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Is difficulty of extraction associated with inferior alveolar nerve proximity on computed tomography and increased injury risk?

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Abstract (J Korean Assoc Oral Maxillofac Surg 2025;51:80-86)

Objectives: Many three-dimensionally-evaluated difficulty indices for impacted third molars have been suggested; however, their radiological and clinical validation according to the inferior alveolar nerve (IAN) remains unknown. This study aimed to evaluate the association of the difficulty index with IAN proximity and injury risk.

Materials and Methods: We retrospectively enrolled patients with cone-beam computed tomography (CBCT) for a fully impacted mandibular third molar from January to December 2020. We evaluated the third molar according to the difficulty index based on panoramic x-ray and the nerve index based on CBCT and analyzed postoperative nerve complications. The relationships among nerve proximity, difficulty indices, and nerve complications were evaluated. Data were analyzed using the Pearson's chi-square test and the Cochran–Armitage test for trends.

Results: We included 367 subjects (177 males, 28.9±9.8 years) with follow-up of at least 1 month. Twenty-two subjects had nerve complications. Radiologic evaluation showed that third molars with a high nerve index had an increased difficulty index (P=0.001). Nerve complication risk showed a statistically significant correlation with both nerve and difficulty indices.

Conclusion: In conclusion, the difficulty index of an impacted third molar was valid in terms of its spatial relationship with the IAN and in predicting nerve complications.

Key words: Cone-beam computed tomography, Classification, Tooth extraction, Impacted third molar, Inferior alveolar nerve

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I. Introduction

The extraction of a mandibular-impacted third molar is a common operation in everyday oral surgery. Because of the anatomic variation in third molars among individuals, many studies have been carried out to establish scientific evidence based on preoperative images to estimate surgical difficulties associated with extraction of the third molar[1-4]. In 2019, Kim et al.[3] suggested a modified difficulty index, considering the spatial relationship, depth, and ramus relationship. In 2020, Ku et al.[4] validated this modified difficulty index based on surgical extraction time with additional consideration of the pathologic condition of the third molar. Surgical extraction is a general procedure; however, postoperative complications need to be overcome. Common postoperative complications associated with surgical extraction are postoperative pain, swelling, infection, trismus, alveolar osteitis (dry socket), and neurologic complications including sensory disturbances from inferior alveolar nerve (IAN) injury[5].

Nerve disturbance is one of the most severe complications, and the most common cause of IAN injury is the mandibular third molar extraction[6,7]. These sensory disturbances are characterized by numbness, tingling, or a painful sensation and may be temporary or prolonged. A previous study showed that 8%-20% of such surgical extractions result in temporary damage and 1%-4% in permanent injury of the IAN[8]. To predict nerve complications, many studies have conducted radiological evaluations of the inferior alveolar canal (loss of the cortical lining, diversion, or narrowing) and periapical as-

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pects of the third molar (root narrowing, darkening, or curving)[6,9].

In 2021, Sklavos et al.[10] suggested that the nerve index is a useful tool for predicting nerve complications according to the degree of compression of the inferior alveolar canal on preoperative cone-beam computed tomography (CBCT). Although the spatial position of the third molar is a critical factor in nerve complications, the difficulty index of the surgical extraction has not been considered in terms of prediction of nerve complications. This study aimed to evaluate the radiologic and clinical validation of the recently suggested difficulty index on the basis of its relationship with the nerve index and postoperative nerve complication. The authors hypothesized that the difficulty index from panoramic x-ray might be associated with the nerve index from CBCT. The specific aim of this study was to determine whether the difficulty index affects nerve complication after third molar extraction.

II. Materials and Methods

This retrospective study was approved by the Institutional Review Board (IRB) of Yonsei University Gangnam Severance Hospital (IRB No. 3-2021-0145) and was conducted according to the principles of the Declaration of Helsinki for research on humans. The written informed consent was waived by the IRB.

