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하악 제3대구치와 하치조신경의 해부학적 위치에 대한 연구

Anatomical Study of Inferior Alveolar Nerve and Mandibular Third Molar

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Abstract

Anatomical Study of Inferior Alveolar Nerve and Mandibular Third Molar

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Extraction of third molar is the most common minor surgery in dental care[1], with various reasons. The extraction of the third molar has a risk of the

complications that can occur inevitably in the extraction process. Especially the possible risk of inferior alveolar nerve (IAN) damage, the mandibular third molar (M3) extraction procedure is discouraged in local dental clinic.

The purpose of this study is to check the anatomical position of IAN in conjunction with the mandibular third molar with computerized tomography (CT) scan.

Subjects included in this study are the patients who want to pull out their third molar to the same surgeon and took panoramic radiographs with CT scan, in Seoul National University Dental Hospital from September 2009 to December 2013. Total 651 patients with 1077 of M3s were included in this study because the roots of M3 were superimposed in panoramic radiographs. Panoramic radiographs and cone beam CT or reformatted localized CT

data were investigated to evaluate the risk of IAN. In addition, after extraction, complications were confirmed by review of the chart of the patient. Among total 1077 mandibular third molars, actual contacted M3s with IAN confirmed on CT scan was 824. Additionally, high risk group was defined in case of intruding of root into IAN canal or compression of IAN with its root. These high risk cases composed of 310 teeth. The number of extracted teeth among subject 1077 M3s was 677. Among these, high risk teeth were only 138. In the same period, regardless of CT taking, total number of surgical extractions of mandibular M3 was 1188.

Symptoms of IAN damage, which contains all of minor sensory deprivation were identified in 8 cases (0.67%) from all of 1188 M3 surgical extractions. Interestingly, all IAN damage cases were confirmed that M3 roots and IAN

are contacted in CT scan. Symptoms lasting over 6 months were found in 3 cases (0.25%). In other aspect, incidences of IAN damage in extracted high risk cases (138 cases) increased to 5.8% and 2.17% respectively. Although the contact of M3 root and IAN is related with nerve damage as a consequence of tooth extraction, the incidence is too low to conclude as causal factor with statistical significance. We can take advantage from CT image to avoid IAN complication, and patients are given warning regarding high risk for IAN damage when IAN contacts with root of third molar. Therefore some patients were not undergone third molar extraction in high risk cases. This is one of the effectiveness of the CT image to help reduce IAN complication of this study.

Keywords : Mandibular third molar, Surgical extraction, Complications, Nerve damage

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Contents

Introduction

Extraction of third molars is the most common minor oral surgery in dental care[1], with various reasons. However, the extraction of the mandibular third molar (M3) has a risk of the complications that can occur unavoidably in the process. One of the troublesome complications is inferior alveolar nerve (IAN) damage[2, 3]. According to previous studies, incidence of IAN damage was about 0.5% to 5%[4-7]. Because of the risk, despite being the most common minor surgery, we are in the midst of an environment that avoids the extraction procedure of third molar in local dental clinic. This phenomenon is evidently shown in tertiary dental hospital with increasing number of these patients. Additionally, as the awareness of the patient's rights is enlightened with social change, complaints related to dental malpractice lawsuits are also increasing. This trend is likely intensified in the future.

Under the current circumstances of dental health, the identification of the frequency of complications after third molar extraction may have a great significance. The purpose of this study is to check the anatomical position of IAN in conjunction with M3. Additionally incidence of IAN damage after M3 extraction was calculated in high risk cases determined with three-dimensional CT data.

