치의과학석사 학위논문

Peri-operative Evaluation of Inferior Alveolar Nerve Function in Patients with Posterior Mandibular Lesions

하악 구치부 병소 수술 전후 하치조신경 감각평가

2019 년 2 월

서울대학교 대학원
치의과학과 구강악안면외과학 전공
전 재 호

Abstract

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Jae-ho Jeon, D.D.S.
Program in Oral and Maxillofacial surgery,
Department of Dental Science,
Graduate School, Seoul National University
(Directed by Professor Hoon Myoung, D.D.S., M.S.D., Ph.D.)

Introduction

The purpose of this study was (1) to estimate the normal mean values of preoperative neurosensory test (NST) and seek for age, gender, or seasonal differences, (2) to compare pre- and post-extraction NST results of patients with sensory disturbance following removal of impacted mandibular third molar (MM3), and (3) to evaluate the risk of nerve impairment in patients with posterior mandibular lesions (PML) by assessing spatial relationship of the lesion and the mandibular canal using computed tomography (CT) analysis.

Methods

472 patients who underwent surgical removal of MM3 and PML by a single proficient oral surgeon at the Department of Oral and Maxillofacial Surgery, Seoul National University Dental Hospital between March 1, 2016 and June 30, 2018 were included in the study. All patients were examined for IAN injury through pre- and post-operative NST. NST consisted of Contact Threshold (CTH), Direction

(DIR), Two-point discrimination (2PD), and Pinprick (PP) tests. Statistical analysis was done using SPSS 22.0 (SPSS Inc, Chicago, IL). P-values of less than 0.05 were considered statistically significant.

1. Normal NST result variance: Pre-operative NST results of all 472 patients were acquired and analyzed through independent t-test, one-way ANOVA, and multiple regression.
2. NST results in MM3 extraction patients: Pre- and post-operative NST results of 482 cases among 301 patients were acquired and analyzed through chi-squared test and paired t-test.
3. NST results in PML removal patients: Pre- and post-operative NST results of 207 cases among 202 patients were acquired and analyzed through chi-squared test, Fisher's exact test, logistic regression analysis, and paired t-test.

Results

1. Normal NST result variance: Female patients showed higher sensitivity in CTH with statistical significance. Age, gender, and season of the year were associated with statistically significant differences in DIR and 2PD results. Gender and season were associated with statistically significant difference in PP results.
2. NST results in MM3 extraction patients: 8 cases of transient IAN impairment were noted, all of which returned to normal in 3 months postoperatively. Paired t-test between pre-operative NST and post-operative NST of the 8 patients showed statistically significant difference in DIR only.

3. NST results in PML removal patients: 29 cases of post-operative IAN impairment were noted. Pathologic diagnosis and spatial relationship between the lesion and the IAN showed statistically significant association with IAN impairment. Post-operative NST showed statistically significant difference from pre-operative NST in all four components: CTH, DIR, 2PD, and PP.

Conclusion

1. Females showed higher sensitivity in pre-operative NST than males.
2. Patients up to 30 years of age showed higher sensitivity in direction and 2-point discrimination tests compared to those over 30 years of age.
3. Normal NST results varied by season by statistically significant difference.
4. Nerve damage after third molar extraction occurred in 1.7% of patients, all of which returned to normal in 3 months. Comparison between pre- and post-operative NST of those with nerve damage showed statistically significant difference in direction test only.
5. Higher probability of nerve damage is expected with more compression or translocation of mandibular canal and higher intimacy between mandibular canal and the lesion. (HZ ratio: 3.467)
6. In patients who reported neurosensory deficit following removal of posterior mandibular lesions, post-operative NST results showed statistically significant difference from pre-operative NST in all test categories.

Key words: Inferior alveolar nerve, Nerve damage, Neurosensory test, Posterior mandibular lesion

Student Number: 2012-21825

CONTENTS

1. Introduction

Inferior alveolar nerve (IAN) is an essential consideration for oral and maxillofacial surgeons. Posterior mandibular lesions (PMLs) adjacent to the IAN are especially prone to damage during removal of the lesion and associated dentition.[1] There has been numerous studies on the frequency and prognosis of sensory anomaly of IAN from dental implant surgery and impacted mandibular third molar (MM3) extraction[2–4]. However, studies on the frequency and risk of damage to the IAN from removal PMLs are rare[5–7].

Neurosensory damage can be categorized into 1) anesthesia, hypoesthesia or dysesthesia depending on symptoms, 2) intraosseous or extraosseous lesions depending on anatomical location of injury, 3) neuroma or fibrosis depending on histological findings, and 4) nerve compression or amputation depending on degree of damage. A comprehensive and standardized evaluation protocol that incorporates all aspects of neurosensory damage is needed because signs and symptoms vary widely by the extent and nature of the nerve injury.[8,9]

The purpose of this study was (1) to estimate the normal mean values of preoperative neurosensory test (NST) and seek for age, gender, or seasonal differences, (2) to compare pre- and post-extraction NST results of patients with sensory disturbance following removal of impacted mandibular third molar (MM3), and (3) to evaluate the risk of nerve impairment in patients with posterior mandibular lesions (PML) by assessing spatial relationship of the lesion and the mandibular canal using computed tomography (CT) analysis.

