Title

The mandible is further retruded under general anesthesia: the latent concept for a favorable outcome in sagittal split ramus osteotomy

Introduction

Cast models and articulators are indispensable for precise surgical planning and splint fabrication in orthognathic surgery. However, in the author's experience, model mounting based on the occlusal bite record taken at centric relation in a conscious patient sitting in the dental chair does not always correctly replicate the actual maxillomandibular relationship with the patient under general anesthesia in the supine position during surgery. In the latter situation, the mandible is often retruded, either automatically or manually. This can be attributed to the condylar position affected by gravity and relaxation of the muscles.

Hence, when performing the fixation of the condyle-proximal segment with the distal segment after sagittal split ramus osteotomy, this difference in position should be taken into consideration. Otherwise, immediate malocclusion or postoperative relapse may occur, both of which are closely related to condylar sag[1]. Iatrogenic temporomandibular joint complications may also occur in later stages. Therefore, it is important to confirm the degree of retrusion before splitting the ramus. This is achieved by applying pressure on the genial portion such that the condyle is seated at the most posterior and superior position in the glenoid fossa.

Some reports have indicated the magnitude of the posterior movement of the mandible in the supine, unconscious patient[2-4]. The study populations, however, were mostly comprised of Caucasians, and therefore the results are not necessarily applicable to Japanese and other Asian populations. Furthermore, to date, the exact extent of retrusion in these population remains unknown. As for the centric relation, previous reports adopted the definition similar to the latest one, the glossary of prosthodontic terms (GPT) -9th edition[5], according to which it is the position where condyle is located in the anterior-superior position against the posterior slopes of the articular eminences.

Present study was carried out to investigate the degree of extra retrusion of the mandible under general anesthesia and to determine the characteristics in each of the 3 original skeletal class patterns in a Japanese population, potentially indicative of Asian patients, based on the definition of GPT-6th edition[6] in which the centric relation was defined as the position in which the condyle was in the most upper and posterior position in the glenoid fossa. Direct measurement of the difference between the two condylar positions was difficult, therefore, the difference between the lower-upper incisor relationship between the conditions was evaluated as a substitute.

Patients and methods

Fifty patients with jaw deformities (14 males, 36 females) were enrolled in this prospective study, their ages ranging from 16 to 49 years. All patients underwent sagittal split ramus osteotomy in Hokkaido University Hospital, Japan, between January 2016 and March 2018. Maxillary surgery was carried out simultaneously in 23 patients. The number of patients in skeletal Classes I, II, and III were 7, 13, and 30, respectively. Before surgery, conventional orthodontic treatment was performed in all patients to alleviate dental crowding, level the curve of Spee, decompensate the dental inclinations, remove any occlusal interferences, and coordinate the upper and lower arches. The mean duration of preoperative treatment was 17 months.

The occlusal bite record at the incisor region obtained from a mounted articulator (bite record object 1) were compared with the records from the oral cavity of the patient under general anesthesia before surgery (bite record object 2) (Fig. 1). Vinyl polysiloxane impression material (PerfectIM® Systems, Morita, USA) was used for bite recording. Mounting of the cast models on the articulator was performed, in advance, in the conventional manner for surgery planning. The occlusal bite was taken by applying gentle pressure on the genial portion after jiggling the mandible lightly and with the patient, relaxed, in a dental chair in an upright position. Consequently, the condyle is located at the most posterior and most upper position in the glenoid fossa, where centric relation had been defined previously according to the GPT-6th edition[6]. The

same maneuver was performed to take the second occlusal bite but in the supine position under general anesthesia.

The linear distance between the reference points at the upper and lower edges of the incisors under different conditions were used as this was easier to measure than the accurate overjet and overbite based on the reference plane, parallel and perpendicular to the occlusal plane. Each of the two bite objects were cut with a fine knife in the sagittal plane so that the upper and lower reference points on the tooth edges were exposed, and the distance between the reference points was measured using Vernier calipers (Fig. 2). The retrusion of the mandible in supine position was defined as the difference in the distances measured between the two reference points in the two situations described above.