Consecutive patients treated with surgical extraction for fully impacted mandibular third molars by experienced oral and maxillofacial surgeons (the authors) in the Department of Oral and Maxillofacial Surgery at Gangnam Severance Hospital from January 2020 to December 2020 were included. With this design, the indices were assessed cross-sectionally and followed by a retrospective cohort evaluation of the subjects' nerve symptoms according to the indices after the third molar extraction. The inclusion criteria were as follows: (1) patients without uncontrolled systematic disease; (2) >19 years old; (3) the third molars were in contact with the IAN on preoperative panoramic x-ray; (4) preoperative CBCT evaluation; and (5) follow-up for at least one month after the extraction. The exclusion criteria were as follows: (1) maxillofacial malformation or syndromes; (2) the third molars had incomplete root formation; (3) cysts or tumors related to the third molar; and (4) extraction performed by surgeons in training.

1. Difficulty index for impacted third molars

Based on the preoperative x-ray, we evaluated the difficulty index of an impacted mandibular third molar based on 4 major parameters: spatial relationship, depth, ramus relationship/space available, and pathologic condition. Briefly, impacted third molars were scored (spatial difficulty score) based on the spatial relationship (1-5 points), depth (1-4 points), and ramus relationship (1-3 points). After calculation of the spatial difficulty score, the difficulty index was defined in consideration of the pathologic condition.(Fig. 1)[3,4]

We scored spatial relationship according to the angle between the long axis of the adjacent molar and the third molar as follows: (1) mesioangular (11° to 79°), (2) horizontal (80° to 100°), (3) vertical (–10° to 10°), (4) distoangular (–11° to –79°), or (5) reverse, where the crown of the third molar was more root-direction than horizontal. We scored the available ramus relationship/space according to the eruption space. Eruption space was defined as the ratio of the distance between the distal side of the second molar to the ascend-

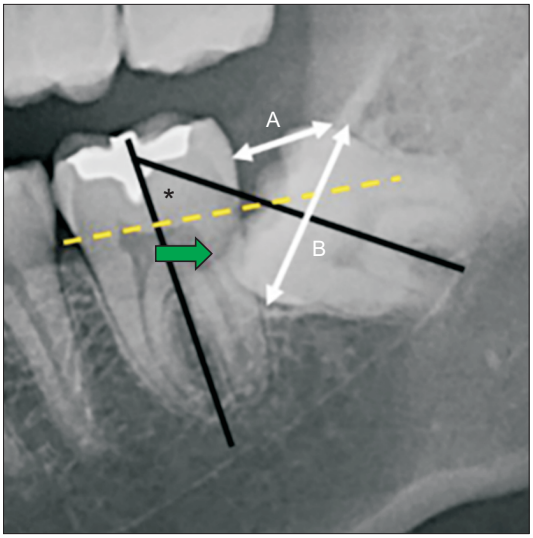

Fig. 1. Measurement and classification of the impacted third molar in panoramic x-ray. The spatial relationship was classified on the basis of the angle measured between the long axis of the impacted third molar and that of the adjacent second molar (black lines and an asterisk mark). Depth was classified on the basis of the line connecting the cemento-enamel junction (CEJ) of the adjacent second molar (dotted yellow line). Ramus relationship/space available was subcategorized on the basis of the ratio between the distance from the ascending ramus to the distal of the second molar (A) and the diameter of the impacted third molar (B) (white arrows). Pathologic condition was identified as cuspal contact below the CEJ (green arrow).
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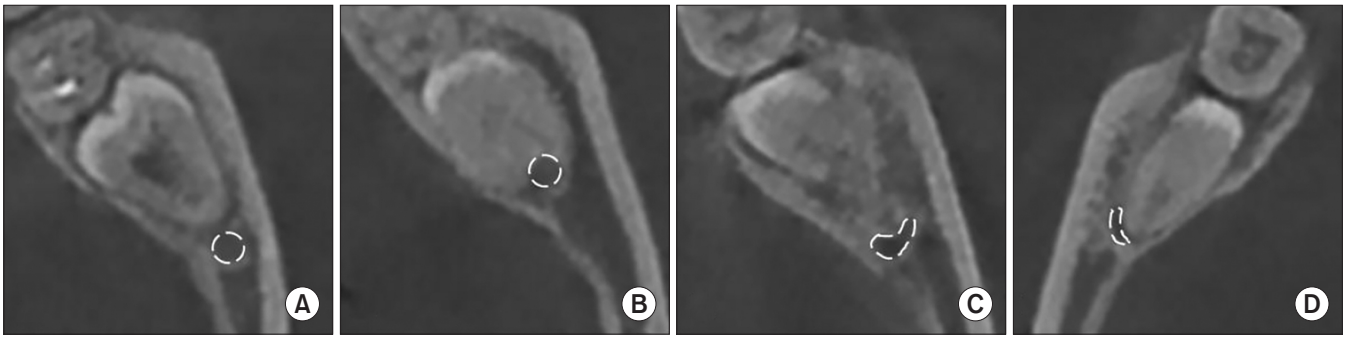

