Assessment of Pterygomaxillary Separation in Le Fort I Osteotomy in Class III Patients

Assessment of pterygomaxillary separation in Le Fort I osteotomy in Class III patients

KOICHIRO UEKI, DDS, PhD, # YUKARI HASHIBA, DDS, PhD ¶ KOHEI MARUKAWA, DDS, PhD, ¶ KATSUHIKO OKABE, DDS § SHAMIUL ALAM, BDS, PhD, * KIYOMASA NAKAGAWA, DDS, PhD, † and ETSUHIDE YAMAMOTO, DDS, PhD, ‡

Department of Oral and Maxillofacial Surgery, Graduate School of Medicine, Kanazawa University, 13-1 Takaramachi, Kanazawa 920-8641, Japan.

Assistant Professor
§ Graduate Student

¶ Clinical Instructor

* International Researcher

† Associate Professor

‡ Professor and Head

Address correspondence to: Koichiro Ueki, DDS, PhD.
Department of Oral and Maxillofacial Surgery, Graduate School of Medicine, Kanazawa University, 13-1 Takaramachi, Kanazawa 920-8641, Japan.
Tel: +81-76-265-2444; Fax: +81-76-234-4268
E-mail: kueki@med.kanazawa-u.ac.jp

Abstract

Purpose. The purpose of this study was to examine the separation of the pterygomaxillary region at the posterior nasal spine level after Le Fort I osteotomy in Class III patients.

Patients and Methods. The study group consisted of 37 Japanese patients with mandibular prognathism and asymmetry, with maxillary retrognathism or asymmetry. A total of 74 sides were examined. Le Fort I osteotomy was performed without a pterygoid osteotome, with an ultrasonic curette used to remove interference at the pterygomaxillary region. Postoperative computed tomography (CT) was analyzed for all patients. The separation of the pterygomaxillary region and the location of the descending palatine artery were assessed.

Results. Although acceptable separation between the maxilla and pterygoid plates was achieved in all patients, an exact separation of the pterygomaxillary junction at the posterior nasal spine level was found in only 18 of 74 sides (24%). In 29 of 74 sides (39.2%), the separation occurred anterior to the descending palatine artery. In 29 of 74 sides (39.2%), complete separation between the maxilla and lateral and/or medial pterygoid plate was not achieved, but lower-level separation of the maxilla and pterygoid plate was always complete. The maxillary segments could be moved to the postoperative ideal position in all cases.

Conclusion. Le Fort I osteotomy without an osteotome does not always induce an exact separation at the pterygomaxillary junction at the posterior nasal spine level, but the ultrasonic bone curette can remove the interference between maxillary segment and pterygoid plates more safely.

Key words:

Descending palatine artery, Pterygoid plate, Le Fort I osteotomy, ultrasonic bone curette, computed tomography

Introduction

Le Fort I osteotomy is a versatile procedure for management of dentofacial deformities.[1-3] Increased knowledge of the basic biology of the Le Fort I osteotomy,[4,5] development of instrumentation tailored to the operation, and use of controlled hypotensive anesthesia has dramatically reduced operating time and morbidity.[6]

In Le Fort I osteotomy, the junction of the bony tuberosity of the maxilla and the anterior part of the pterygoid plates represents the site of least certain separation. Pterygomaxillary dysjunction and maxillary down fractures become even more dangerous if these are traumatic in nature. Anatomic variants can occur at the base of skull such as bony defects or incomplete ossification,[7,8] or abnormally thick posterior walls of the maxilla and pterygoid plates can occur and increase patient risk.[9,10] Many complications of Le Fort I osteotomy occur from unfavorable dysjunction of the pterygoid plates from the posterior maxillary wall, including excessive bleeding,[11,12] cranial nerve injury[,13,14] and carotid artery injury.[9,15,16]

We previously used an ultrasonic bone curette to remove bone interference in the pterygomaxillary region, preserving the descending palatine artery, after down fracture of the maxilla without an osteotome.[17] The region surrounding the great palatine canal, including the descending palatine artery and anterior part of the pterygoid plates, is critical for moving the maxilla posteriorly and superiorly, which can be measured by knowing the separation pattern at the posterior nasal spine level. Although a modified Le Fort I osteotomy has been reported, an evaluation of separation accuracy has not been performed.

The purpose of this study was to examine the separation of the pterygomaxillary region at the posterior nasal spine level after Le Fort I osteotomy in Class III patients.

Patients and Methods

Patients

The 37 Japanese adults (men: 11, women: 26) in this study presented with jaw deformities diagnosed as mandibular prognathism and asymmetry, with maxillary retrognathism or asymmetry. At the time of orthognathic surgery, the patients ranged in age from 16 to 42 years, with a mean age of 24.2 years (standard deviation, 6.1 years). Informed consent was obtained from patients and the study was approved by Kanazawa University Hospital. Twenty-nine patients underwent Le Fort I osteotomy with bilateral sagittal split ramus osteotomies (BSRO) and eight patients underwent Le Fort I osteotomy with intraoral vertical ramus osteotomy (IVRO).