Patients and Methods

Patients

Subjects of the study consist of the patients who visit to the same surgeon for mandibular third molar extraction in the department of Oral and Maxillofacial Surgery, Seoul National University Dental Hospital from September 2009 to December 2013. Including criteria for this study was the M3s taking CBCT or reformatted CT because the roots of M3 superimposed with IAN in panoramic radiograph. Total 651 patients with 1077 M3s were included in this study. During the same period of time, surgically extracted M3 were 1188. The difference was originated from the additional surgically extracted cases which took only panoramic radiographs before surgery and some of high risk M3s which were not removed after taking CT scan. This study investigated panoramic

radiographs first and then Cone Beam CT or reformatted localized CT were taken when the root of M3 superimposed with IAN on panoramic radiographic view. These data were evaluated the relative position of IAN and root of third molars. Total superimposed teeth were 1077 on panoramic radiographs. Total number of extracted M3 including patients who did not take CT scan in the period was 1188. In addition, any complications were searched by reviewing patient's chart postoperatively.

This study was approved by the Institutional Review Board in Seoul National University School of Dentistry (IRB NO : S-D20140016).

Surgical technique

Extractions of third molars were operated by one Oral and Maxillofacial Surgeon with over 20 years of clinical experience. This procedure was conducted under local anesthesia or general

anesthesia in aseptic condition, which is in accordance with the protocol and criteria of Seoul National University Dental Hospital. Usually, only one side of third molars was surgically removed under local anesthesia in an appointment, but bilateral third molars were removed at the same time under general anesthesia. High speed hand piece with surgical round bur was used for removing overlying alveolar bone and sectioning of impacted third molars. After removal of impacted tooth, extraction socket was thoroughly irrigated by sterile saline and the flap was sutured with 4-0 vicryl. The patients were instructed to apply ice pack on the overlying skin of extraction site for 2 days postoperatively. Routinely sutures were removed after about a week.

Data analysis

Collection of data was based on the panoramic radiographs, CT scan data, and patient's medical records. The location, depth,

angulation, and relationship between M3 and IAN were collected through panoramic radiographs and classified as superimposed or separated with IAN (Figure 1). M3s classified with panoramic radiographs according to Pell and Gregory's classification[8] and Winter's classification[9]. More precise spatial relationship between third molar and IAN were classified as separated, contacted, or high risk in CT scan data (Figure 2). High risk group was further subclassified as intruded (I) and compressed (C). Intruded IAN (I-IAN) was classified as penetrated nerve in it's path with roots of third molars (Figure 2 C). Compressed IAN (C-IAN) was defined as the nerve was pushed away in it's path in the inferior alveolar canal and deformed the shape of cross section (Figure 2 D).

The postoperative complications were filed as IAN damage, pain, and dry socket, loss of taste.

Results

Classical classification of the location of mandibular third molars

In total 1077 M3s which were tested both panoramic radiograph and CT scan, lack of enough space between ramus and third molar (Class II) was the most common feature, followed by enough eruption space (Class I), almost no space (Class III) (Table 1). Regarding impaction depth, level A, the top of impacted third molar was even level with occlusal height of second molar was most commonly seen, followed by level B, and level C which were located more inferiorly compared to the second molar (Table 2). In the aspect of tooth angulation, mesioangular impaction and horizontal impaction were commonly seen with similar frequency (39.1%, 38.4% respectively). Inverted teeth and transverse teeth were very rare (0.3% respectively) (Table 3).

Relationship between M3 and IAN on CT images

The true spatial relationship of M3 and IAN of 1077 teeth were evaluated by CT images. In 253 cases (23.5%), IAN and the roots of M3 were separated three dimensionally. The lightly contact cases were 514 (47.7%), in which the risk factor is considered as low. The other cases of 310 (28.8%) were classified as high risk for IAN damage during extraction (Table 4). In the case of high risk teeth, the cases with C-IAN (severe loss of cortical bone or displacement or compression of mandibular canal) were 65.5%, and the other cases with I-IAN (roots located in mandibular canal partially or possible hindrance of the mandibular canal during extraction) were 34.5% (Table 5).

Actual incidence of contact when superimposed on panoramic radiographs

Total number of subject teeth showed superimposed image on panoramic radiograph is 1077. In these cases, the incidence of true contact of M3 and IAN were found to be 76.5% (824 cases). In addition, 310 cases (28.8%) were classified high risk cases of nerve damage. In the group of class I teeth shows 69.9% of contact rate. Class II shows 77.7%, and class III shows 86.7% increasingly. Like the preceding, level A shows 69.6% of contact rate, level B shows 82.4%, level C shows 100% increasingly (Table 6). There is a clear increasing tendency between impaction location or depth of teeth and the occurrence of contact.