Fig. 2. Representative images for the nerve index. A. If there was no contact between the third molar and the inferior alveolar canal (IAC, dotted line), the nerve index was zero. B. Nerve index I represented contact with the third molar without conformational change of the IAC. C. Nerve index II represented a decrease in IAC diameter by less than 50% because of the third molar. D. Nerve index III represented a decrease in the IAC diameter by more than 50% because of the third molar.
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ing ramus (A) and the diameter of the third molar (B). An eruption space (A/B) larger than two-thirds the distance was defined as (1) Class I, between one-third and two-thirds was (2) Class II, and smaller than one-third was (3) Class III. Depth was scored as levels A (1), B (2), C (3), or D (4). Level A was defined as a condition when more than half of the third molar crown was above the cemento-enamel junction (CEJ) of the adjacent second molar. Level B was defined when less than half of the third molar crown was above the CEJ of the adjacent second molar. When the entire third molar crown was positioned below the CEJ of the adjacent second molar, it was defined as either level C or level D. Level C was defined as when more than half of the third molar crown was positioned superior to the mid-level of the adjacent second molar root. Level D was defined when the third molar crown level was inferior to that mentioned above. We calculated the spatial difficulty score regarding the total points as follows: I (3-4 points), II (5-7 points), III (8-10 points), and IV (11-12 points). In addition, the difficulty index was finalized by raising the index by one level if the third molar was associated with a pathologic condition such as caries, pericoronitis, deformed roots, cuspal contact below the CEJ of the adjacent molar, or root resorption of the adjacent tooth[4,11].

2. Nerve index for impacted third molars

The primary outcome variable was the nerve index. The relationship between the IAN and the third molar was evaluated according to Sklavos's classification[10]. The nerve index was determined by spatial relationship with the third molar and a decrease of inferior alveolar canal diameter in the cross-sectional area from an axial view. By moving the section at 0.3 mm thickness, the cross-sectional area is assessed at the point of its smallest diameter around the third molar. The degree of spatial relationship was then classified: (0) no contact, (I) no compression, (II) the diameter is reduced by at least 25% and compressed by less than 50%, and (III) compressed by more than 50%.(Fig. 2)

3. Postoperative nerve complications

Patients were assessed for postoperative complications. Standard postoperative care was administered to follow-up patients the day after extraction, the following week, and 1 month after surgery. Postoperative nerve complication were evaluated based on sensory changes. Numbness was measured using a visual analog scale (VAS) of loss of sensation on a scale of 0 (normal) to 10 (no sensation).

4. Statistical analysis

The data included descriptive statistics for age, sex, and number of third molars included in the study. We used ANOVA for continuous variables and chi-square test for categorical data. The predictor variable was the difficulty index, and the outcome variables were the nerve index and nerve complications. First, the nerve and difficulty indices of the third molar were measured by two examiners (J.K.K. and S.M.K.). The two examiners measured 100 randomly selected patients, and Cohen's kappa statistic showed that these categorical indices had 100% agreement. To resolve clustered outcomes of both sides on the same patient, only one third molar was randomly selected for each patient following a simple random sampling procedure. The Microsoft Excel RAND function

Table 1. Demographic information of the patients according to the difficulty index

