the student group had the lowest score at 2.29 points ($p<.001$). As a result of post-mortem analysis, students were statistically lower than office workers.

Table 2. Psychological and physiological responses based on general characteristics

Division		n	Psychological response		Physiological response	
			M±SD	t/F(p)	M±SD	t/F(p)
Sex	Female	112	3.13±1.45	1.13 (.266)	2.92±1.06	0.72 (.459)
	Male	93	2.77±1.64		2.81±1.42	
Age	≤ 19	25	2.58±1.42 ^{ab}	15.64 ($<.001$)	2.62±1.49 ^a	14.91 ($<.001$)
	20s	37	2.23±0.75 ^a		2.20±0.82 ^a	
	30s	45	2.99±1.39 ^b		2.68±1.41 ^a	
	40s	50	4.11±1.35 ^c		3.98±1.45 ^b	
	≥ 50s	48	2.90±1.36 ^b		2.79±1.59 ^a	
Job	Student	34	2.48±1.13 ^a	6.90 ($<.001$)	2.29±1.07 ^a	5.59 ($<.001$)
	Service worker	53	3.22±1.54 ^{abc}		3.08±1.64 ^{ab}	
	Office worker	47	3.71±1.46 ^c		3.45±1.56 ^b	
	Specialized worker	38	3.30±1.58 ^{bc}		3.20±1.50 ^{ab}	
	Other	33	2.75±1.40 ^{ab}		2.76±1.49 ^a	

*by t-test or one-way ANOVA, *^{a,b,c} Tdenotes the same sub group by Scheffe test

3. Awareness of Dental Noise according to Dental Experience

Table 3. shows the results of analyzing the degree of recognition of dental noise according to dental experience by dividing it into voice noise, dental machine sound noise, environment noise. It showed statistically significant differences in treatment, clinic type, and visit period in terms of voice noise, treatment and clinic type in terms of dental machine sound noise, treatment and visit period in terms of environment. The results of the survey on the awareness degree of voice noise are as follows. As for the treatment, it was the highest at 3.35 points in the "prosthetic treatment" group, and the lowest at 1.41 points in the "orthodontic treatment" group(p<.01). As for the clinic type was the highest at 3.01 points in the "open-ended" group, and the lowest at 2.40 points in the "stand-alone" group(p<.05). And as for the visit period was the highest at 3.18 points in the "less than 6 months" group, and the lowest at 2.19 points in the "more than 12 months" group(p<.001). As a result of post-mortem analysis, the group over 12 months was statistically significantly lower in the group under 12 months.

The results of the survey on the awareness degree of dental machine noise are as follows. As

for the treatment, it was the highest at 4.06 points in the "Oral prophylaxis" group and the lowest at 2.95 points in the "oral examination" group(p<.05).

As for the clinic type, the "section" group was the highest at 3.98, and the "stand-alone" was the lowest at 3.15 points(p<.001). As a result of post-mortem analysis, the standalone clinic was statistically significantly lower than that of the sectional and open type.

The results of the survey on the awareness degree of environment noise are as follows.

As for the treatment, the highest score was 3.30 in the "prosthetic treatment" group, and the lowest score was 1.68 in the "orthodontic treatment" group(p<.001). As for the visit period was the highest at 3.30 points in the "less than 6 months" group, and the lowest at 2.00 points in the "more than 12 months" group(p<.001). As a result of post-mortem analysis, the group over 12 months was statistically significantly lower in the group under 6 months.

4. Psychological or Physiological Response to Dental Experience

Table 4. shows the results of analyzing the difference in the degree of psychological or physiological response according dental experience.