Surgical procedure

All patients underwent a standard Le Fort I osteotomy following a periodontal incision at the anterior teeth and a vestibular incision at the posterior teeth to prevent the postoperative scar at the labial gingival tissue, with inter-maxillary fixation screws (Stryker LEIBINGER, Freiburg, Germany or Jeil Medical, Seoul, Korea) implanted in the bimaxillary anterior alveolar bone. The lateral wall of the maxillary sinus was cut using a reciprocating saw, and the nasal septum and the lateral nasal walls were sectioned with a chisel. Pterygomaxillary separation was performed without an osteotome. A bone separator was fixed in a thick bony area of the lateral wall of the maxillary sinus, attached with screws implanted in the maxilla, and wired to fracture and pull down the maxillary segment. This method could facilitate the down fracture rather than conventional method. Furthermore, pulling down the wires could make it easy to see and operate the pterygomaxillary region. The posterior wall of the maxillary sinus, the maxillary tuberosity, and the pterygoid process were then exposed. The maxillary segment was pulled down and forward and small bone pieces were removed along with surplus sinus membranes, allowing the descending palatine artery to be seen from the pterygopalatine fossa to the nasal wall. The Sonopet UST-2001™ ultrasonic bone curette (Miwatec Co., Ltd., Kawasaki, Kanagawa, Japan) was used to remove interference between the pterygoid process and the posterior part of the maxilla without damaging the descending palatine artery or other vessels and nerves (Fig. 1). The maxillary segment was then repositioned with an intermediate occlusal splint and fixed with mini-plates and monocortical screws.

CT assessment

The patients were placed in the gantry with the tragacanthal line perpendicular to the ground for CT scanning. They were instructed to breathe normally and to avoid swallowing during the scanning process. CT scans were obtained in the radiology department by skilled radiology technicians using a high-speed, advantage-type CT generator (Light Speed Plus; GE Healthcare, Milwaukee, WI, USA) with each sequence taken 1.25 mm apart for the 3D reconstruction (120 kV, average 150 mA, 0.7 sec/rotation, helical pitch 0.75). The resulting images were stored in the attached workstation computer (Advantage workstation version 4.2; GE Healthcare, Milwaukee, WI, USA), and 3D reconstruction was performed using the volume rendering method. ExaVision LITE version 1.10 medical imaging software (Ziosoft, Inc, Tokyo, Japan) was used for 3D morphologic measurements (Fig. 1).

Measurements using CT

The horizontal image at the horizontal Le Fort I osteotomy line parallel to the FH (Frankfurt) plane (approximately posterior nasal spine level) was selected to measure the descending palatine canal and pterygomaxillary region, but this plane differed on each side. A total of 74 sides (37 right and 37 left sides) were measured. The RL line was defined as the line between the most anterior points of the bilateral auricles. The pterygomaxillary fissure line was defined as the line passing through the most concave point of the pterygomaxillary region parallel to the RL line, on each side (Figs 2 and 3). The separation differed between the posterior nasal spine level and the lower level, so separation on the lower level was also checked (Fig. 4).

1) Lateral separation distance: The distance between the separation point on the lateral sinus wall and the pterygomaxillary fissure line.
2) Medial separation distance: The distance between the separation point on the medial

sinus wall and the pterygomaxillary fissure line.

3) Position of great palatine canal: The distance between the most posterior point of the great palatine canal and the pterygomaxillary fissure line.
4) Lateral plate distance: The distance between the pterygomaxillary fissure line and the most anterior point of the separated lateral pterygoid plate. A negative value means that the most anterior point of the lateral pterygoid plate is posterior to the pterygomaxillary fissure.
5) Medial plate distance: The distance between the pterygoid fissure line and the most anterior point of the separated medial pterygoid plate. A negative value means that the most anterior point of the medial pterygoid plate is posterior to the pterygomaxillary fissure.

On the basis of these measurements, the variation of the separation at the pterygomaxillary region was classified as follows (Fig. 5):

A) The lateral separation distance and medial separation are 0. (Exact separation)
B) The lateral separation distance is 0 and the medial separate distance is positive.
C) The lateral separation distance is 0 and the medial separate distance is negative.
D) The lateral separation distance is positive and the medial separation distance is 0.
E) The medial separation distance is larger than the position of the great palatine canal and there is lateral and medial plate distance.
F) The medial separation distance is larger than the position of the great palatine canal and there is no lateral and/or medial plate distance.
G) The medial separation distance is smaller than the position of the great palatine canal and there is lateral and medial plate distance.
H) The medial separation distance is smaller than the position of the great palatine canal and there is no lateral and/or medial plate distance.

All CT images were measured by an author. Fifteen patients were selected randomly and CT images were measured again 10 days later (paired t-test; $p>.05$).

Statistical analysis

Data were compared between right and left with a paired t-test using the Stat View™ version 4.5 software program (Abacus Concepts, Inc., Berkeley, CA, USA). The differences were considered significant at $p<0.05$.

Results

No fracture was noted in the upper third of the pterygoid plates, and there was no fracture of the cranial base. Twenty-nine patients (58 sides) underwent an artificial pterygoid fracture or bone removal in the pterygomaxillary region. “Artificial fracture” means the removal of the interference between segments by use of ultrasonic bone curette after maxillary down fracture. The maxillary segments could be moved to the postoperative ideal position in all cases. Blood loss was small and no patient required transfusions.