Variable	Difficulty index				Overall *P*-value
	I (n=42)	II (n=213)	III (n=95)	IV (n=17)	
Age (yr)	26.0±7.3	28.2±9.6	30.1±10.2	36.8±11.7	0.001[1]
Sex					0.006[2]
Male	22 (52.38)	90 (42.25)	51 (53.68)	14 (82.35)	
Female	20 (47.62)	123 (57.75)	44 (46.32)	3 (17.65)	

[1]One-way ANOVA. [2]Chi-square test.
Values are presented as mean±standard deviation or number (%).
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Table 2. Demographic information of patients according to the nerve index

Variable	Nerve index				Overall *P*-value
	0 (n=99)	I (n=110)	II (n=69)	III (n=89)	
Age (yr)	27.5±8.0	29.9±12.0	27.7±9.0	30.0±9.1	0.166[1]
Sex					0.127[2]
Male	52 (52.5)	59 (53.6)	32 (46.4)	34 (38.2)	
Female	47 (47.5)	51 (46.4)	37 (53.6)	55 (61.8)	

[1]One-way ANOVA. [2]Chi-square test.
Values are presented as mean±standard deviation or number (%).
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Table 3. Demographic information of the patients according to the occurrence of nerve complications

Variable	Nerve complication		Overall *P*-value
	No (n=347)	Yes (n=20)	
Age (yr)	28.6±9.6	34.6±11.7	0.007[1]
Sex			0.123[2]
Male	164 (47.3)	13 (65.0)	
Female	183 (52.7)	7 (35.0)	

[1]One-way ANOVA. [2]Chi-square test.
Values are presented as mean±standard deviation or number (%).
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Table 4. Relationship between the difficulty index and occurrence of nerve complications

Variable	Nerve complication		Overall *P*-value
	No (n=347)	Yes (n=20)	
Difficulty index			0.004[1]
I	41 (11.8)	1 (5.0)	
II	204 (58.8)	9 (45.0)	
III	90 (25.9)	5 (25.0)	
IV	12 (3.5)	5 (25.0)	

[1]Chi-square test.
Values are presented as number (%).
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Table 5. Relationship between the nerve index and occurrence of nerve complications

Variable	Nerve complication		Overall *P*-value
	No (n=347)	Yes (n=20)	
Nerve index			<0.001[1]
0	98 (28.2)	1 (5.0)	
I	108 (31.1)	2 (10.0)	
II	64 (18.4)	5 (25.0)	
III	77 (22.2)	12 (60.0)	

[1]Chi-square test.
Values are presented as number (%).
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(ver. 2016; Microsoft) generated a number for each patient with a third molar on both sides; if the number was odd, the left side was selected, and if the number was even, the right side was selected. We analyzed the relationship between the nerve complication and the indices by logistic regression. Analyses were performed using SAS ver. 9.4 (SAS Institute), and two-sided *P*-values <0.05 were considered statistically significant.

III. Results

Concerning nerve complications, among the 367 patients (177 males and 190 females, 28.9±9.8 years) who had a follow-up of at least 1 month during the chart review (Tables 1, 2), 20 (5.4%) had nerve complication. The patients with nerve complication were older (34.6±11.7 vs. 28.6±9.6 years, *P*=0.007, Table 3) than those without. There was a statistically significant correlation with nerve complication between the difficulty index (*P*=0.004, Table 4) and the nerve index (*P*<0.001, Table 5). The difficulty index was statistically significantly correlated with the nerve index (*P*<0.001, Table 6).

Table 6. Relationship between the difficulty and nerve indices

Variable	Difficulty index				Overall *P*-value[1]	Post-hoc analysis[2]
	I (n=42)	II (n=213)	III (n=95)	IV (n=17)		
Nerve index					<0.001	I vs. II: <0.001
0	30 (71.4)	62 (29.1)	7 (7.4)	0 (0.0)		I vs. III: <0.001
I	12 (28.6)	60 (28.2)	36 (37.9)	2 (11.8)		I vs. IV: <0.001
II	0 (0.0)	36 (16.9)	29 (30.5)	4 (23.5)		II vs. III: 0.001
III	0 (0.0)	55 (25.8)	23 (24.2)	11 (64.7)		II vs. IV: 0.004
						III vs. IV: 0.041