Table 3. Awareness of Dental Noise according to Dental Experience

Division		n	Degree of recognition of dental noise					
			Voice noise		Machine noise		Environment noise	
			M±SD	t/F(p)	M±SD	t/F(p)	M±SD	t/F(p)
Treatment	Oral prophylaxis	59	3.20±1.41	3.26 (.007)	4.06±1.13	2.45 (.035*)	3.16±1.32	4.77 (<.001)
	Dental preservation	78	2.49±1.19		3.50±1.05		2.32±1.25	
	Prosthetic Tx.	28	3.35±1.65		3.62±1.53		3.30±1.68	
	Oral examination	14	2.89±1.88		2.95±1.94		2.66±1.76	
	Surgical operation	23	2.57±1.42		3.77±1.24		2.49±1.51	
	Orthodontic Tx.	3	1.41±0.39	3.71±0.71	1.68±0.03			
Visit period	≤6M	48	3.18±1.62 ^b	10.59 (<.001)	3.86±1.34	2.70 (.065)	3.30±1.49 ^b	14.31 (<.001)
	6-12M	116	2.82±1.04 ^b		3.63±1.21		2.52±1.46 ^{ab}	
	more than 12M	41	2.19±0.79 ^a		3.46±0.83		2.00±0.62 ^a	
Clinic type	Open-ended	105	3.01±1.31	3.68 (.027)	3.86±1.08 ^b	6.71 (<.001)	2.87±1.36	2.89 (.051)
	Stand-alone	42	2.40±1.25		3.15±1.29 ^a		2.65±1.40	
	Section	58	2.87±1.59		3.98±1.25 ^b		2.90±1.59	
Dental size	Private hospital	161	2.82±1.45	1.06 (.347)	3.79±1.14	2.80 (.052)	2.79±1.52	0.40 (.709)
	General hospital	29	2.80±1.39		3.44±1.55		2.82±1.51	
	University hospital	15	2.29±1.56		3.07±1.41		2.43±1.70	

*by one-way ANOVA, *^{a,b,c} Tdenotes the same sub group by Scheffe test

Table 4. Psychological and Physiological Response to Dental Experience

Division		n	Psychological Response		Physiological Response	
			M±SD	t/F(p)	M±SD	t/F(p)
Treatment	Oral prophylaxis	59	3.39±1.48	4.81 (<.001)	3.20±1.65	4.35 (<.001)
	Dental preservation	78	2.53±1.25		2.35±1.13	
	Prosthetic treatment	28	3.49±1.63		3.38±1.77	
	Oral examination	14	2.79±1.89		2.71±1.78	
	Surgical operation	23	1.73±0.31		2.54±1.51	
	Orthodontic Tx.	3	1.70±0.00		1.40±0.00	
Visit period	≤ 6M	48	3.23±1.48 ^b	8.40 (<.001)	3.12±1.59 ^b	9.16 (<.001)
	6-12M	116	2.77±1.42 ^{ab}		2.75±1.42 ^{ab}	
	more than 12M	41	2.39±0.89 ^a		2.12±0.85 ^a	
Clinic type	Open-ended	105	3.01±1.45	2.81 (.065)	2.89±1.58	2.78 (.068)
	Stand-alone	42	2.58±1.64		2.47±1.46	
	Section	58	2.92±1.63		2.78±1.59	
Dental size	Private hospital	161	2.89±1.53	1.78 (.175)	2.68±1.50	1.58 (.211)
	General hospital	29	3.25±1.59		3.12±1.62	
	University hospital	15	2.26±1.54		2.26±1.59	

*by one-way ANOVA, *^{a, b} Tdenotes the same sub group by Scheffe test

There was a statistically significant difference in treatment and visit period in dental experience. The results of the survey on the psychological response are as follows. As for the treatment, the "prosthetic treatment" group had the highest score of 3.49 points, and the "orthodontic treatment" group had the lowest score of 1.70 points. As for the visit period, the "less than 6 months" group had the highest score of 3.23 points, and the "more than 12 months" group had the lowest score of 2.39 points. As a result of post-mortem analysis, the psychological response was statistically significantly lower in the group over 12 months than in the group under 6 months.

And the "orthodontic treatment" group had the lowest score of 1.40 points. The visit period was the highest in the "less than 6 months" group with 3.12 points, and the "more than 12 months" group with 2.12 points($p<.001$). As a result of post-mortem analysis, the group over 12 months had a statistically significantly lower physiological

response than the group under 6 months.

5. Relationship between Recognition of Dental Noise and Responses

Table 5. shows the results of analyzing the correlation between cognitive sub-factors and psychological responses, and physiological responses of dental noise. For the recognition of dental noises such as voice noise, dental machine noise, environment noise, psychological response, and physiological responses, all showed positive correlations. In other words, the higher the recognition of dental noise, the higher the degree of psychological and physiological response ($p<.01$). In particular, the higher the psychological response, the higher the correlation with the physiological response($r=.89$), and the higher the recognition of environment noise, the higher the psychological response($r=.86$).