The mean lateral separation distance was 3.0 ± 3.0 mm on the right and 1.7 ± 2.3 mm on the left. The mean medial separation distance was 4.8 ± 4.6 mm on the right and 4.2 ± 5.3 mm on the left. The mean position of great palatine canal was 4.3 ± 1.9 mm on the right and 4.3 ± 2.1 mm on the left. The mean lateral plate distance was -2.3 ± 2.2 mm on the right and -2.8 ± 1.6 mm on the left. The mean medial plate distance was -1.1 ± 2.6 mm on the right and -2.1 ± 1.7 mm on the left (Table 1.).

The lateral separation distance was significantly different between right and left ($P<0.0079$), but not for other measurements. There were no significant differences between Le Fort I osteotomy with SSRO and Le Fort I osteotomy with IVRO, and distances in men and women were not significantly different.

Type A separation at the pterygomaxillary junction occurred in only 18 of 74 sides (24.3%). Although not exact separation, type B (5 sides), C (3 sides), and D (4 sides), including separation at the pterygomaxillary fissure, was found in 12 sides (16.2%). Type E

(8 sides) and F (21 sides) (39.2% of total) separation occurred anterior to the descending palatine artery. Type G occurred on 7 sides. Type F and H (8 sides) totaled 29 of 74 sides (39.2%), with incomplete separation between the maxillary tuberosity and the lateral and/or medial pterygoid plate at the pterygomaxillary junction (Table 2.). However, separation between the maxilla and pterygoid plate was completed at the lower level in all cases.

Discussion

Usually, a curved Obwegeser osteotome is used through a blind approach to the pterygomaxillary fissure, but other approaches include the swan-neck and shark-fin osteotomes and ultrasonic bone curette, which improve safety.[17,18,19] Leverage alone avoids the use of osteotomes for pterygomaxillary disarticulation.[20] Separation of the posterior maxillary area may also be achieved by the osteotome transecting the tuberosity. Osteotomy through the tuberosity reduces unfavorable fractures of the pterygoid plates and also increases the safety margin by avoiding encroachment on structures of the sphenopalatine fossa.[21,22]

Successful separation of the pterygomaxillary junction depends greatly on technique. One method involves separation of the pterygoid plate from the posterior maxilla using Tessier distraction forceps applied initially at the piriform rims and then later at the maxillary tuberosity, rather than an osteotome.[20] They performed this pterygomaxillary separation in more than 500 cases without any complications. In their next study using CT,[23] they noted that acceptable separation between the maxilla and the pterygoid process took place in 80% of cases using a chisel and in 86% of those without a chisel. Fracture of the pterygoid plates took place in 87% of cases using a chisel and 82% of cases without a chisel. Although the definition of acceptable separation they reported was unclear, this study suggested that a chisel or osteotome is not always necessary to perform the Le Fort I osteotomy down fracture. Furthermore, the high rate of pterygoid plate fracture observed in the study occurred irrespective of the use of a pterygoid chisel.

However, there were no complications related to these types of fractures, causing the authors to question the assumption that pterygoid plate fracture is the cause of hemorrhage and nerve injury.

The high incidence of fractures of the pterygoid plate during separation of the pterygoidmaxillary junction (58.4%) in the study of Renick et al[24] is similar to the results of Robinson and Hendy.[25] In their experiments, using an identical separation technique, but in unfixed cadavers, separation was complicated in 75% of cases. Research using fixed specimens, published by Wikkeling and Tacoma, yielded a much lower incidence of unfavorable separation and may not simulate the clinical situation.[26]

Here, exact separation of the pterygomaxillary junction at the posterior nasal spine level was found in only 18 of 74 sides (24%). In 29 of 74 sides (39.2%), separation occurred anteriorly to the descending palatine artery. In 29 of 74 sides (39.2%), complete separation between the maxillary tuberosity and the lateral and/or medial pterygoid plate did not occur at the pterygomaxillary junction at the posterior nasal spine level. However, exact separation occurred more frequently at the lower level, with no complications. We did not use an osteotome to separate the pterygomaxillary junction, suggesting a green stick fracture occurred in most cases when the maxillary segment was fractured down. Pterygomaxillary dysjunction was found in only 24% of cases, so the pterygomaxillary junction might not always be adequate to separate the segments at the posterior nasal spine level. Differences in right and left lateral separation distance might be due to surgery by different operators or different impaction levels. These results suggest that the portion anterior to the pterygomaxillary junction is more suitable to fracture down the maxilla at the posterior nasal spine level, as an osteotome was not used.

Hwang *et al*.[27] reported in an experimental study of Le Fort I osteotomy using an osteotome in Korean dry skulls that the thickness of the pterygomaxillary region was significantly greater in the dysjunction group than in the fracture group. The mean thickness of the pterygomaxillary region was 7.70 mm in the dysjunction group and 4.70 mm in the fracture group. In our study, the mean position of the great palatine canal was 4.3 ± 1.9 mm on the right and 4.3 ± 2.1 mm on the left. The distance between the great palatine canal and the pterygomaxillary fissure at the level of the posterior nasal spine tended to be larger than at 3 mm above the nasal floor. Therefore, measurement position affects the measured thickness of the pterygomaxillary region. The thickness of the pterygomaxillary region in our study was more similar to the fracture group in their study, suggesting that the osteotome could have induced unexpected fractures of the pterygomaxillary region in our study. A short distance between the great palatine canal and the medial separation allowed the descending palatine artery to be easily identified. Exact separation at the pterygomaxillary junction and avoiding fractures of the pterygoid do not affect Le Fort I osteotomy safely outcomes. However, there is good clinical evidence supporte by radiographic documentation that high level pterygoid plates fractures can result in complications like hemorrhage and false aneurysm formation.[28] Therefore, sufficient attention should be paid, when the high level pterygoid plate is treated.