[1]Chi-square test. [2]Bonferroni correction.
Values are presented as number (%).
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Table 7. Multivariate analysis of potential risk indicators for the occurrence of nerve complications

Variable	Univariable		Multivariable			
			Age, sex, difficulty index		Age, sex, nerve index	
	OR (95% CI)	*P*-value	OR (95% CI)	*P*-value	OR (95% CI)	*P*-value
Age	1.05 (1.01-1.09)	0.010	1.03 (1.00-1.07)	0.079	1.05 (1.01-1.09)	0.021
Sex	-	-	-	-	-	-
Male	Ref.	-	-	-	-	-
Female	0.48 (0.19-1.24)	0.130	0.72 (0.28-1.86)	0.491	0.43 (0.17-1.11)	0.082
Difficulty index						
I	Ref.	-	Ref.	-	-	-
II	1.29 (0.22-7.57)	0.781	1.23 (0.21-7.17)	0.816	-	-
III	1.68 (0.26-10.82)	0.584	1.45 (0.23-9.20)	0.696	-	-
IV	12.17 (1.74-85.11)	0.012	7.67 (1.06-55.37)	0.043	-	-
Nerve index						
0	Ref.	-	-	-	Ref.	-
I	1.81 (0.16-20.31)	0.629	-	-	1.18 (0.15-9.15)	0.877
II	7.65 (0.87-66.98)	0.066	-	-	5.83 (0.94-36.25)	0.059
III	15.26 (1.94-119.90)	0.010	-	-	10.93 (1.95-61.20)	0.007

(OR: odds ratio, CI: confidence interval, –: not available)
Predictor variables were difficulty index and nerve index, and outcome variable was occurrence of nerve complication.
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In univariate analysis, the age (*P*=0.010) and the highest difficulty index (*P*=0.012) and nerve index (*P*=0.010) were significant risk indicators associated with nerve complications. (Table 7) Specifically, logistic regression analysis demonstrated that increased risk for nerve complication was associated with age (odds ratio [OR], 1.05; 95% confidence interval [CI], 1.01-1.09). In multivariate analysis, difficulty index IV (OR, 7.67; 95% CI, 1.06-55.37, *P*=0.043) and nerve index III (OR, 10.93; 95% CI, 1.95-61.20, *P*=0.007) were significantly associated with an increased risk of nerve complications. (Table 7)

Among the 20 patients (34.6±11.7 years) who complained of nerve complications after extraction, 12 complained of prolonged nerve complications. Patients with prolonged nerve complications had a higher VAS score (6.7±2.2, 4.0±1.9; *P*=0.046) than those without prolonged nerve complications.

IV. Discussion

We hypothesized that the difficulty index from panoramic x-ray could be validated as a predictor of both the nerve index from CBCT and nerve complication, because it reflects the spatial position of the third molar. Our study identified two important findings. First, although the difficulty index does not reflect the spatial position of the IAN, it is statistically correlated with the nerve index and can statistically predict nerve complication.

Second, the clinical effectiveness of the difficulty index is hard to validate in prospective studies. In 2020, the difficulty index was validated in a retrospective study on the basis of the extraction time[4], since previous studies demonstrated that extraction time was associated with postoperative complications[12-14]. To the best of our knowledge, this is the first study to report the validation of the difficulty index in relation to the preoperative nerve index and nerve complication. The difficulty index from panoramic x-ray was statistically correlated with nerve index on three-dimensional CBCT. This result demonstrated that a higher difficulty index could predict longer extraction time and closer spatial proximity to the IAN. This finding underscores the importance of special

considerations such as intentional coronectomy for high-difficulty extractions, beyond the positional relationship of the IAN.