Student's t-test was applied for statistical analysis. A p-value of <0.05 was considered statistically significant.

Results

Retrusion in the supine position under general anesthesia was observed in all skeletal classes, and it was significantly greater in skeletal Class II, compared to skeletal Class I and III ($P<0.05$; Fig. 3). In skeletal Class II, the mandible was retruded around 1 mm on average.

The relationship between the upper and lower jaw in the articulator was not precisely the same, as in the oral cavity.

Discussion

Certainly, there is quite a difference between the movement measured by occlusal recording of the incisors and the real movement of the condyle in the body. However, direct evaluation of the condyle is very difficult and therefore procedural error can occur. Then, the author chose former evaluation method based on previous report[3]. As a result, extra retrusion of the mandible of patients in the supine position, under general anesthesia, was observed irrespective of original skeletal pattern. A significant difference was observed in skeletal Class II despite the degree of retrusion being as small as 1 mm. However, a difference of 1 mm in the oral cavity can be serious as it can affect

the interdigitation of the teeth. An adjustment of this amount by moving all teeth straightly back or forward postoperatively can be difficult and requires some extended treatment time.

Present findings indicate that the mandible will be in general retruded with muscular relaxation, and the maxillomandibular relationship with the articulator does not necessarily replicate the actual condition of the patient. Indeed, it is natural that differences occur due to occlusal bite records being taken in different situations. Some surgeons, however, are not aware of this; however, surgeons should be aware of the difference and the average magnitude required for a successful outcome when stabilizing the condyle-proximal segment of the mandible against the distal segment.

As for a reproducible position for the condyle, this study relied on the “centric relation.” Originally, the concept of centric relation came from prosthetics as a core theme in the fabrication of prostheses. There have been over 26 different definitions since the term was first introduced[7], but little attention has been given to body position and muscle condition. Shafagh et al. reported that there is a difference between the position of the condylar in the morning and in the afternoon[8]. Thus, a situation in which the mandible is separated into three segments with the patient in the supine position under general anesthesia and the condyle can be positioned everywhere, is not assumed. Therefore, applying a concept from prosthetics to orthognathics might have been flawed from the very beginning. The association of centric relation with muscle relaxation and gravity, all being intricately intertwined with one another has been given little consideration. Yet centric relation remains an indispensable term and one of the cardinal concepts in dentistry.

In the author’s opinion, as mentioned in the outdated GPT definitions, up to GPT-6th edition[6] and acceptable 7 definitions in GPT-8th edition[9], the most posterior and most superior position is desirable for orthognathic surgery because seating of the condyle in this position is relatively easy, and it is a more reproducible position in the author’s experience. The condyle should be positioned at the most posterior and superior position at first, and then adjustment of the condylar position can be carried out from this reference position, by pulling condyle-proximal segment forward or pushing it backward.

In the clinical situation, when stabilizing segments in skeletal Class I and Class III, the author has been positioning the condyle-proximal segment 0.5-1.0 mm anteriorly from the most posterior-superior position in the fossa to give some allowance for jaw movement, depending on the extent of the required backward movement of the dentate segment and the condition of the surrounding tissues. In skeletal Class II, however, mandibular retrusion was greater than in the other classes, and, clinically, the condyle-disc-fossa relationship is rather unstable. When stabilizing the segments, the author applies firm pressure on the anterior edge of the condyle-proximal segment with the positioning instrument, so that the meandering condyle moves further both posteriorly and superiorly. Extraoral digital pressure is simultaneously applied to the angle of the condyle-proximal segment, pushing it superiorly and distally. This maneuver may enable the condyle to move 1 mm backward, the amount of which is also identical to the extra retrusion in Class II patients of this study. This leaves no space between the condyle and glenoid fossa for further posterior movement of the distal segment. This maneuver is justified as reasonable and the trend of the extra movement, which is different from the other two skeletal classes, also corresponds to the present result. Therefore, the results of this study also support the legitimacy of the author's surgical approach as the mandibular retrusion has distinct features from that of skeletal Classes I and III. This characteristic difference is also reflected in author's plating technique involving a two-plate fixation on each side of the mandible (Fig. 4). An additional L-shaped plate sufficiently strengthens the fixation, and it also avoids counter-clockwise rotation of the distal segment in a sagittal plane post-operatively, produced by the masseter and internal pterygoid muscle actions[10]. This technique is very effective in case of skeletal Class II and open bite.