Use of a micro-oscillating saw may decrease the incidence of pterygoid plate fractures and reduce blood loss intra-operatively.[29] Because the pterygoid plates are usually left intact, there may be a decreased incidence of bleeding from tears in the pterygoid muscle, which is commonly encountered secondary to pterygoid plate fractures with an osteotome. The major disadvantage of this technique is that it is harder to reposition the maxilla posteriosuperiorly. When setback or impaction of the maxilla is performed, removal of the maxillary tuberosity, posterior wall, and the anterior part of the pterygoid plates are occasionally necessary. The posterior bone of the maxilla around the great palatine canal and the anterior part of pterygoid plates interfere with this procedure. If the maxillary segment cannot be moved posteriorly, an artificial fracture of the pterygoid plates and bone removal are also necessary. An ultrasonic bone curette helps shape the pterygomaxillary region, preserving the descending palatine artery.[17] During maxilla pull down, the ultrasonic bone curette could easily remove the interference between bone segments. Even if separation of the pterygomaxillary region was anterior to the pterygomaxillary junction at the posterior nasal spine level, the ultrasonic bone curette allowed movement of the maxilla anterior-inferiorly and posterior-superiorly. In this study, the mean lateral plate distance was -2.3 ± 2.2 mm on the right and -2.8 ± 1.6 mm on the left. The mean medial plate distance was -1.1 ± 2.6 mm on the right and -2.1 ± 1.7 mm on the left. Space frequently occurred between the maxilla and pterygoid plate. However, the lateral or medial plate distance showed a positive value in some cases, meaning the pterygoid plate was fractured or the anterior part of the pterygoid plate was removed to move the maxilla posteriorly, where the most anterior point of the pterygoid plate could be anterior to the pterygomaxillary fissure.

In conclusion, these results suggest that Le fort I osteotomy without an osteotome does not always induce exact separation of the pterygomaxillary junction at the posterior nasal spine level, although the separation between the maxilla and pterygoid plates occurred at the lower level. But, the ultrasonic bone curette can remove the interference between maxillary segment and pterygoid plates more safely.

References

1) Obwegeser HL: Surgical correction of small or retrodisplaced maxilla. The “dish-face deformity.” Plast Reconstr Surg 43: 351, 1969.
2) Bell W, Proffit W, White R: Surgical Correction of Dentofacial Deformities, vols 1 and 2. Philadelphia, Saunders, 1980.
3) Bell WH, Mannal C, Luhr HG: Art and science of the Le Fort I downfracture. Int J Adult Orthod Orthognath Surg 1: 23, 1988.
4) Bell WH, Fonseca RI, Kennedy JW, Levy BM: Bone healing and revascularization after total maxillary osteotomy. J Oral Surg 33: 253, 1975.
5) Epker BN: Vascular consideration in orthognathic surgery: II. Maxillary osteotomies. Oral Surg 57: 473, 1984.
6) Ueki K, Marukawa K, Shimada M, et al.: The assessment of blood loss in orthognathic surgery for prognathia. J Oral Maxillofac Surg 63: 350, 2005.
7) Feuerman TF, Hieshima GB, Benston JR, et al: Carotid-cavernous fistula following nasopharyngeal biopsy. Arch Otolaryngol 110:412, 1984.
8) Renn W, Rhoton A: Microsurgical anatomy of the sellar region. J Neurosurg 43:288, 1975.
9) Lanigan DT, Tubman DE: Carotid-cavernous sinus fistula following Le Fort I osteotomy. J Oral Maxillofac Surg 45:969, 1987.
10) Dupont C, Ciaburro H, Prévost Y: Simplifying the Le Fort I type of maxillary osteotomy. Plast Reconstr Surg 54:142, 1974.
11) Newhouse RF, Schow SR, Krau RA, Price JC: Life-threatening hemorrhage from a Le Fort I osteotomy. J Oral Maxillofac Surg 40:117,1982.
12) Reaume CE, MacNicol BM: Complications encountered during Le Fort I osteotomy in a patient with mandibulofacial dysostosis. J Oral Maxillofac Surg 46: 1003, 1988.
13) Watts PG: Unilateral abducent nerve palsy: Rare complication following a Le Fort I maxillary osteotomy. Br J Oral Maxillofac Surg 22: 212, 1984.
14) Reiner S, Willoughby JH: Transient abducens nerve palsy following a Le Fort I

Maxillary osteotomy: Report of a case. J Oral Maxillofac Surg 46: 699, 1988.

15) Habal MB: A carotid cavernous sinus fistula after maxillary osteotomy. Plast Reconstr Surg 77:981, 1986.

16) Lanigan DT: Injuries to the internal carotid artery following orthognathic surgery. Int J Adult Orthod Orthognath Surg 4:215, 1988.

17) Ueki K, Nakagawa K, Marukawa K, et al: Le Fort I osteotomy using an ultrasonic bone curette to fracture the pterygoid plates. J Craniomaxillofac Surg 32: 381, 2004.

18) Cheng LH, Robinson PP: Evaluation of a swan's neck osteotome for pterygomaxillary dysjunction in the Le Fort I osteotomy. Br J Oral Maxillofac Surg 31: 52, 1993.