Incidence of Inferior alveolar nerve injury

Total number of surgically extracted M3 regardless of CT taking in the study period was 1188. Among these, symptoms of IAN damage, which contains all of minor sensory deprivation were identified in 8 cases (0.67%, 8/1188). Symptoms of IAN damage lasted over 6

months in 3 cases (0.25%, 3/1188). In all cases of the IAN damage, roots of M3 and IAN are contacted and classified as high risk. These rates can be recalculated by subset of population as a high risk group (138 cases of surgically extracted high risk M3). The incidences of the IAN damage increase 5.8% and 2.17% respectively.

Other complications occurred in this study were listed in Table 7. Pain, dry socket, and temporary loss of taste were displayed in postoperatively.

Prognosis of inferior alveolar nerve damage

In 8 cases including minor neurological damage, 3 cases were identified permanent damage lasting more than 6 months, which patients has a difference between left and right feeling. In addition, it was confirmed that the symptoms were getting better on every visit little by little in all three cases.

Discussion

Extraction of third molar is one of the most common minor surgery in dental hospitals. It is needed for various clinical reasons. However, extraction of third molar sometimes has a risk of the complications that can occur inevitably in the extraction process such as swelling, postoperative pain, trismus, alveolar osteitis, hemorrhage and nerve injury[3]. Especially the possible risk of IAN damage, the mandibular third molar extraction surgery is discouraged in local dental clinic these days.

In other previous studies, the incidence of IAN damage was about 0.5% to 5%[4-7]. But there was no proper study revealed the actual incidence of IAN damage among high risk cases with tight contact between M3 and IAN. If the

realistic incidence of IAN damage in high risk group for impacted third molar extraction can be calculated, vague risk of extraction can be deducted. For this reason, this study focused on high risk surgical extractions of M3s.

There are many risk factors on panoramic radiographs can affect the occurrence of IAN damage such as interruption of the white line and darkening of root, deflected roots, narrowing of the root, dark and bifid roots, interruption of the white line, diversion of the inferior alveolar canal, narrowing of the inferior alveolar canal[10-14]. All of these findings are related with high risky appearance in the panoramic radiographs. The incidence of injury to IAN also differs according to surgeon's clinical experience, anatomical relation between IAN and M3[4, 15, 16]. Therefore this study limited the cases for one surgeon who has more than 20 years clinical experience to enable exclude operator factor for ensuring

consistency of data and focused on anatomical relationship of IAN and M3 in three-dimensionally with CT images.

Based on this study, actual rate of IAN damage after mandibular third molar extraction can be calculated. Total 677 teeth were extracted among total 1077 subject M3s with dental CT images. In fact, the total number of all cases of surgically removed M3 during the same period was 1188. That means the other 511 teeth were extracted only after taking panoramic radiographs without CT scan. Including all of the symptoms of mild nerve damage to the IAN occurred in 8 cases. Patients with hypoesthesia more than six months who did not come fully back to feeling after extraction were found in 3 cases. Lasting over 6 months IAN damage occurred approximately 0.25% rate among cases with surgical extraction (1188 cases regardless CT images) during the same study period. But this is for all the cases included low, moderate, and high risk groups, so the true incidence of IAN damage in high risk group would be

different and higher. The general incidence of IAN damage in surgical extraction of M3 was 0.67% (8/1188), and decreased sensation lasting more than 6 months was 0.25% (3/1188). This study shows a significantly lower incidence of IAN damage compared to other studies (0.5% to 5%)[4], by not recommending surgical extraction for high risk cases and avoiding the dangerous situation during extraction. This may prove usefulness of application of CT images for superimposed M3 with IAN on panoramic radiographs. Among 310 cases of high risk group, only 138 cases (44.5%) were undergone surgical extractions and 172 cases (55.5%) were not extracted. In extracted high risk 138 cases, 8 cases occurred neurologic symptoms of IAN damage. Recalculated incidence of IAN damage during extraction of high risk group was 5.8% (8/138) and 2.17% (3/138) respectively. In cases of high risk group determined by CT scan, surgeons should pay enough attention to minimize the occurrence of complications or give the patients another option not to extract at

the moment.