2. Methods

The design of this retrospective cohort study was approved by the institutional review board of Seoul National University Dental Hospital (Seoul, Korea). 472 patients who underwent surgical removal of MM3 and PML by a single proficient oral surgeon at the Department of Oral and Maxillofacial Surgery, Seoul National University Dental Hospital between March 1, 2016 and June 30, 2018 were included in the study. All patients were examined for IAN injury through pre- and post-operative NST.

Exclusion criteria were 1) patients who underwent surgery that did not involve IAN (e.g. maxillary lesions, maxillary third molars, and anterior mandibular lesions), 2) patients with prior history of IAN damage, and 3) patients who declined preoperative NST.

Neurosensory Test (NST)

The neurosensory test (NST) consisted of Contact Threshold (CTH), Direction (DIR), Two-point discrimination (2PD), and Pinprick (PP) tests. All tests were performed by single well-trained examiner. Complete NSTs were performed at least twice to each patient: before surgery and one week after surgery. For patients with post-operative sensory disturbance, additional NST was performed 3 months after surgery.

In order to take into account both subjective and objective aspects of neurosensory function, both self-reported symptoms and NST results were collected. Patients were first interviewed for subjective neurosensory symptoms, and NST followed. Patients' subjective symptoms were prioritized over NST results in determining presence or absence of neurosensory impairment.

During NST, patients were instructed to keep their eyes closed and answer with the least lip movement as possible. If a response was uncertain, it was regarded as "no" (CTH), "incorrect" (DIR, 2PD), or "not painful" (PP). NST was performed on lower lip and chin area. Each side (left or right) were divided into sextants as shown in Fig.1. Tests were conducted in the order of superior to inferior, medial row first and then the lateral. Unaffected side was tested first, followed by the affected (injured) side. For pre-operative tests and in cases where patient reported no subjective symptoms of nerve damage, right sides were tested first.

1) Contact threshold (CTH)

Contact threshold test was performed by applying Von Frey hair (Figure 2) perpendicular to the skin surface and pressing until it bends slightly for about 1 second. Each point was tested 3 times consecutively, and positive response to at least one stimulus was regarded as "positive." Starting with No.1.65, ascending order of tests were done until a positive response was noted. Then starting from 3 steps stiffer, descending order of tests were done until a negative response was

noted. In the descending series, last stimulus that evoked positive response was recorded as threshold; that is, one step stiffer than the final stimulus that resulted in negative response. Average of the two threshold values from ascending and descending series was recorded.

2) Direction (DIR)

Direction test was performed in the sextant that showed the lowest contact threshold on each side. The thinnest hair that the patient began to perceive during the ascending series of CTH was used. Unaffected side (or right side) was tested first. Von Frey hair was pressed at the center of the designated sextant until it bent slightly and move to right, left, and downward over 1 cm in a straight line. The patient was asked to answer the direction of movement. 20 strokes per side were done, and the percentage of correct answers was recorded. 7 strokes to the right, 7 to the left, and 6 downward strokes were performed in random order.

3) Two-point discrimination (2PD)

Two-point discrimination tests were performed in the same regions as the direction tests. A compass with rounded 23-gauge needle tips on both legs (Figure 3) and a ruler were used for the test. Compass was applied perpendicularly to the center of the sextant for 1 second without causing depression or blanching of the skin. Unaffected sides were tested first. Ascending order test was done in 1mm increments from 1 mm to 15 mm and in 2 mm increments from 15 mm to 25 mm.

Then, a descending order test starting from 3 steps higher was done vice versa. This process was repeated, thus 2PD test on each sextant comprised of ascending-descending-ascending-descending series, and the 4 resulting values were averaged.

4) Pin prick (PP)

Pin prick tests were performed in the same regions as the direction tests. A dial tension gauge with rounded 23-gauge needle tip attached was used (Figure 4). Rounded needle tip was pressed perpendicularly onto skin surface and slowly pressed in 10g increments. Patient was asked to say "stop" when the he/she began to feel sharp pain instead of dull pressure. Pressure was increased only up to 150g in order to prevent skin injury. The test was conducted 3 times, and the values were averaged.

Statistical analysis

Statistical analysis was done using SPSS 22.0 (SPSS Inc, Chicago, IL) and P value less than 0.05 ($p<0.05$) was considered statistically significant. Test results were analyzed in three following categories

1) Normal NST variance:

Total of 944 sides of 472 patients were analyzed through independent t-test, one-way ANOVA and multiple linear regression analysis. Groups were divided by age (up to and including 30 vs. over 30), gender (male vs. female), and season of the

year (Spring: March - May, Summer: June - August, Autumn: September - November, and Winter: December - February). For the CTH value, Average of 6 regions per side was recorded.

2) NST results in MM3 extraction patients:

Pre-operative and post-operative NST results of 482 cases among 301 patients were acquired. Results were grouped by gender and sides (left or right) and analyzed through chi-squared test and paired t-test.

3) NST results in PML removal patients:

Preoperative and postoperative NST results of 207 cases among 202 patients who underwent excision of lesions in mandibular first premolar to mandibular body and ramus region. Positional relationship between IAN and lesion was classified into 6 categories through CT evaluation. Chi-squared test, Fisher's exact test, logistic regression analysis and paired t-test were performed.