19) Laster Z, Ardekian L, Rachmeil A, et al: Use of the 'shark-fin' osteotome in separation of the pterygomaxillary junction in Le Fort I osteotomy: a clinical and computerized tomography study. Int J Oral Maxillofac Surg 31: 100, 2002.

20) Precious DS, Morrison A, Richard D: Pterygomaxillary separation without the use of an osteotome. J Oral Maxillofac Surg 49: 98, 1991.

21) Trimble LD, Tideman H, Stoelinga P: A modification of the pterygoid plate separation in low level maxillary osteotomies. J Oral Maxillofac Surg 41: 544, 1983.

22) O'Regan B, Bharadwaj: Prospective study of the incidence of serious posterior maxillary haemorrhage during a tuberosity osteotomy in low level Le Fort I operations. Br J Oral Maxillofac Surg 45: 538, 2007.

23) Precious DS, Goodday RH, Bourget L, Skulsky FG: Pterygoid plate fracture in Le Fort I osteotomy with and without pterygoid chisel: A computed tomography scan evaluation of 58 patients. Oral Maxillofac Surg 51:151, 1995.

24) Renick BM, Symington JM: Postoperative computed tomography study of pterygomaxillary separation during the Le Fort I osteotomy 49:1061, 1991.

25) Robinson PP, Hendy CW: Pterygoid plate fractures caused by the Le Fort I osteotomy. Br J Oral Maxillofac Surg 24:198, 1986.

26) Wikkeling OME, Tacoma J: Osteotomy of the pterygomaxillary junction. Int J Oral Surg 4:99, 1975.

27) Hwang K, Lee DK, Chung IH, et al: Le Fort I osteotomy with sparing fracture of lateral

pterygoid plate. J Cranio-fac Surg 12: 48, 2001.

28) Lanigan DT: Discussion. False aneurysm of the sphenopalatine artery after a Le Fort I osteotomy: Report of 2 cases. J Oral Maxillofac Surg 61: 524, 2003.

29) Lanigan DT, Loewy: Postoperative computed tomography scan study of the pterygomaxillary separation during the Le Fort I osteotomy using a micro-oscillating saw. J Oral Maxillofac Surg 53: 1161, 1995.

30)

Legends

Fig.1 Intraoperative finding. The use of the ultrasonic bone curette (SONOPET 2001 UST-2001™) during pulling down of the maxilla.

Fig. 2 Measurements of the pterygomaxillary region in the right side in a typical case. 1) Lateral separation distance. 2) Medial separation distance. 3) Position of great palatine canal. 4) Lateral plate distance. 5) Medial plate distance.

Fig. 3 Measurements of the pterygomaxillary region in a case of maxillary setback. Anterior part of the pterygoid plate was removed and divided into the medial and pterygoid plates. 1) Lateral separation distance. 2) Medial separation distance. 3) Position of the great palatine canal. 4) Lateral plate distance. 5) Medial plate distance.

Fig. 4 The difference of the separation in slice level. A) The nasal spine level line is described in the sagittal image. B) The slice line at the lower level is described in the sagittal image.

Fig. 5 The schematic drawing of classification in the separation type at the pterygomaxillary region in the right side. Black spots show the great palatine canal.

Table 1. The results of CT measurements. SD indicates standard deviation. * indicates significant difference at $p<0.05$.

Table 2. The distribution of classifications of the separation.