In addition, in this study, data shows that, as the M3 located deeply and had less available space for eruption, contact occurrence of IAN and the roots of M3 increased. In deeper location of the jaw, there are not enough space to be separated, so this tendency can be showed. If impaction location of third molar is deeper, difficulty of extraction will increase, also contact incidence with IAN increases.

In reality, because nerve injury during surgical extraction is very few, to determine the statistical significance according to the various risk factors or tooth location and depth is hard to conclude. Expanding the scope including all the extracted M3s in general, long-term follow-up to determine the frequency of complications according to high risk factors will be needed for future study with statistical significance.

Conclusion

This study could show the incidence of complications such as IAN damage after mandibular third molar extraction. Rate of IAN nerve damage was 0.67% and rate of IAN nerve damage lasting over 6 months was 0.25%. In high risk group, rate of IAN nerve damage was increased to 5.8% and 2.17%, respectively. In the diagnostic process, computer tomographic images can reduce the occurrence of complications by determining based on more accurate positional relationship between IAN and the roots of the M3s.

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Table 1. Distribution of mandibular third molar (Available space)

	Number of cases
Class I	289 (26.8%)
Class II	683 (63.4%)
Class III	105 (9.7%)
Total	1077

Table 2. Distribution of mandibular third molar (Depth)

	Number of cases
Level A	552 (51.3%)
Level B	448 (41.6%)
Level C	77 (7.1%)
Total	1077

Table 3. Distribution of mandibular third molar (Angulation)

	Number of cases
Mesioangular	421 (39.1%)
Vertical	231 (21.4%)
Distoangular	3 (0.3%)
Horizontal	414 (38.4%)
Transverse	5 (0.5%)
Inverted	3 (0.3%)
Total	1077

Table 4. Relationship between mandibular third molar and inferior alveolar nerve on CT scan images

	Number of cases
Separated	253 (23.5%)
Contacted	514 (47.7%)
High risk	310 (28.8%)
Total	1077

Table 5. Classification of high risk cases

	Number of cases
Compression (C-IAN)	203 (65.5%)
Intruded (I-IAN)	107 (34.5%)
Total	310

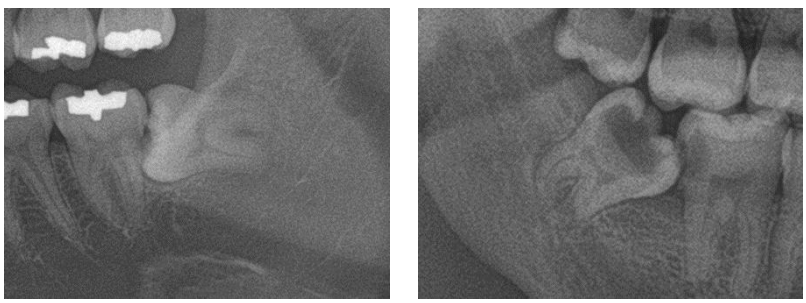
Table 6. The numbers of mandibular third molars which contacted with the inferior alveolar nerve on panoramic radiographs or CT images and the percentage of actual contact

	Class I	Class II	Class III	Total
Level A	90/146(61.6)	255/360(70.8)	39/46(84.8)	384/552(69.6)
Level B	85/114(74.6)	236/279(84.6)	48/55(87.3)	369/448(82.4)
Level C	27/29(93.1)	40/44(90.9)	4/4(100.0)	71/77(92.2)
Total	202/289(69.9)	531/683(77.7)	71/105(86.7)	824/1077(76.5)

* the number of superimposed teeth on panoramic radiographs/the number of superimposed teeth on CT images (the percentage of the actual contact with mandibular third molar and IAN among superimposed teeth on panoramic radiographs)

Table 7. Complications occurred in target period

Complications	Number of patients
IAN damage	8/3 (temporary/permanent)
Pain	2
Dry socket	1
Loss of taste(temporary)	1



A B

Figure 1. Panoramic radiograph shows (A) a separated mandibular third molar (M3) and (B) a superimposed one with inferior alveolar canal.

