[Original] Matsumoto Shigaku 22 : 297～303, 1996
key words : Mandible — Corpus — Ramus — Third molar — Eruption

Eruption State of Mandibular Third Molar and Morphology of Mandible

NAOTO OSUGA, YU-FAANG LIN, HIROSHI NAKAMURA,
HIROSHI IWASAKI and HIROO MIYAZAWA

Department of Pedodontics, Matsumoto Dental College
(Chief : Prof. H. Miyazawa)

Summary

Recent studies have indicated that even in cases in which the existence of tooth germs are observed, third molars cannot perfectly erupt because there is too little space for eruption in the distal end of the 2nd molar, and that cases of impaction or semi-impaction are increasing. The purpose of this study was to compared the morphological variation of the mandible as the mandibular corpus and the mandibular ramus among three groups : a group of full impaction of the third molar in the mandibular dental arch (A group), a group of semi-impaction (B group), and a group of full eruption (C group).

The following results were obtained.

1) Concerning the measurements representing distance : R (the width of the mandibular ramus), was significantly longer in group A while it was shorter in group C. M (total length of the mandible), C (length of the mandibular corpus) and the distance between Cd and Gn were all significantly longer in group C than in group A.
2) Concerning the measurements representing angles, the Go angle was significantly larger in group C than in group A.
3) All the measurements in group B approached the median value of those of group A and group C.

It was suggested that there was no impaction of the mandibular third molar observed due to the reduction of the mandible, and that the eruption of the mandibular third molars appears to be affected by the growth and change in the mandibular corpus and the mandibular ramus and/or the change in the Go angle.

Introduction

The third molar demonstrates the most significant degeneration of human teeth. Reportedly, approximately 30% of the human population do not have maxillary third molars and 20% do not have mandibular third molars[1]. Recent studies[2] have indicated that even in cases in which the existence of tooth germs are observed, third molars cannot perfectly erupt because there is too little

(submitted October 16, 1996 ; accepted November 13, 1996)

space for eruption in the distal end of the 2nd molar, and that cases of impaction or semi-impaction are increasing. This can cause serious problems, especially in the formation of the mandibular dental arch[3]. Furthermore, this becomes an important issue in pedodontics, which generally attempts to develop the complete mastication system by building up normal dental arch formation.

The considerable factors that may hinder eruption of mandibular third molars are : [1] shortened mandible due to undergrowth[2], inappropriateness of tooth size and[3] discrepancy between tooth and space for eruption. Inoue[4] considered abnormal eruption of the third molar (impaction and ectopic eruption) to be a discrepancy syndrome due to the preference for soft food starting from childhood. However, the report of Japanese Society Pediatric Dentistry[5] indicated that although the development of the mandible was somehow affected by the increase in body size compared to children of the late 1950's and early 1960's, it was not clear whether the size of the mandible was reduced due to the preference for soft food from childhood. It was also reported[6] that, compared to the size of mandible, tooth size was hardly affected by functional factors, and that the third molars were rather degenerative, in other words, it shoud be easier for the tooth to erupt.

Therefore, it can be considered that impaction or semi-impaction cases are related not only to reduced mandible size but also discrepancy between the tooth and the space for its eruption. The reason is that tooth germs of the mandibular molars first existed in the mandibular ramus and then moved to the mandibular corpus where eruption occurs as a concomitant development of the mandibular corpus and the mandibular ramus[7]. In light of this finding, it is inappropriate to evaluate the eruption space generated by growth and development around the anterior margin of the mandibular ramus or to understand the relationship between eruption of the mandibular third molar and mandible if the mandible is regarded as a single bone.

The purpose of this study was to compared the morphological variation of the mandible as the mandibular corpus and the mandibular ramus among three groups: a group of full impaction of the third molar in the mandibular dental arch, a group of semi-impaction, and a group of full eruption, by using the method proposed by Lin et al[8].

Subjects and Methods

Male students from the Dentistry Department of Matsumoto Dental College who were determined to be of normal occlusion acted as subjects in the present study. They were divided into three groups based on the state of eruption of the bilateral mandibular third molars ; 12 subjects of full impaction of the mandibular third molar were assigned to group A ; 12 subjects of semi-impaction were group B ; and 12 subjects of full eruption were group C (Table 1. and Fig 1.). Subjects were diagnosed as follows : the cases in which the existence of the bilateral mandibular third molars were observed by X-ray examination but the mandibular third molars were not observed during an oral cavity check were criticized as full impaction ; cases in which half the crown of the bilateral mandibular third molars were observed during an oral cavity check but the eruption seemed difficult based on X-ray examination were criticized as semi-impaction ; cases in which the bilateral mandibular third molars were totally erupted and were in the line of the occlusal plane were criticized as full eruption.