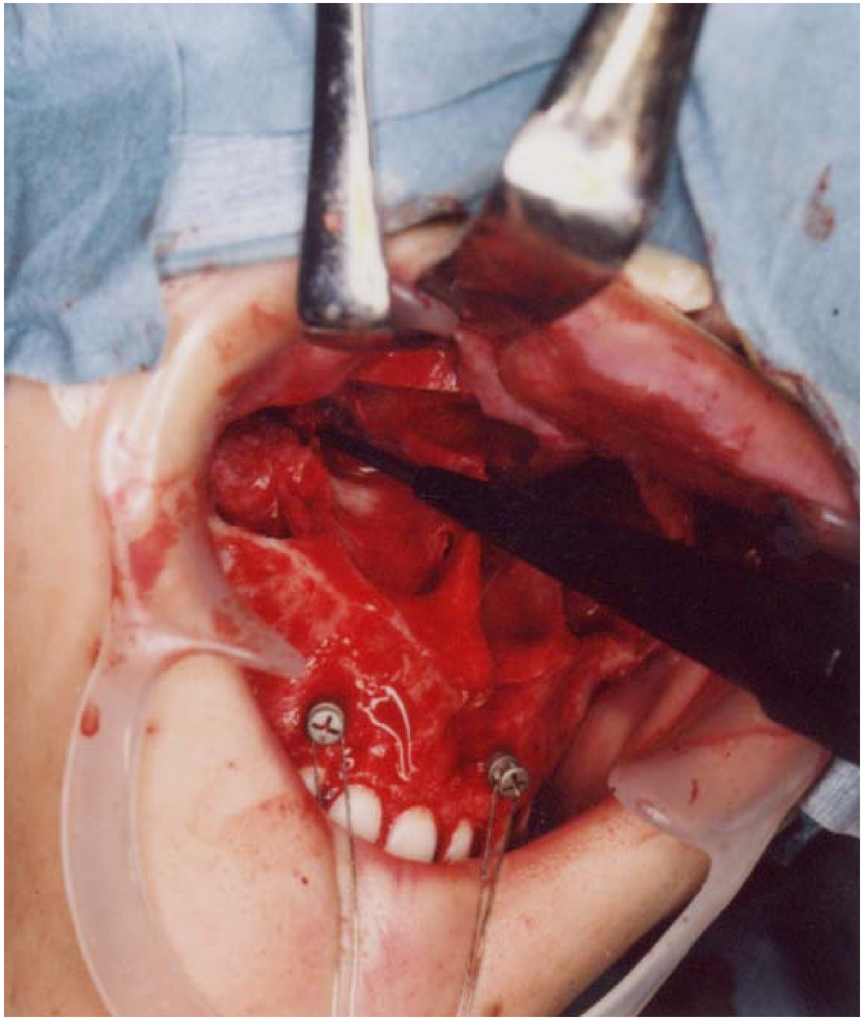


Fig. 1