Table 5. Correlation between Psychological and Physiological Responses and Dental Noise Awareness

Variables	Voice noise	Machine noise	Environment noise	Psychological response	Physiological response
Voice noise	1				
Machine noise	.719**	1			
Environment noise	.859**	.751**	1		
Psychological response	.804**	.727**	.863**	1	
Physiological response	.855**	.692**	.819**	.898**	1

** $p<.01$ The data were analyzed by person correlation coefficient

IV. Conclusions

The results of analyzing the patient's dental noise recognition level and response are as follows.

As a result of investigating the degree of recognition of voice noise, dental machine noise, and environment noise according to general characteristics, the level of recognition of noise was higher in 40 to 49 years old group and office worker group. In this study, it is thought that the office worker group perceived noise better because their hearing was preserved compared to field workers who were exposed to noise[6].

As a result of investigating the responses according to general characteristics, the degree of responses was higher in the 40 to 49 years of age. It was reported that the large amount of change in the hearing threshold causes a large hearing loss, and that hearing loss is occurring in the 40s or older[7][8]. Through this, it is believed that 40 to 49 are exposed to stress while undergoing various changes, increasing their sensitivity to noise, which is thought to affect responses. The response to noise varies according to the noise of the work environment by job, and as a result, it is believed that when office workers with low thresholds are exposed to noise, the response to noise is high[10].

In terms of the degree of recognition of voice noise, dental machine noise, and environment noise according to dental experience, voice noise

and environment noise according to treatment were the highest in the "prosthetic treatment" group, and

dental machine noise was the highest in the "Oral prophylaxis" group. By sound generated during dental treatment, the noise felt in the "prosthetic treatment" group and the "Oral prophylaxis" group was the highest, as ultrasonic scaling stimulation caused relatively higher levels of stimulation [3][5][11]. It is necessary to provide soundproof protective equipment to medical care and treatment personnel during scaling treatment, and to provide a separate space exclusively for scaling to reduce

indoor noise in hospitals, and to introduce a masking system[12].

Voice noise according to the clinic type was the highest in the 'open-ended' group and the lowest in the 'stand-alone' group. As for the dental machine noise, the 'section' group was the highest and the 'stand-alone' was the lowest. In the case of open-ended type and section-type clinics, the radius of exposure to noise is larger than that of the stand-alone clinic, so it seems that such research results were found. As for the voice noise and environment noise according to the visit period, the shorter the visit period, the higher the awareness and sensitivity to noise, and it is believed that the shorter the visit period, the better the noise was felt[3].

In terms of responses according to dental experience, prosthetic treatment was high score among the contents of treatment. Handpieces, the most commonly used device for prosthetic treatment, are reported to have a very loud sound of deleting or polishing prosthetics because they rotate, and through this, it is shown that the response was higher in prosthetic treatment in this study[11]. In this study, the shorter the visit period, the better the response was revealed. According to the fact that the shorter the period of accepting auditory information, the higher the recall accuracy, the 'less than 6 months' group showed higher response scores in this study.

Finally, as a result of confirming the correlation between dental noise perception and responses, all showed high correlations, among them, environment noise and psychological response was the highest, and dental machine noise and physiological response was the lowest. It was confirmed that the association between noise and psychological or physiological responses was high as the noise in the dentist increased[3][6].

The limitations of this study were the possibility of not being able to recognize noise due to a disease in the hearing-related organs among the subjects, the failure to consider such subjects, and

the failure to survey immediately after the patient's treatment. In addition, since it is limited to a specific area, there is a limit to generalization, and it was difficult to discuss the results due to the lack of research on patients in the dental care environment. In the future, research on various variables and noise in dental care environments will be actively conducted in the field of dental hygiene, and further discussions will be possible when the research results are accumulated. But this study is significant in that it compared the factors of noise in the dentist and the psychological and physiological responses of patients to noise.

Taking the above results together, it was confirmed that there is a relationship between the noise in the dentist and the patient's psychological or physiological response. Clinical studies such as confirming the effect of noise reduction through the study of the sound insulation effect of noise canceling earphones to apply noise reduction devices in dental clinical settings should be conducted continuously. Further research is conducted in the future to evaluate other related risk factors such as dental specialties and treatment hours, and efforts are needed to prevent hearing loss by paying attention to the noise-generating environment for essential improvement.

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