CT evaluation

Axial, sagittal, and coronal CT images were used to assess the spatial relationship between the IAN and the lesion three-dimensionally (Figure 5).

- If the IAN and the lesion were separated from each other, it was classified as "Level 1"

- If the IAN and the lesion were in contact but the cortical lining of mandibular canal was intact, it was classified as “Level 2”
- If the IAN and the lesion were in contact and erosion of cortical lining of mandibular canal was less than 5.0mm without deformation of the cross-section of mandibular canal, it was classified as “Level 3”.
- If the cortical lining erosion was 5.0mm or more and the cross section of mandibular canal shows oval deformation, it was classified as “Level 4”.
- If the mandibular canal showed lingual or buccal displacement with flattening deformation, it was classified as “Level 5”.
- If the mandibular canal ran through the middle of the lesion, it was classified as “Level 6”.

3. Results

1) Normal NST result variance

Of the 472 participants, 242 were male and 230 were female. Patient age ranged from 5 to 88 years with mean age of 33.2 years and median of 30 years.

The average pre-operative CTH per region ranged from 1.669 to 1.714. The most sensitive area was the upper medial part, while the dullest area was the lower medial part. The mean value of pre-operative DIR was about 80%, 2PD was 7.7 mm, and PP was 50 g (Figure 6).

Patient gender was associated with statistically significant difference in CTH, DIR, 2PD, and PP. Female patients showed higher sensitivity than males in all tests, and the differences were all statistically significant (Tables 1).

Patients under 30 years of age showed higher mean sensitivity compared to those over 30 in all 4 components of NST, but only DIR and 2PD results varied with statistical significance. (Table 2)

NST results showed seasonal variance that were different from one component to another. (Table 3 and 4)

- CTH showed the highest mean sensitivity in the Summer and the lowest in the Spring. (Summer > Autumn > Winter > Spring)

- DIR showed the highest mean sensitivity in the Summer and the lowest in the Spring. (Summer > Winter > Autumn > Spring)
- 2PD showed the highest mean sensitivity in the Summer and the lowest in the Autumn. (Summer > Spring > Winter > Autumn)
- PP showed the highest mean sensitivity in the Winter and the lowest in the Spring. (Winter > Summer > Autumn > Spring)

And only significant differences in gender were found in multiple linear regression analysis (Table 5).

2) NST results in MM3 extraction patients

Among 482 cases of MM3 extraction, 229 were male and 253 were female. Mean age of the patients was 27.7 years. Post-operative neurosensory impairment was reported in 8 cases, all of which had recovered by 3 months after surgery. Chi-squared test showed no statistically significant association between occurrence of neurosensory impairment and gender or sides—right and left (Tables 6 and 7). Paired t-test comparing pre-operative and post-operative NST of those with neurosensory impairment following MM3 extraction showed statistically significant difference only in DIR results (Table 8).

3) NST results in PML removal patients

Among 207 cases of PML removal, 130 were male and 77 were female. Patient

age ranged from 6 to 82 years with mean age of 40.8 years. Post-operative neurosensory impairments were reported in 29 cases. Pathologic diagnoses included Dentigerous cyst (85 cases), Odontogenic Keratocyst (32 cases), Pericoronitis (21 cases), Osteomyelitis (18 cases), Periapical cyst (13 cases), Ameloblastoma (9 cases), and others (29 cases) (Figure 7). Chi-squared test, and Fisher's exact test results showed no significant association between post-operative sensory impairment and patient gender. However, pathologic diagnosis and spatial relation of lesion to mandibular canal showed statistically significant association with post-operative sensory impairment (Figures 8,9). The logistic regression analysis showed higher probability of nerve damage when there is more compression or displacement of mandibular canal, and higher proximity between mandibular canal and the lesion (Table 9). Paired t-test comparing pre-operative and post-operative NST of those with neurosensory impairment following PML removal showed statistically significant difference in all 4 components (CTH, D, 2PD, and PP) (Table 10).

4. Discussion

Among different types of nerve injury classifications, clinical symptom-based diagnosis (category 1) was used in this study. In order to accurately take into account the patients' subjective symptoms and objective data of NST, both self-reported symptoms and NST results were collected at a single visit. Patients were asked first to describe neurosensory symptoms, and neurosensory function test followed. Patients' subjective symptoms were prioritized over NST results in determining presence or absence of neurosensory impairment.

G.E. Ghali et al.[10] recommended two point discrimination, static light touch, brush directional stroke, pinprick and thermal discrimination tests for IAN nerve injured patients. Thermal discrimination test was included in the NST protocol, but the collected data was not included in the study because patients responded in short answers, thus the information could not be analyzed statistically. Thermal test results did, however, show tendency to be more sensitive in patients with neurosensory impairments. Unlike many similar previous studies, all patients included in this study underwent pre-operative NST. Therefore, instead of arbitrary norms, actual baseline measurements were used for comparison, making the statistical analyses more reliable.

In order to quantify sensory disturbance, Essick et al.[11] emphasized that both interview and standardized neurosensory test should be utilized. They proposed a 3-

stage test: first stage is the direction and two-point discrimination tests, second stage is the contact threshold test, and the last stage is the pinprick nociception test.