Using the conventional lateral cepholometric radiography and the method developed by Lin et al[8] (Fig 2.), several measurement sites were established to evaluate the lateral cephalometric radiographs obtained during the above procedures. These measurement sites were as follows : Ra is the point where the occlusal plane of intersects the anterior margin of the mandibular ramus ; Rp is the point where the occlusal plane intersects the posterior margin of the mandibular ramus; R is the width of the ramus, i. e., the distance between Ra and Rp; Pog', Ra' and Cp' are the intersecicular lines drawn from Pog, Ra and Cp (the distal end of the condylar) to mandibular plane, respectively; M is the total length of the mandible, i. e., distance between Pog' and Cp'; C is the length of mandibular corpus i. e., distance between Pog' and Ra'. Some other measurement sites that may represent the total length of the mandible such as Go-Me and Cd-Gn were also measured. In addition, mesio-distal diameters of the crown of each tooth were measured on plaster models.

Results

Table 2. shows the mean and SD of the major linear and angular measurements of those 3 groups. Results with an asterisk in the table are statistically different at the $p<0.05$ level. Concerning the measurements representing distance: R, the width of the mandibular ramus, was significantly longer in group A while it was shorter in group C. M (total length of the mandible), C (length of the mandibular corpus) and the distance between Cd and Gn were all significantly longer in group C than in group A. All the measurements in group B approached the median value of those of group A and group C.

Concerning the measurements representing angles, the Go angle was significantly larger in group C than in group A. On contrast, with conventional angular analysis of lateral cephalometric radiographs, there was no significant difference between any groups.

As shown in Table 3. that lists the measurements of mesio-distal diameters of the crown of each mandibular tooth, there was no significant difference between any groups.

Discussion

Recently, full eruption of the third molar appears to be decreasing and cases of semi-impaction and/or total impaction are increasing[8]. It has been also reported that a change in eating habits is affecting the growth of the mandible[4]. Eruption of the mandibular third molar depends on the growth and development of the space for eruption which is from the distal surface of the second molar to the anterior margin of the mandibular ramus. The space for eruption can be provided by bone resorption in the anterior margin of the mandibular ramus. It is also known that the mandible develops posterior through bone resorption in the anterior margin of the mandibular ramus and bone deposition in its posterior margin. It can be assumed that an imbalance in bone resorption at the anterior margin and bone deposition at the posterior margin of the mandible may cause problems such as dental eruption disturbances, and maxillofacial disharmony. Therefore, it seems reasonable to regard the mandible as two parts, the corpus and the ramus, and investigate each part separately to evaluate the whole mandible. Lin et al[8]. found and reported, using lateral cephalometric radiographs of dry skulls of various Hellman's dental stages, that at any growth stage, the perpendicular line from point Ra (the intersect of the occlusal plane and the anterior margin of the mandibular ramus) to the mandibular plane was consistent with the posterior margin of the mandibular corpus , i. e., the posterior margin of the lingual tuberosity. This finding allowed evaluation by dividing the mandible into the corpus and the ramus along the perpendicular line. However, it is difficult to establish the occlusal plane for cases of Hellman's dental stage VA due to the curve of Spee. Therefore, subjects with a significant curve of Spee of the permanent dental arch were excluded from our study since it was not possible to establish the occlusal plane nor subsequently, to separate the mandible into the ramus and the corpus using the perpendicular line.

Table 1. Subjects

Full impaction (Group A)	Semi-impaction (Group B)	Full eruption (Group C)
Male 12cases	Male 12cases	Male 12cases

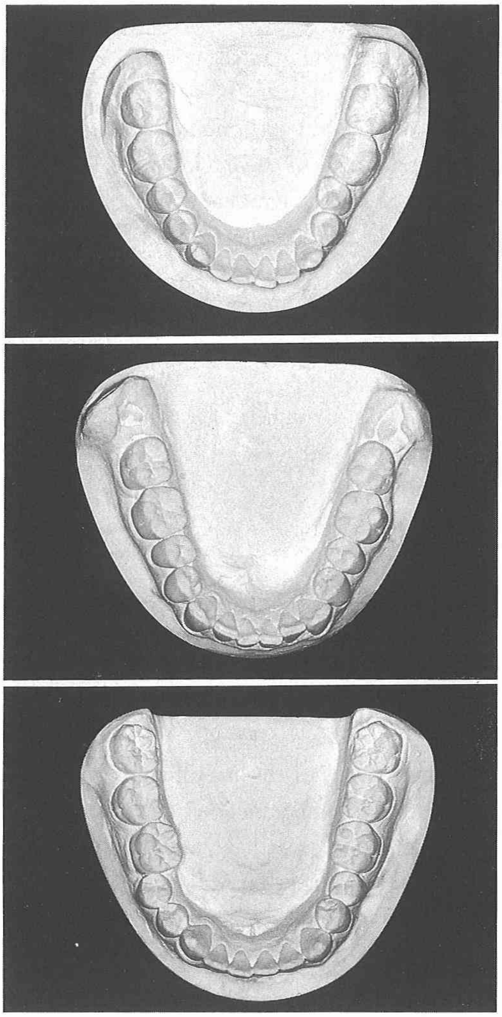

Fig 1. State of eruption of mandibular thrid molar ; (A) full impaction ; (B) semi-impaction ; (C) full eruption.