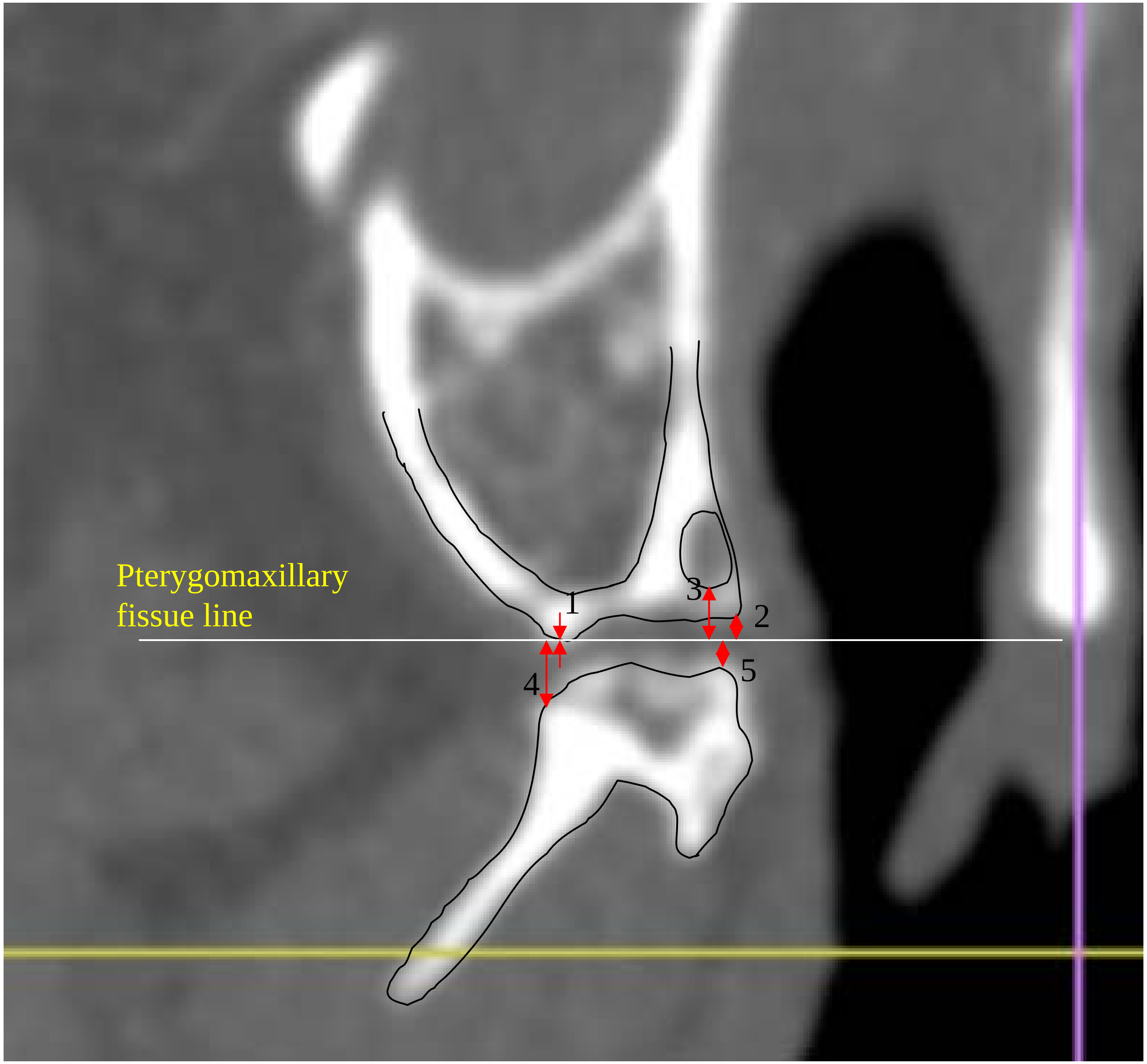
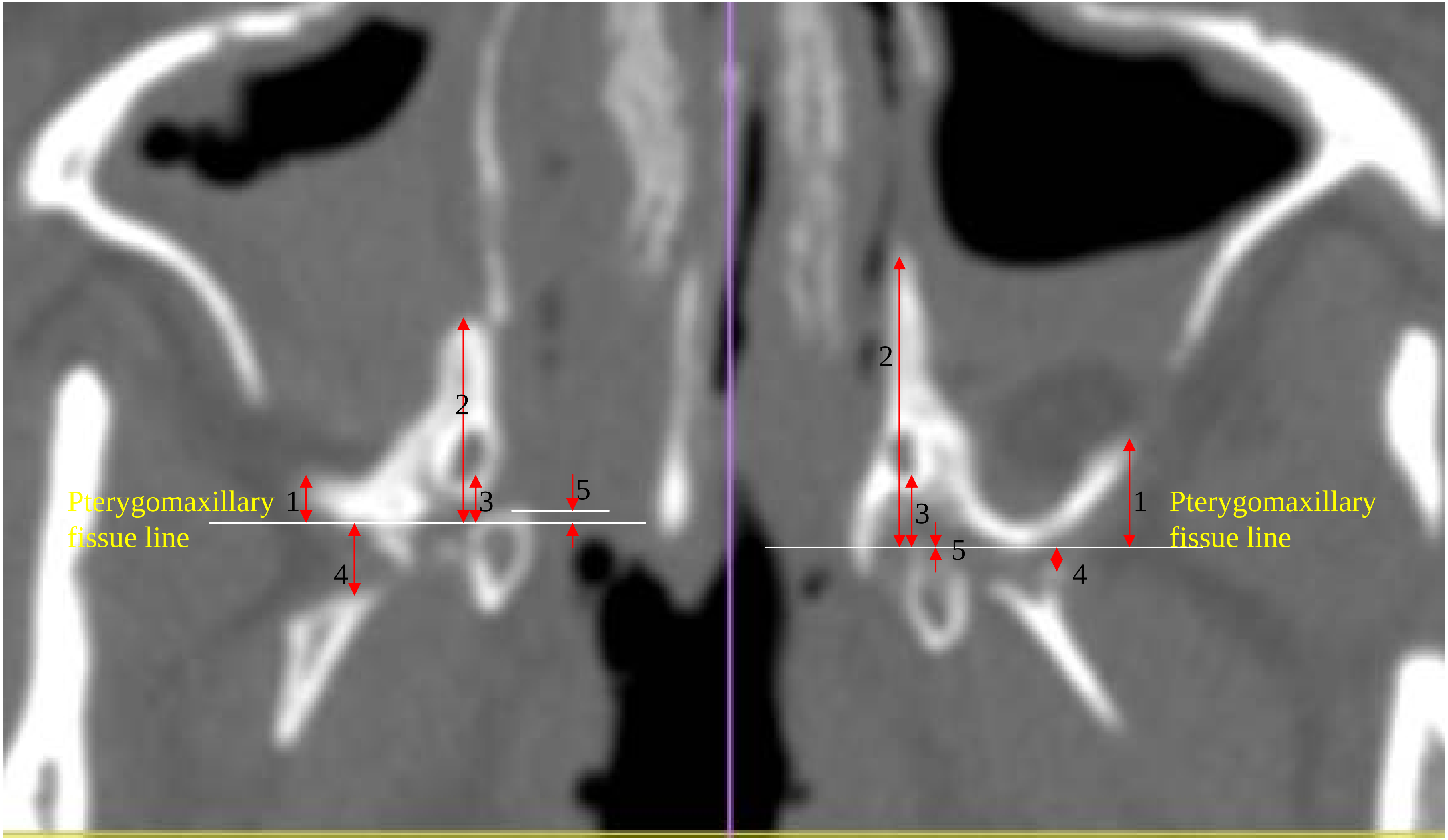