This study aimed to incorporate pre-operative NST result and subjective symptoms with post-operative counterpart in order to accurately assess patients' cognitive and recovery level of neurosensory function regardless of presence or absence of actual nerve injury. For those with obvious neurosensory impairments, separate statistical comparison was done within the group for further investigation.

Lee et al.[12] reported results of IAN NST on 40 healthy Korean men and women aged 27-29 years to estimate the normal NST response and identify variance within healthy population. They reported that mean CTH was 1.65 for both male and female, while females showed significantly higher sensitivity to DIR and PP tests. Mean 2PD distance was smaller in women but the difference was not statistically significant. In this study, gender differences were statistically significant in all 4 tests, and females showed higher sensitivity to all tests.

One interesting attempt included in this study was to link normal NST data with the season of year the tests were undertaken. Interestingly, CTH, DIR, and 2PD showed significantly higher sensitivity during summer while PP was the most sensitive during winter season. CTH and DIR were least sensitive in the spring. This result may help clinicians understand seasonally varying response to NST in certain

long-term follow-up cases. Furthermore, results of this study may be referenced in future studies on outcomes of nerve repair and nerve graft cases.

Reported incidence of IAN damage from MM3 extraction ranges from 0.5% to 8%, and the mean incidence is approximately 5%[3,13,14] The incidence of IAN disturbance from MM3 extraction in this study was about 1.7%, which is relatively low. Also, all neurosensory impairments following MM3 extractions were transient, and all patients recovered within 3 months.

This study is notable in design since pre-operative NST data was directly compared to post-operative NST data of patients with neurosensory impairments. Usually, NST is done only when a patient reports of sensory disturbance. In such case, post-operative values can only be compared to population norm instead of the affected individual's pre-operative state. Interestingly, according to the results of this study, only DIR values showed statistically significant difference in cases of sensory impairments following MM3 extraction. Such finding is in support of Essick and colleagues' suggestion of performing DIR as the first stage test in cases of suspected nerve damage.[11]

There has been a number of studies on evaluation of panoramic x-ray and CBCT to assess the risk of nerve damage in MM3 extraction cases.[15–17] However, similar studies regarding PML removal are hard to find. In order to grand objectivity in CT analysis, six categories of spatial relationship between mandibular canal and PML

were classified. The authors classified the relationship between nerve and PML into six levels and assess each group's risk of nerve damage, based on review of previous studies on MM3 extraction. Hasani et al. and Ghaeminia, H. *et al.* assessed on panoramic radiograph and cone beam computed tomography for analyzing anatomical relationship between the mandibular canal and roots of the third molar[17,18],

Park and colleagues assessed the risk of nerve damage during extraction of MM3 based on CT analysis. They wrote that the primary predictor variable for nerve damage during MM3 extraction was the cortical integrity of the mandibular canal[19]. With reference to similar previous studies involving CT imaging, classification of spatial relationship between mandibular canal and PML was proposed in this study. Axial, sagittal, and coronal CT view at the borderline between mandibular canal and the lesion were examined and 6 classes of spatial relationship were determined. Incidence of post-operative neurosensory impairments was correlated with the spatial classification and risk of nerve damage was assessed for each class. As expected, the risk of nerve injury was higher with increasing order of positional classification. Higher order of positional classification between mandibular canal and PML was shown to be a statistically significant risk factor in logistic regression analysis. (HZ ratio: 3.467)

Nevertheless, this study had some limitations. First, even though the neurosensory tests were performed by a highly skilled examiner, there could have been bias and

inconsistencies because there was only one examiner. Also, almost 30% of patients who underwent pre-operative NST refused the post-operative test, so paired t-test between preoperative and postoperative NST of patients without neurosensory symptoms could not be performed.

NST protocol used in this study seems to be a safe and accurate method to assess pre-operative and post-operative IAN function status. Since IAN is one of the most commonly injured sensory nerve in the maxillofacial region, accurate and comprehensive medical record is of utmost importance. In addition, according to the survey completed by patients who were enrolled in the study, most patients acknowledged the necessity of NST and accepted the cost of the test without objection. If it is possible to incorporate patient's subjective expression into NST and successfully objectify the numerical data of each test component, NST may have an essential function as a standard protocol for treatment of posterior mandibular lesions.

5. Conclusion

1. Females showed higher sensitivity in pre-operative NST than males.

2. Patients up to 30 years of age showed higher sensitivity in direction and 2-point discrimination tests compared to those over 30 years of age.

3. Normal NST results varied by season by statistically significant difference.

4. Nerve damage after third molar extraction occurred in 1.7% of patients, all of which returned to normal in 3 months. Comparison between pre- and post-operative NST of those with nerve damage showed statistically significant difference in direction test only.

5. Higher probability of nerve damage is expected with more compression or translocation of mandibular canal and higher intimacy between mandibular canal and the lesion. (HZ ratio: 3.467)

6. In patients who reported neurosensory deficit following removal of posterior mandibular lesions, post-operative NST results showed statistically significant difference from pre-operative NST in all test categories.