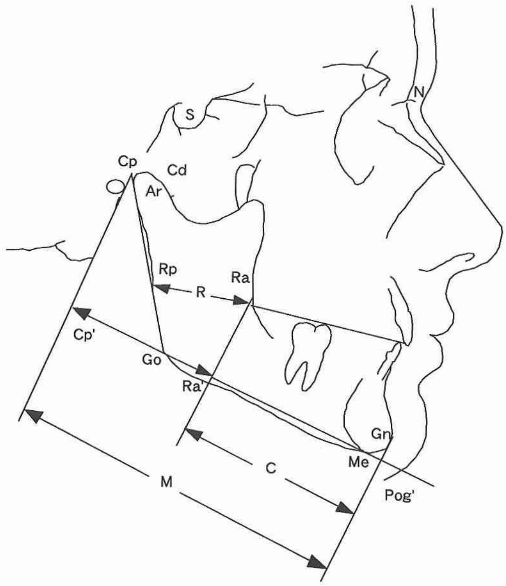

Fig 2. Measurement sites on lateral cephalometric radiograph.

Table 2. Major linear and angular measurements

		Group A	Group B	Group C
C	$\overline{X}$	58.40	58.84	63.82
	SD	4.69	3.85	3.78
R	$\overline{X}$	41.48	39.90	37.13
	SD	2.74	2.70	3.38
M	$\overline{X}$	115.32	117.96	123.70
	SD	6.43	7.90	5.53
Cd-Gn	$\overline{X}$	127.41	129.67	133.89
	SD	6.82	6.82	5.33
Go-Me	$\overline{X}$	79.64	79.06	80.39
	SD	6.42	3.83	4.14
∠Go	$\overline{X}$	119.64	121.23	124.81
	SD	7.76	6.60	7.21

mm. degree * $P < 0.05$

Table 3. Mesio-distal crown size of mandibular teeth

		Group A	Group B	Group C
central incisor	$\overline{X}$	5.68	5.69	5.68
	SD	0.30	0.40	0.22
lateral incisor	$\overline{X}$	6.07	6.38	6.72
	SD	0.40	0.42	0.27
canine	$\overline{X}$	7.33	7.56	7.34
	SD	0.34	0.41	0.40
first premolar	$\overline{X}$	7.65	7.64	7.53
	SD	0.40	0.49	0.36
second premolar	$\overline{X}$	7.53	7.46	7.56
	SD	0.44	0.51	0.20
first molar	$\overline{X}$	12.03	11.75	11.48
	SD	0.53	0.48	0.60
second molar	$\overline{X}$	11.58	11.34	11.16
	SD	0.84	0.71	0.59

mm.

Concerning the linear measurements, the width of the mandibular ramus (R) was significantly larger in group A while it was smaller in group C. Total length of the mandible (M), length of the mandibular corpus (C), the distance between Cd and Gn, and the Go angle were all significantly larger in group C than in group A. However, there was no significant difference in the Go-Me distance between groups A and C. The measurements M and the Cd-Gn distance which represent the total length of the mandible were significantly larger in group C than in group A, and consequently it was assumed that the mandible was larger in group C than in group A, on the contrary, there was no significant difference of the Go-Me distance between group A and group C, and in addition, the Go angle was larger in group C, it can be assumed that the enlargement of the Go angle was the main factor involved in extending the total length of the mandible (M), and the Cd-Gn distance in group C.

Therefore, it was considered that the mandibular corpus was longer in group C not because of a larger mandible ; rather, morphologically, the mandible in group C was characterized by a longer mandibular corpus, narrower mandibular ramus and enlarged Go angle.

In this study, although there was no obvious difference in the conventional measurements between the groups, there were significant differences in the measurements regarding the mandibular corpus, mandibular ramus and Go angle. Such findings suggested that the concomitant growth of the mandibular ramus and the mandibular corpus and the change of Go angle might possess a regulatory effect in determining the size of the whole 8 mandible corresponding to the size of the maxillofacial skull. In other word, it was considered that compensatory mechanism might appear in various ways during the growth of the mandible so that the growth can be balanced with the development of the maxillofacial skull, and as a result, the eruption of the mandibular third molar might be affected by the development growth of the mandibular corpus and the mandibular ramus.