A condylar positioning device has been reported to provide accurate anterior-posterior positioning of the condyle[11] However, it is vital to determine how and where the condyle should be positioned when setting up the device. First of all, there is no evidence that the original condyle position in habitual occlusion is anatomically correct, because patients will masticate food in a more stable position with less cusp interference by involuntarily moving the

jaw laterally or anteriorly. Anterior displacement of the disk occurs frequently, and fibrosis is also observed in the retrodiscal tissue[12]. Joint effusion is sometimes seen particularly in the superior articular cavity as well. These findings imply that the soft tissue around the condylar is always influenced by forces and conformational changes frequently develop. Patients with a jaw deformity will potentially have a deformity of the surrounding components of the jaw. In fact, it is not inaccurate to say that there is no temporomandibular joint which is anatomically “correct.” Correct shape and position of the both disc and retrodiscal tissue are no longer expected if the dislocated condition has continued for a long time. Repositioning the condyle merely in its original position may do more harm than good. This point supports the findings of Gerressen et al.[13], who demonstrated that it is possible to seat the condyle in a stable position without the use of any device. Hence, a desirable and stable, but not necessarily an anatomically correct position postoperatively should be found.

Finally, standardization of the condylar position for orthognathic surgery may be desirable. It is, however, far from being realized because there are many variations of skeletal deformity, condyle structure, condition of disk and retrodiscal tissue, and many symptoms related to these variations. The treatment modality also varies depending on which relevant factor should be weighted on. So, handling upon an original philosophy of the doctors concerned, based on individual experience, may be dominant. As for the GPT, we do not always have to follow the latest definition. Sometimes the older definition is superior to the new one in case of certain conditions. The attitude regarding how to use the definition and how to apply it may be more meaningful in the clinical situation.

Conclusion

Backward movement of the mandible is observed in the supine position under general anesthesia, compared to the position when the occlusal bite was taken preoperatively, even if the condyle is seated in the most posterior and most superior position. A significant difference was observed in skeletal Class II compared to other classes. Although this is affected by the difference

of the conditions and may seem minute, it is an essential, albeit latent, concept to achieve initial and permanent stability and optimal function.

References

1. Reyneke JP, Ferretti C. Intraoperative diagnosis of condylar sag after bilateral sagittal split ramus osteotomy. Br J Oral Maxillofac Surg 2002; 40: 285-292.

2. Bamber MA, Abang Z, Ng WF, Harris M, Linney A. The effect of posture and anesthesia on the occlusal relationship in orthognathic surgery. J Oral Maxillofac Surg 1999; 57: 1164-1172.

3. Yaghmaei M, Ejlali M, Nikzad S, Sayyedi A, Shafaeifard S, Pourdanesh F. General anesthesia in orthognathic surgeries: does it affect horizontal jaw relations? J Oral Maxillofac Surg 2013; 71: 1752-1756.

4. Jolivet C. Variation in centric relation in the conscious and the anesthetized patient. J Dentofacial Anom Orthod 2011; 14: 310-320.

5. The Academy of Prosthodontics. Glossary of prosthodontic terms 9th edn. J Prosthet Dent 2017; 117: e1-e105.

6. The Academy of Prosthodontics. Glossary of prosthodontic terms 6th edn. J Prosthet Dent 1994; 71: 41–112.

7. Palaskar JN, Murali R, Bansal S. Centric relation definition: a historical and contemporary prosthodontic perspective. J Indian Prosthodont Soc 2013; 13: 149-154.

8. Shafagh I, Yoder JL, Thayer KE. Diurnal variance of centric relation position. J Prosthet Dent 1975; 34: 574-582.

9. The Academy of Prosthodontics. Glossary of prosthodontic terms 8th edn. J Prosthet Dent 2005; 94:10–92.

10. Matsushita K, Inoue N, Totsuka Y. In vitro biomechanical evaluation of the effect of an additional L-shaped plate on straight or box plate fixation in sagittal split ramus osteotomy using a bioabsorbable plate system. Oral Maxillofac Surg 2011; 15: 139-146.