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Figure Legend

Figure 1. NST data recording sheet – UM: Upper medial, MM: Middle medial, LM: Lower medial, UL: Upper lateral, ML: Middle lateral, LL: Lower lateral,

Figure 2. Von Frey hair

Figure 3. A compass with rounded 23-gauge needle tips on both legs

Figure 4. A dial tension gauge with rounded 23-gauge needle tip attached

Figure 5. CT evaluation: spatial relationship between the IAN and the lesion

A,B– Level 1, C,D – Level 2, E,F - Level 3,

G,H - Level 4, I,J - Level 5, K,L – Level 6.

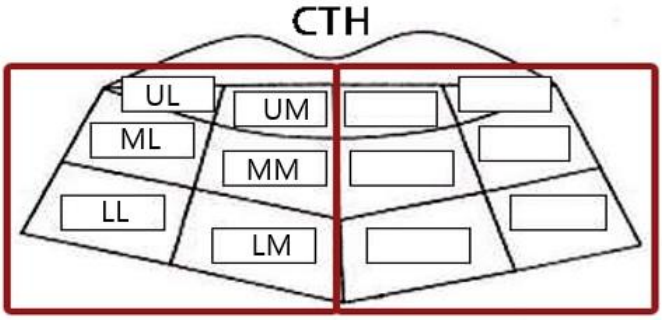
Figure 6. Overall average value of IAN sensory test.

Figure 7. Pathologic diagnoses of PMLs.

Figure 8. IAN damage after surgery by pathologic diagnosis.

Figure 9. IAN damage after surgery by relationship between nerve and lesion.

Figure 1.



	Rt	Lt
Direction		
2PD		
PP		

Figure 2.


2.44 kHz
2.36 kHz
1.65 kHz
2.83 kHz
3.22 kHz
3.61 kHz
3.84 kHz
4.08 kHz
4.17 kHz
4.31 kHz
4.56 kHz
4.74 kHz
4.93 kHz
5.07 kHz
5.18 kHz
5.48 kHz
5.88 kHz
6.10 kHz
6.45 kHz
6.85 kHz

Figure 3.

Figure 4.

Figure 5

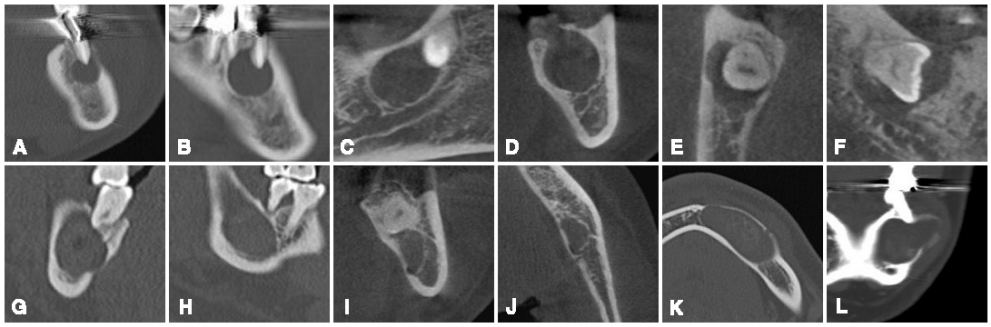
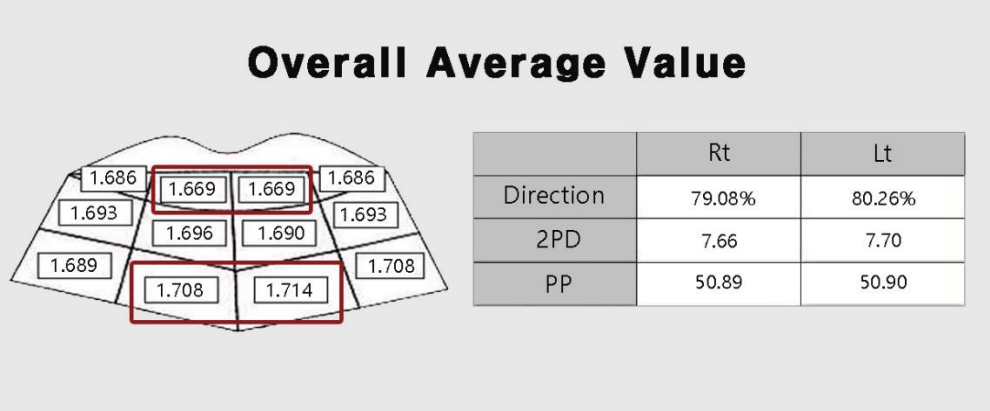


Figure 6.



	Rt	Lt
Direction	79.08%	80.26%
2PD	7.66	7.70
PP	50.89	50.90

Figure 7.