Postoperative nerve complications can affect general health-related quality of life and can sometimes persist, with little return to normal sensation[15-17]. Therefore, many studies have been conducted to predict the proximity of the IAN using radiographic means[6,9,10]. Specific radiographic signs suggested the proximity of the IAN to the third molar, such as 'darkening of the third molar root' and 'curved root tip'[18]. During extraction, compression injury could be transmitted to the fragile nerve bundle by the direct extraction force[17]. Similar to previous studies, we found that the rate of postoperative nerve complication was significantly higher in third molars with a high nerve index and closer proximity to the IAN. (Tables 3, 4)

However, the nerve index was measured on CBCT. Although CBCT is considered the standard for a high-risk mandibular third molar on panoramic x-ray, it should be reformatted on the basis of the mandibular arch to measure the difficulty index[4]. This difficulty index obtained from panoramic x-ray also was a significant predictor of the occurrence of nerve complications (Table 5), comparable to the value of the nerve index. Even with correction for age and sex, third molar extraction with the highest difficulty index had a 7.67-fold increased risk of nerve complications compared with difficulty index I (P=0.043, Table 7). In cases with a high difficulty index, the third molar may receive excessive extraction force because of low accessibility and insufficient space for luxation. As a result, the difficulty index could be more reliable for predicting nerve injury compared with the nerve index evaluated by preoperative radiographs.

Leung and Cheung[19] reported that older age was one of the risk factors for nerve complications; however, we could not analyze age due to the small number of patients with nerve complication. This study included a patient who had a mandibular third molar, which could have affected postoperative nerve complaints. This retrospective study is limited by the small number of patients with nerve complications and by possible radiography measurement errors. Nevertheless, the surgeon was able to systematically evaluate surgical difficulty and the risk of nerve complications. For extremely difficult third molar extractions, nerve complications should be considered in the extraction strategy, including corticosteroid prescription or coronectomy surgery[6,20]. Given that patients with prolonged nerve complications showed a higher VAS score (>6/10) the day after surgery, the degree of numbness might predict the prognosis of nerve complications. Further prospectively designed studies on extraction strategies are needed to prevent nerve complications in extremely difficult third molar extractions.

V. Conclusion

Extraction difficulty was clinically associated with nerve index and nerve-related complications after third molar extraction, regardless of nerve location. Nerve complications after extraction of impacted third molars could be predicted by the nerve and difficulty indices. Special care should be taken to prevent prolonged nerve complications in impacted third molars with a higher difficulty index.

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Authors' Contributions

J.K.K. and J.Y.K. conceived the idea and wrote the paper. J.K.H. was responsible for critical revision of the article. J.K.K. and S.M.K. were responsible for the acquisition of the data. J.K.K. and J.Y.K. were responsible for clinical/literature search and analysis and interpretation of the data collected. All authors made substantial contributions to the discussion of content and reviewed and edited the manuscript before submission.

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Ethics Approval and Consent to Participate

This retrospective study was approved by the Institutional Review Board (IRB) of Yonsei University Gangnam Severance Hospital (IRB No. 3-2021-0145) and was conducted according to the principles of the Declaration of Helsinki for research on humans. The written informed consent was waived by the IRB.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