Conclusion

It was concluded that there was no impaction of the mandibular third molar observed due to the reduction of the mandible, and that the eruption of the mandibular third molars appears to be affected by the growth and change in the mandibular corpus and the mandibular ramus and/or the change in the Go angle. Since the mandible contains space for eruption which directly relates to the eruption of teeth, it was assumed that a shorter mandibular corpus might disturb eruption of the third molar. According to the results, it was suggested that the recent increase in the number of cases of impaction of the mandibular third molar indicates concomitant growth and change of the mandibular corpus and the mandibular ramus that are closely related to the eruption of the teeth and development of the dental arch. Although the reason for such morphological characteristics is still unknown, it can be assumed that some functional factors including mastication might create these differences between the groups in bone resorption at the anterior margin of the mandibular ramus and bone deposition at the posterior margin of the mandibular ramus and/or change of Go angle.

Appendix

This study was supported by a 1995 Matsumoto Dental College special study grant. The part of this report was presented at the 34th meeting of JSPD (held in Sapporo on 7th June, 1996).

References

1) Kawanishi, H. (1959) Statistical survey of Japanese third molar, the appearances, development, eruption timing and eruption frequency. J. Stomatol. Soc., Jpn. **26** : 463—478. (in Japanese)
2) Kindaichi, J. (1989) The third morlar and discrepancy syndrome. Medical Chugai **42** : 642—645. (in Japanese)
3) Ricketts, R. M. (1972) The principle of arcial growth of the mandible. Angle Orthod. **42** : 368—385.
4) Inoue, N. (1980) Tooth to denture base discrepancy in human evolution. J. Anthrop. Soc. Nippon. **88** : 69—82. (in Japanese, English abstract)
5) Japanese Society of Pediatric Dentistry (1993). Research concerning the sizes of primary tooth crown, primary dental arch and the condition of primary occlusions of the Japanese. Jpn. J. Ped. Dent. **31** : 375—388. (in Japanese, English abstract)
6) Asakura, M. (1975) Relationships of size and form of the remaining teeth to third molar agenesis. Aichi-Gakuin J. Dent. Sci. **13** : 207—301. (in Japanese, English abstract)
7) Van der Linden, F. P. G. M. and Duterloo, H. S. (1976) Development of the human Dentition—An Atlas Medical Dept, 14—50. Harper and Row, Hagerstown.
8) Lin, Y. F., Ono, Y. and Ono, H. (1992) A study on a method to indentify the border between mandibular corpus and ramus on lateral cephalometric radiograph. Bull. Tokyo Med. Dent. Univ. **39** : 1—7.

抄録：下顎第3大臼歯の萌出程度と下顎骨の形態について

大須賀直人，林　于昉，中村浩志，岩崎　浩，宮沢裕夫（松本歯大・小児歯科）

近年，第3大臼歯は，萌出が困難な症例が多く認められ，特に下顎の歯列形成に深刻な問題を惹起しているといわれている．そこで，下顎第3大臼歯の萌出状態と下顎骨形態との関係を明らかにするため，口腔模型より正常咬合と思われる症例より，下顎第3大臼歯の萌出状態を，完全埋伏（A群），半埋伏（B群），完全萌出（C群）の3群に分類し，通法の側方頭部X線規格写真分析にLinらの方法を加え，下顎骨を下顎体と下顎枝に分け，3群間の下顎骨の形態差異および歯牙の大きさについて比較検討した．

距離的計測項目では，下顎枝の幅RはA群の方が有意に大きく，逆にC群は小さい傾向が認められた．下顎骨全長M，下顎体長C，Cd-Gn間距離は，C群の方がA群よりも有意に大きい傾向が認められた．角度的計測項目では，Go-angleはC群の方がA群よりも有意に大きく，その他の角度的分析および歯牙の大きさでは各群に有意差は認められなかった．

以上の結果より，下顎骨全長を代表する計測項目MとCd-Gn間距離はC群の方がA群より有意に大きいということから，C群の下顎体も当然大きいと予想される．しかし，A群，C群間においてGo-Me間に有意差は認められず，Go-angleはC群がA群より有意に大きいことから，C群の下顎骨全長M，Cd-Gn間距離を増大する要因として，Go-angleの開大が影響すると考えられた．したがって，C群の長い下顎体は，大きい下顎骨によるものではなく，むしろ長い下顎体，幅の狭い下顎枝およびGo-angleの開大がC群特有の下顎骨形態であることが考えられた．

しかし，このような形態的特徴が生じる理由は明確ではないが，咀嚼や機能的影響により，下顎枝前縁の骨吸収と後縁の骨添加，または，Go-angleの変化になんらかの理由で差異が生じたものと考えられた．