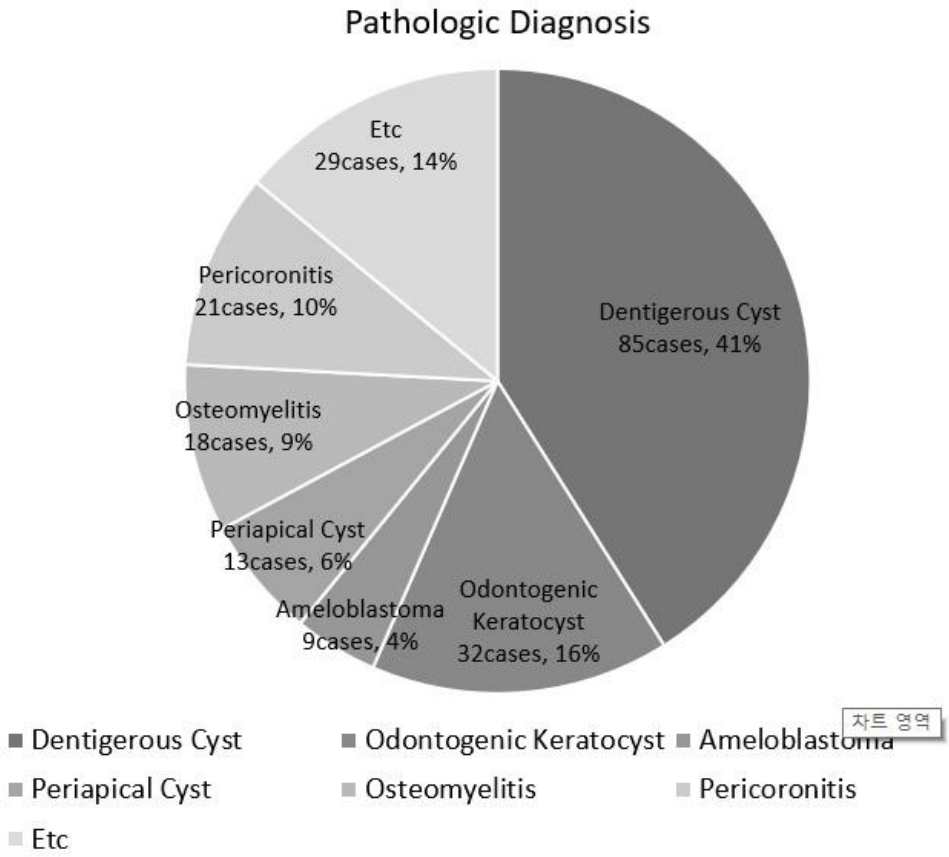

Pathologic Diagnosis
Etc
29cases, 14%
Pericoronitis
21cases, 10%
Dentigerous Cyst
85cases, 41%
Osteomyelitis
18cases, 9%
Periapical Cyst
13cases, 6%
Ameloblastoma
9cases, 4%
Odontogenic
Keratocyst
32cases, 16%
차트 영역
Dentigerous Cyst
Odontogenic Keratocyst
Ameloblastoma
Periapical Cyst
Osteomyelitis
Pericoronitis
Etc

Figure 8.

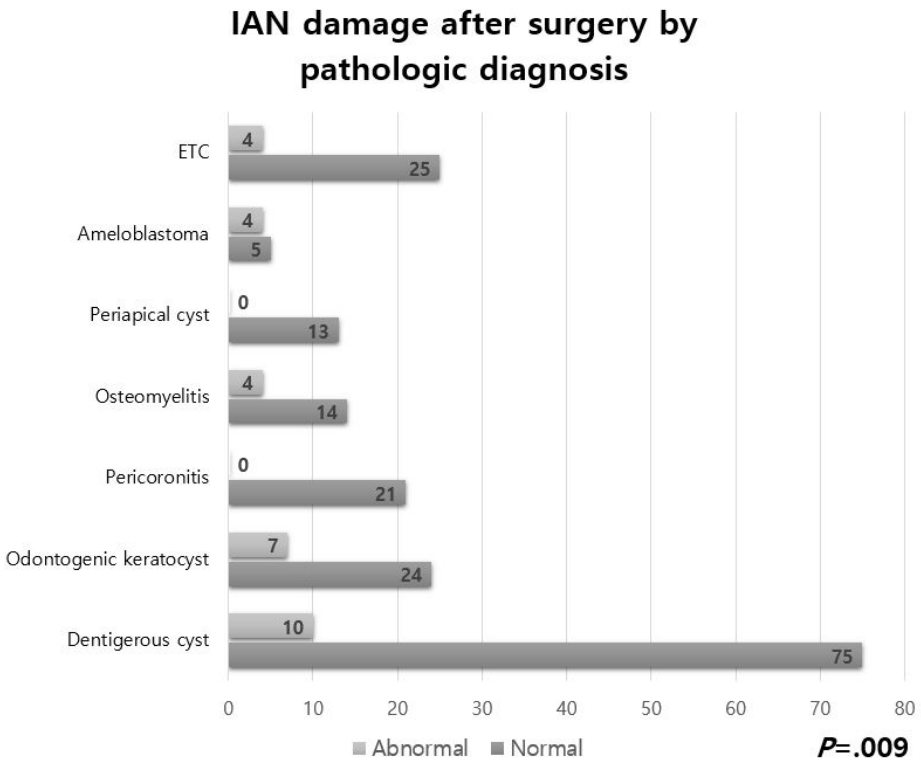

IAN damage after surgery by pathologic diagnosis
ETC
Ameloblastoma
Periapical cyst
Osteomyelitis
Pericoronitis
Odontogenic keratocyst
Dentigerous cyst
4
25
4
5
0
13
4
14
0
21
7
24
10
75
0
10
20
30
40
50
60
70
80
Abnormal
Normal
P=.009

Figure 9.