Fig. 2

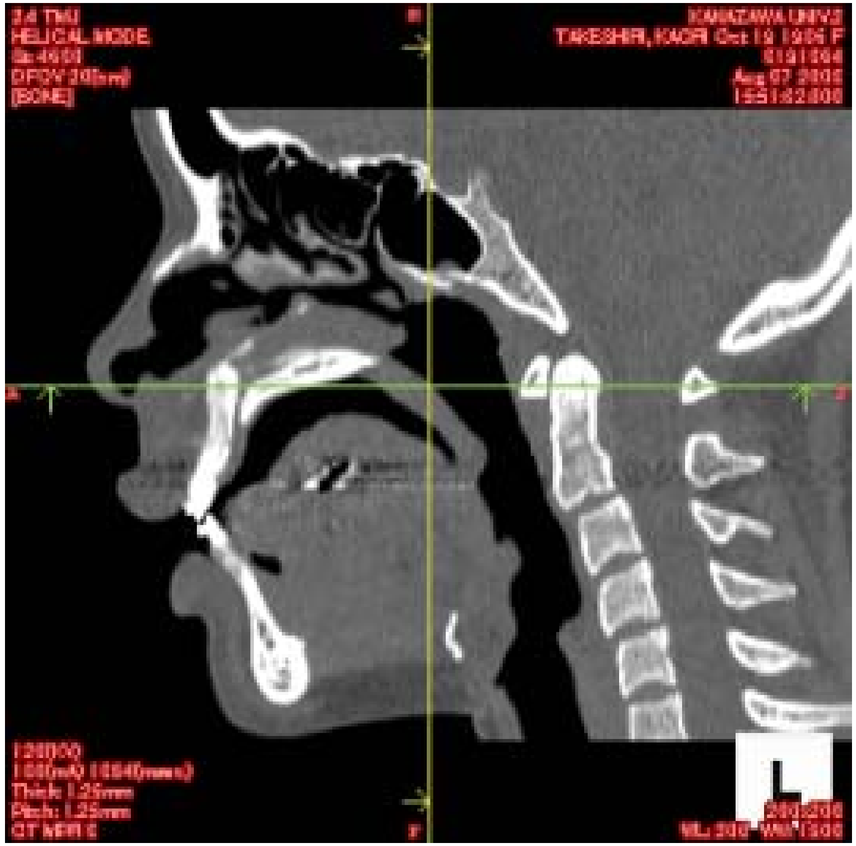


Pterygomaxillary fissue line
1
2
3
4
5
2
3
5
4
1
Pterygomaxillary fissue line

Fig. 3

A

Fig. 4



B

Fig. 4

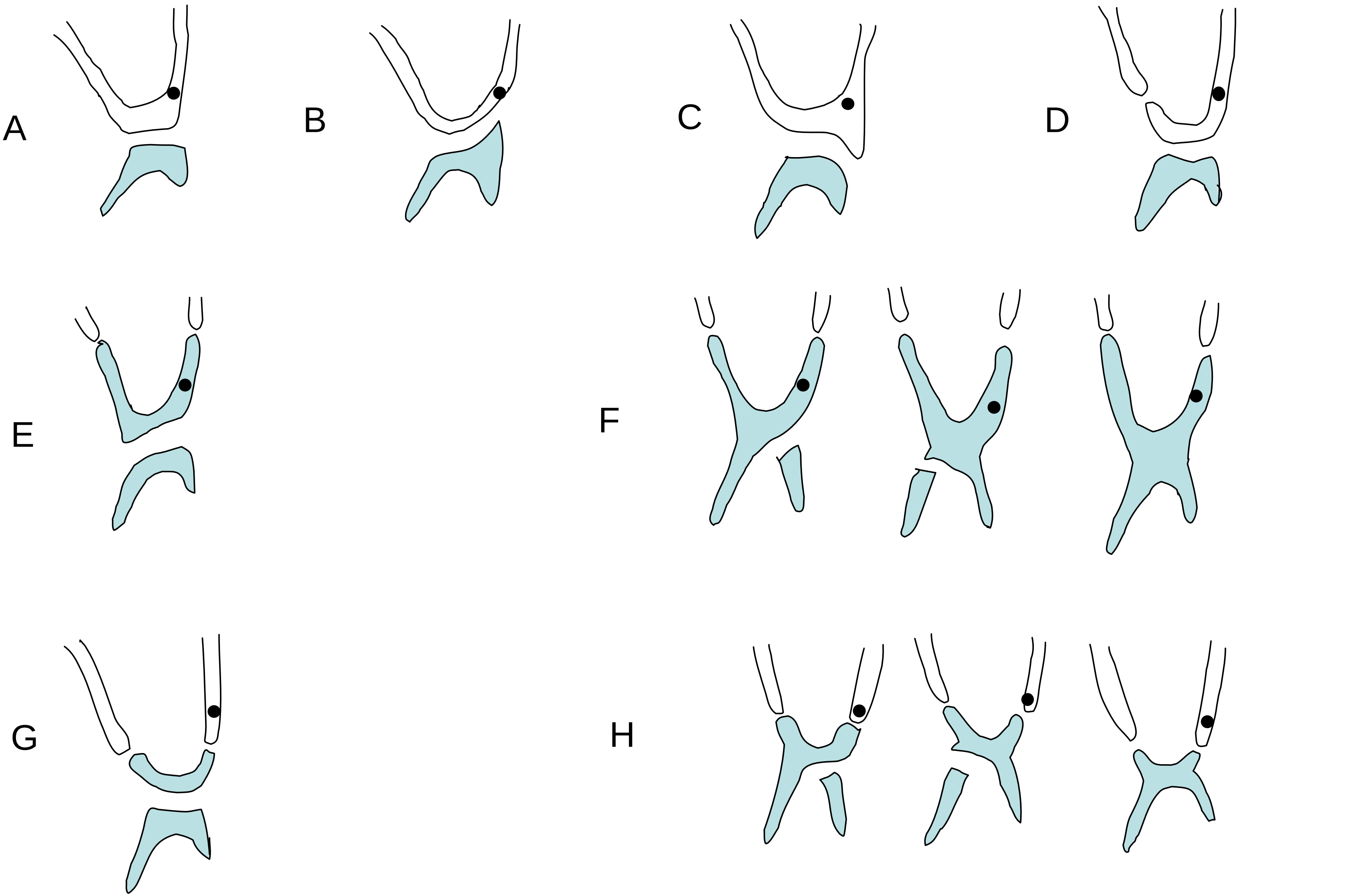


Fig. 5

		Right Meaan	SD	Left Mean	SD	
Lareral separation distance	(mm)	3.0	3.0	1.7	2.3	*
Medial separation distance	(mm)	4.8	4.6	4.2	5.3	
Position of great palatine canal	(mm)	4.3	1.9	4.3	2.1	
Lateral plate distance	(mm)	-2.3	2.2	-2.8	1.7	
Medial plate distance	(mm)	-1.1	2.6	-2.1	1.7	

Table 1.

	Sides	%
Type A	18	24.3
Type B	5	6.8
Type C	3	4.1
Type D	4	5.4
Type E	8	10.8
Type F	21	28.4
Type G	7	9.5
Type H	8	10.8
total	74	

Table 2.