References

1. Bali A, Bali D, Sharma A, Verma G. Is Pederson index a true predictive difficulty index for impacted mandibular third molar surgery? A meta-analysis. J Maxillofac Oral Surg 2013;12:359-64. https://doi.org/10.1007/s12663-012-0435-x
2. Sammartino G, Gasparro R, Marenzi G, Trosino O, Mariniello M, Riccitiello F. Extraction of mandibular third molars: proposal of a new scale of difficulty. Br J Oral Maxillofac Surg 2017;55:952-7. https://doi.org/10.1016/j.bjoms.2017.09.012
3. Kim JY, Yong HS, Park KH, Huh JK. Modified difficult index adding extremely difficult for fully impacted mandibular third molar extraction. J Korean Assoc Oral Maxillofac Surg 2019;45:309-15. https://doi.org/10.5125/jkaoms.2019.45.6.309
4. Ku JK, Chang NH, Jeong YK, Baik SH, Choi SK. Development and validation of a difficulty index for mandibular third molars with extraction time. J Korean Assoc Oral Maxillofac Surg 2020;46:328-34. https://doi.org/10.5125/jkaoms.2020.46.5.328
5. Cho H, Lynham AJ, Hsu E. Postoperative interventions to reduce inflammatory complications after third molar surgery: review of the current evidence. Aust Dent J 2017;62:412-9. https://doi.org/10.1111/adj.12526
6. Ali AS, Benton JA, Yates JM. Risk of inferior alveolar nerve injury with coronectomy vs surgical extraction of mandibular third molars-a comparison of two techniques and review of the literature. J Oral Rehabil 2018;45:250-7. https://doi.org/10.1111/joor.12589
7. Contar CM, de Oliveira P, Kanegusuku K, Berticelli RD, Azevedo-Alanis LR, Machado MA. Complications in third molar removal: a retrospective study of 588 patients. Med Oral Patol Oral Cir Bucal 2010;15:e74-8. https://doi.org/10.4317/medoral.15.e74
8. Pitros P, O'Connor N, Tryfonos A, Lopes V. A systematic review of the complications of high-risk third molar removal and coronectomy: development of a decision tree model and preliminary health economic analysis to assist in treatment planning. Br J Oral Maxillofac Surg 2020;58:e16-24. https://doi.org/10.1016/j.bjoms.2020.07.015
9. Rood JP, Shehab BA. The radiological prediction of inferior alveolar nerve injury during third molar surgery. Br J Oral Maxillofac Surg 1990;28:20-5. https://doi.org/10.1016/0266-4356(90)90005-6
10. Sklavos A, Delpachitra S, Jaunay T, Kumar R, Chandu A. Degree of compression of the inferior alveolar canal on cone-beam computed tomography and outcomes of postoperative nerve injury in mandibular third molar surgery. J Oral Maxillofac Surg 2021;79:974-80. https://doi.org/10.1016/j.joms.2020.12.049
11. Campbell JH. Pathology associated with the third molar. Oral Maxillofac Surg Clin North Am 2013;25:1-10, v. https://doi.org/10.1016/j.coms.2012.11.005
12. Ku JK, Kim JY, Jun MK, Jeong YK, Huh JK. Influence of general and local anesthesia on postoperative pain after impacted third molar surgery. J Clin Med 2021;10:2674. https://doi.org/10.3390/jcm10122674
13. Qiao F, Huang X, Li B, Dong R, Huang X, Sun J. A validated model to predict postoperative symptom severity after mandibular third molar removal. J Oral Maxillofac Surg 2020;78:893-901. https://doi.org/10.1016/j.joms.2020.02.007
14. Bello SA, Adeyemo WL, Bamgbose BO, Obi EV, Adeyinka AA. Effect of age, impaction types and operative time on inflammatory tissue reactions following lower third molar surgery. Head Face Med 2011;7:8. https://doi.org/10.1186/1746-160x-7-8
15. Ziccardi VB, Zuniga JR. Nerve injuries after third molar removal. Oral Maxillofac Surg Clin North Am 2007;19:105-15, vii. https://doi.org/10.1016/j.coms.2006.11.005
16. Hillerup S, Stoltze K. Lingual nerve injury II. Observations on sensory recovery after micro-neurosurgical reconstruction. Int J Oral Maxillofac Surg 2007;36:1139-45. https://doi.org/10.1016/j.ijom.2007.06.005
17. Leung YY. Management and prevention of third molar surgery-related trigeminal nerve injury: time for a rethink. J Korean Assoc Oral Maxillofac Surg 2019;45:233-40. https://doi.org/10.5125/jkaoms.2019.45.5.233
18. Leung YY, Cheung LK. Correlation of radiographic signs, inferior dental nerve exposure, and deficit in third molar surgery. J Oral Maxillofac Surg 2011;69:1873-9. https://doi.org/10.1016/j.joms.2010.11.017
19. Leung YY, Cheung LK. Risk factors of neurosensory deficits in lower third molar surgery: an literature review of prospective studies. Int J Oral Maxillofac Surg 2011;40:1-10. https://doi.org/10.1016/j.ijom.2010.09.005
20. Seo K, Tanaka Y, Terumitsu M, Someya G. Efficacy of steroid treatment for sensory impairment after orthognathic surgery. J Oral Maxillofac Surg 2004;62:1193-7. https://doi.org/10.1016/j.joms.2004.06.033

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