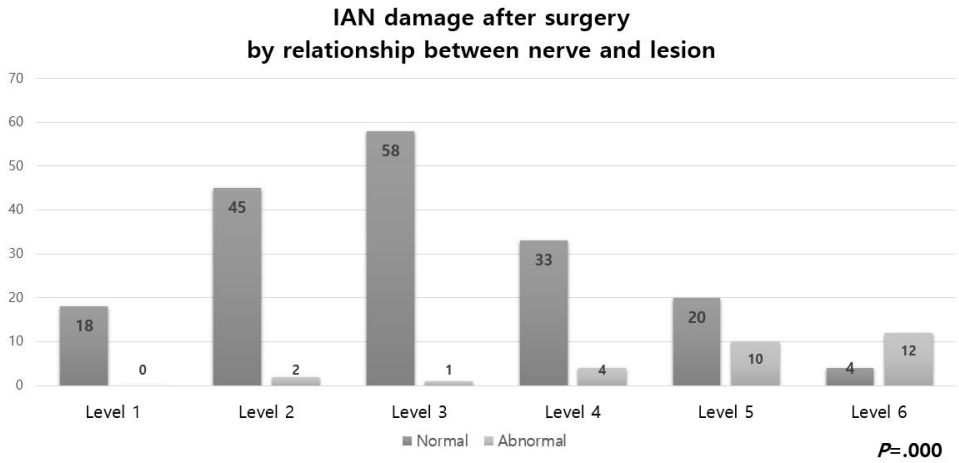

IAN damage after surgery
by relationship between nerve and lesion
70
60
50
40
30
20
10
0
18
0
45
2
58
1
33
4
20
10
4
12
Level 1
Level 2
Level 3
Level 4
Level 5
Level 6
Normal
Abnormal
P=.000

Table. 1 Independent t-test by gender (Normal NST result variance)

	Mean ± SD		
Sensory Test	Males (N=486)	Females (N=458)	***P***
CTH	1.71±1.14	1.65±0.05	***.000****
DIR (%)	67.7±26.9	92.3±13.1	***.000****
2PD (mm)	7.8±2.1	7.4±2.0	***.001****
PP (g)	54.3±27.0	46.6±24.8	***.000****

SD indicates standard deviation

**P*<0.05.

Table. 2 Independent t-test by Age (Normal NST result variance)

Sensory Test	Mean ± SD		***P***
	30≥ (N=490)	30< (N=454)	
CTH	1.68±0.11	1.69±0.12	***.234***
DIR (%)	84.1±22.4	74.8±26.0	***.000****
2PD (mm)	7.2±2.02	8.1±2.1	***.000****
PP (g)	49.7±24.2	51.5±28.3	***.277***

SD indicates standard deviation

**P*<0.05.

Table 3. One–way ANOVA by season (Normal NST result variance)

	Mean ± SD				
Sensory Test	Spring (N=306)	Summer (N=246)	Autumn (N=254)	Winter (N=138)	***P***
CTH	1.710±0.146	1.667±.079	1.684±0.109	1.690±0.101	***.000****
DIR (%)	73.7±26.6	85.8±19.4	78.4±26.4%	84.0±21.9	***.000****
2PD (mm)	7.6±2.3	7.3±2.1	7.9±1.9	7.8±1.8	***.005****
PP (g)	57.3±33.1	46.4±20.4	50.4±23.9	43.5±17.9	***.000****

ANOVA indicates analysis of variance.

SD indicates standard deviation

**P*<0.05.

Table 4. One–way ANOVA by season (Normal NST result variance)

Sensory Test	Season vs Season		***P***
CTH	Spring	Summer	***.000****
	Spring	Summer	***.000****
DIR	Spring	Winter	***.000****
	Summer	Autumn	***.002****
2PD	Summer	Autumn	***.002****
	Spring	Summer	***.000****
	Spring	Autumn	***.026****
PP	Spring	Winter	***.000****
	Autumn	Winter	***.008****

ANOVA indicates analysis of variance.

**P*<0.05.

Table 5. Multiple regression analysis (Normal NST result variance)

	t	***P***
Age	1.265	***.206***
Gender	-7.806	***.000****
Season	-1.546	***.122***

**P*<0.05.

Table 6. Crosstabulation by gender (MM3 extraction patients)

P=.727*		Gender		Total
		Male	Female	
Nerve Injury	Post-op Normal	226	248	474
	Post-op Abnormal	3	5	8
Total		229	253	482

Table 7. Crosstabulation by location (MM3 extraction patients)

***P**=1.000**		Location of MM3		Total
		Left (#38)	Right (#48)	
Nerve Injury	Post-op Normal	238	236	474
	Post-op Abnormal	4	4	8
Total		242	240	482

Table 8. Paired t-test (MM3 extraction patients)

Sensory Test		Mean	SD	***P***
CTH	Upper Medial	-.37375	.58010	***.111***
	Upper Lateral	-.18750	.34784	***.171***
	Middle Medial	-.37375	.58010	***.111***
	Middle Lateral	-.01000	.55235	***.961***
	Lower Medial	-.43250	.70441	***.126***
	Lower Lateral	-.56375	1.13528	***.203***
DIR		33.12500%	31.50255%	***.021****
2PD		-4.5000	7.9821	***.155***
PP		-1.8750	44.0728	***.908***

SD indicates standard deviation

**P*<0.05.

Table 9. Logistic regression analysis (PML removal patients)