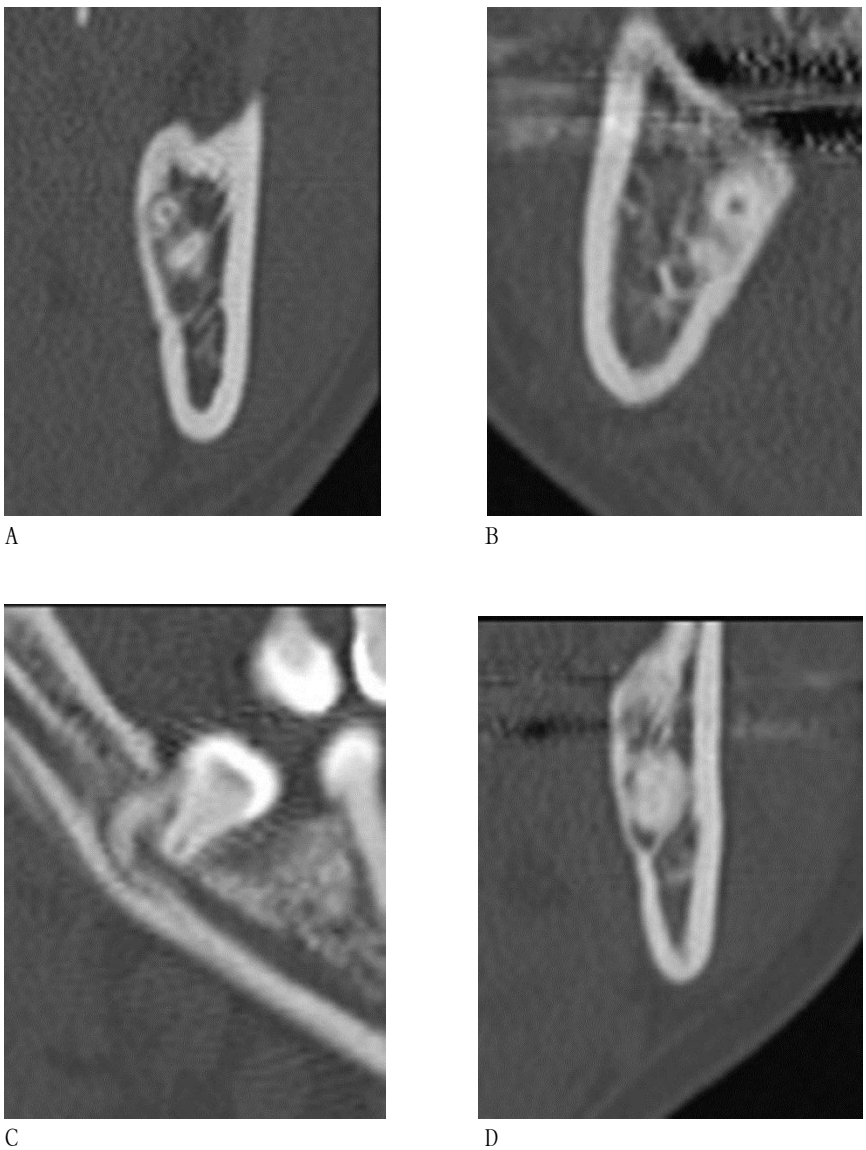


Figure 2. True relationship of M3 and IAN on CT images.