	C.I.		**Hazard ratio**	***P***
	Low	High		
Relationship between nerve and lesion	2.161	5.562	***3.467***	***.000****
Pathological diagnosis	.903	1.694	*1.237*	***.186***
Age	.608	4.535	*1.661*	***.322***
Sex	.352	2.543	*.946*	***.912***

C.I indicates confidence interval

**P*<0.05.

Table 10. Paired t-test (PML removal patients)

Sensory Test		Mean	SD	***P***
CTH	Upper Medial	-.76207	1.12826	***.001****
	Upper Lateral	-.75483	1.06035	***.001****
	Middle Medial	-.80759	1.14302	***.001****
	Middle Lateral	-.95138	1.12228	***.000****
	Lower Medial	-.98207	1.18029	***.000****
	Lower Lateral	-1.05276	1.15248	***.000****
DIR		39.31034%	28.21234%	***.000****
2PD		-4.8621	8.6838	***.005****
PP		-24.5862	51.2588	***.015****

SD indicates standard deviation

**P*<0.05.

국문초록

하악 구치부 병소 수술 전후 하치조신경 감각평가

전 재 호

서울대학교 대학원 치의과학과 구강악안면외과학 전공

(지도교수 명 훈)

1. 목 적

본 연구는 첫째, 하치조신경 술 전 검사 상 정상 값을 분석하고자 하였으며 둘째, 하악 매복 제3대구치 발치 후 감각이상이 온 환자들의 검사 값을 분석하고 마지막으로 하악 구치부 병소를 가진 환자에서 병소와 신경과의 관계를 전산화 단층 촬영 영상 분석을 통하여 신경손상 위험도를 평가하고자 하였다.

2. 방 법

2016년 3월 1일부터 2018년 6월 30일 사이에 서울대학교 치과병원 구강악안면외과에서 한 명의 숙련된 외과의에게 하악 구치부 매복치아 및 병소 제거술을 받은 총 472명의 환자를 대상으로 술 전, 술 후의 하치조신경 감각 검사를 통하여 손상 여부를 조사하였다.

검사항목은 접촉인지검사, 방향식별검사, 두점식별검사, 압통검사 등 총 4가지 방법으로 시행되었다. 통계분석은 SPSS 22.0 (SPSS Inc, Chicago, IL)으로 시행하였으며, $P<0.05$ 값을 유의한 결과로 해석하였다.

1) 술 전 검사 분석

총 472명의 술 전 검사 데이터로 independent t-test, one-way ANOVA, multiple regression analysis를 시행하였다.

2) 매복 제3대구치 발치 술 전 후 검사 분석

총 301명의 환자의 482증례를 대상으로 술 전, 술 후 검사 데이터로 chi-square와 paired t-test를 시행하였다.

3)하악 구치부 병소 수술 전 후 검사 분석

총 202명의 207증례를 대상으로 술 전 및 술 후 검사 데이터로 chi-square, fisher's exact test, logistic regression analysis, paired t-test를 시행하였다.

3. 결 과

(1) 술 전 검사 분석

접촉인지 검사는 성별에서만 유의하게 차이가 나타났다. 방향성 검사는 나이, 성별, 계절별로 유의하게 차이가 나타났다. 두점식별검사는 나이, 성별, 계절별로 유의하게 차이가 나타났다. 압통검사는 성별, 계절별로 유의하게 차이가 나타났다.

(2) 매복 제3대구치 발치 술 전 후 검사 분석

술 후 감각 저하는 8례였고 술 후 3개월 경과관찰시 모두 정상으로 돌아왔다. 술 후 감각저하가 온 8명의 술 전 후 데이터로 paired t-test 시행한결과 오직 방향식별검사에서만 유의하게 차이를 보였다.

(3) 하악 구치부 병소 수술 전 후 검사 분석

술 후 감각 저하는 29례였다. 나이, 성별, 병리진단명, 병소와 하치조신경과의 관계를 Logistic regression analysis 시행한 결과 병리진단명

과 병소와 신경과의 관계에서 유의미한 차이를 보였다. 술 후 감각저하가 온 29례의 술 전 후 데이터로 paired t-test 시행한 결과 4가지 검사항목 모두에서 유의미한 차이가 있었다.

4. 결 론

1) 여자가 남자보다 정상수치가 예민하게 측정되었다.
2) 30세 이하의 나이군이 30세 이상보다 방향식별검사에 민감하고 두점식별검사의 평균값이 낮게 측정되었다.
3) 계절별로 정상수치가 통계적으로 유의한 차이가 있었다.
4) 사랑니 발치 후 신경손상은 약 1.7%에서 나타났고 수술 전 후 검사 비교시 방향성 검사항목만 유의미한 차이를 보였다.
5) 병소와 신경이 가깝고 눌려있고 피질골로 밀려 있을수록 술 후 신경손상 가능성이 높아진다(HZ ratio: 3.467).
6) 하악 구치부 병소 수술 후 신경손상은 약 14%에서 나타났고, 수술 전 후 검사 비교시 모든 검사항목에서 유의미한 차이를 보였다.

주요어: 하치조신경, 하악 구치부 병소, 하악 제3대구치, 감각신경평가

학번: 2012-21825