A. Separated roots with IAN

B. Contacted root with IAN

C. Intruded roots into IAN canal (I-IAN) with high risk

D. Compressed IAN by M3 root (C-IAN) with high risk

국문초록

제3대구치의 발치는 치과 의료에서 가장 흔히 접할 수 있는 소수술이며, 많은 증례들에서 여러 가지 이유로 발치를 시행하게 된다. 그러나 제3대구치의 발치는 그 과정에서 불가피하게 발생할 수 있는 합병증의 위험이 존재하여 진료 위험 부담이 크기 때문에 가장 흔한 소수술임에도 불구하고 발치 수술을 기피하는 환경에 처해 있다.

본 연구의 목적은 하악 제3대구치 발치 후 발생 가능한 하치조신경 손상의 원인 요소로 볼 수 있는 하치조신경과 제 3대구치의 해부학적인 위치를 컴퓨터 단층 촬영 영상을 활용하여 분류하고 이를 토대로 실제 임상에서 발생된 신경 손상이 어떤 위치관계에서 나타났는지 밝히고자 한다.

본 연구의 대상은 2009년 9월부터 2013년 12월까지 서울대학교 치과병원에 하악 제3대구치 발치를 위해 내원하여 파노라마 방사선 촬영 후 하치조신경과 하악 제3대구치의 치근이 겹쳐 보이는 경우 컴퓨터 단층 촬영을 시행하였던 동일 술자의 환자들이며, 총 651명의 파노라마 사진

상에서 하치조신경과 중첩되어 보이는 1077개의 하악 제3대구치를 대상으로 하였다. 서울대학교 치과병원 구강악안면방사선과에서 촬영된 파노라마 방사선 영상 및 하악 제3대구치 관련 cone beam CT (CBCT) 혹은 reformatted localized CT 자료를 조사하여 환자의 하치조신경 손상 위험성을 평가하였다. 고위험군에 해당하는 환자에 대해서는 위험성을 설명하고 일부 환자는 발치를 보류하였다. 발치한 환자의 경우, 차트를 열람하여 발치 후 내원 시의 합병증 발생 여부와 예후 등을 확인하였다.

총 1077 치아 중 CT 영상을 통해 확인한 하악 제3대구치와 하치조 신경의 실제 접촉은 824례 였다. 치근이 하치조관 안에 위치해 있거나, 치근에 의해 하치조신경이 눌려 있는 경우 고위험군으로 분류하였으며, 310개의 치아가 고위험군으로 분류되었다. 본 연구의 대상인 1077개의 하악 제3대구치 중 발치가 진행된 치아의 수는 677개였다. 이 중 고위험군으로 분류된 치아는 138개였다. 같은 기간 동안 컴퓨터 단층 촬영 시행 여부와 관계없이 외과적으로 발거한 총 하악 제3대구치의 수는 1188개였다.

총 1188개의 하악 제3대구치 발치 증례 중 8명의 환자에서 경미한 감

각 이상까지 포함하는 하치조신경 손상 징후들이 확인되었고(0.67%), 3례에서 6개월 이상 증상이 지속되었다(0.25%). 이 모든 손상 증례는 CT 영상을 촬영하였으며 하악 제3대구치 치근과 하치조신경의 접촉이 확인되었다. 발치 고위험 증례들(138례)로 모집단 대상을 한정할 경우 하치조신경 손상의 빈도는 각각 5.8%와 2.17%로 증가하였다. CT 영상을 통해 평가한 하악 제3대구치 치근과 하치조신경의 접촉 여부가 발치 후의 신경 손상과 관련이 있는 것으로 확인되나, 발생 빈도가 너무 낮고, 접촉이 있는 증례에서도 합병증을 보이지 않는 경우가 많아 통계적인 유의성을 결론짓기에는 무리가 있다. 다만 신경과 치근 간의 더 정확한 위치 관계를 확인하고, 발치 시의 득실을 판단하여 무리한 발치를 피함으로써 합병증 발생을 줄이는 데 CT 영상을 활용할 수 있으며, 본 연구의 매우 낮은 합병증 발생 빈도를 통해서 CT 영상의 효용성을 확인할 수 있다.

주요어 : 하악 제3대구치, 발치, 합병증, 신경 손상

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