11. Rotskoff KS, Herbosa EG, Villa P. Maintenance of condyle-proximal segment position in orthognathic surgery. J Oral Maxillofac Surg 1991; 49: 2-7.

12. Ooi K, Inoue N, Matsushita K, Yamaguchi H, Mikoya T, Minowa K, Kawashiri S, Nishikata S, Tei K. Incidence of anterior disc displacement without reduction of the temporomandibular joint in patients with dentofacial deformity. Int J Oral Maxillofac Surg 2018; 47: 505-510.

13. Gerressen M, Stockbrink G, Smeets R, Riediger D, Ghassemi A. Skeletal stability following bilateral sagittal split osteotomy (BSSO) with and without condylar positioning device. J Oral Maxillofac Surg 2007; 65: 1297-1302.

Legends

Fig. 1 Preoperative occlusal bite record

Occlusal bite record of the incisor region taken using PerfectIM® (Morita, USA) in the patient's oral cavity before surgery.

Fig. 2 Measurement of the distance between reference points on incisors

The 2 bite records are cut in the same sagittal plane passing through the reference points at the edge of the upper and lower incisors.

Fig. 3 Retrusion in supine position under general anesthesia

Mandible retrusion in almost all cases, irrespective of original skeletal classes. In Class II, the amount is significantly greater than that in the other classes.

Fig. 4 Plating technique to stabilize the mandible

An additional L-shaped plate was placed at the superior-posterior portion of a conventional straight plate, just crossing over the upper-lateral edge of the buccal shelf. This configuration effectively prevents the tail of the distal segment from moving upward in the sagittal plane. A gap was seen in the cortical bone to allow for advancement of the distal segment.

Fig. 1

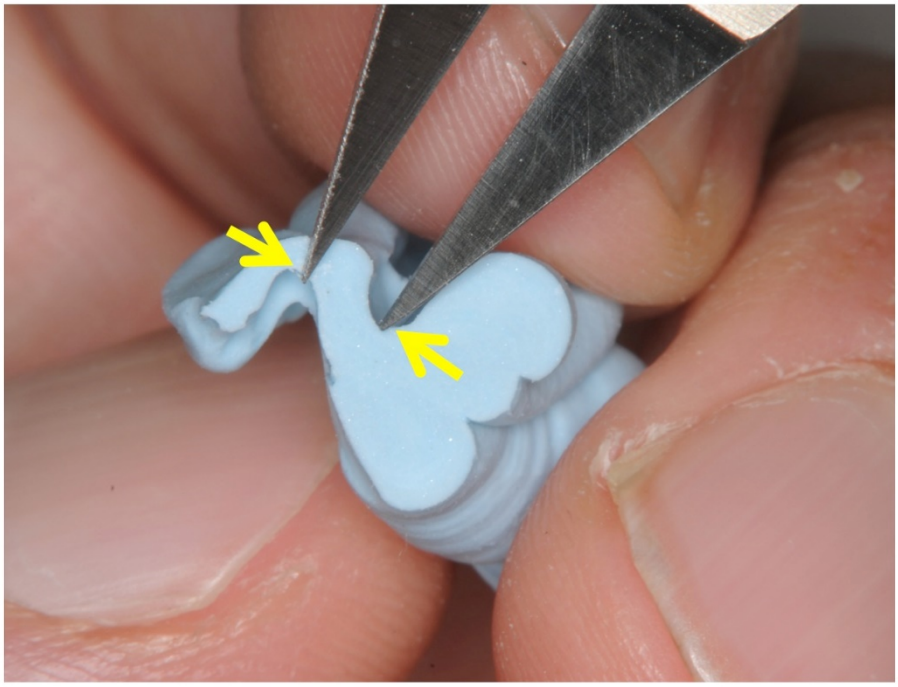

Fig. 2

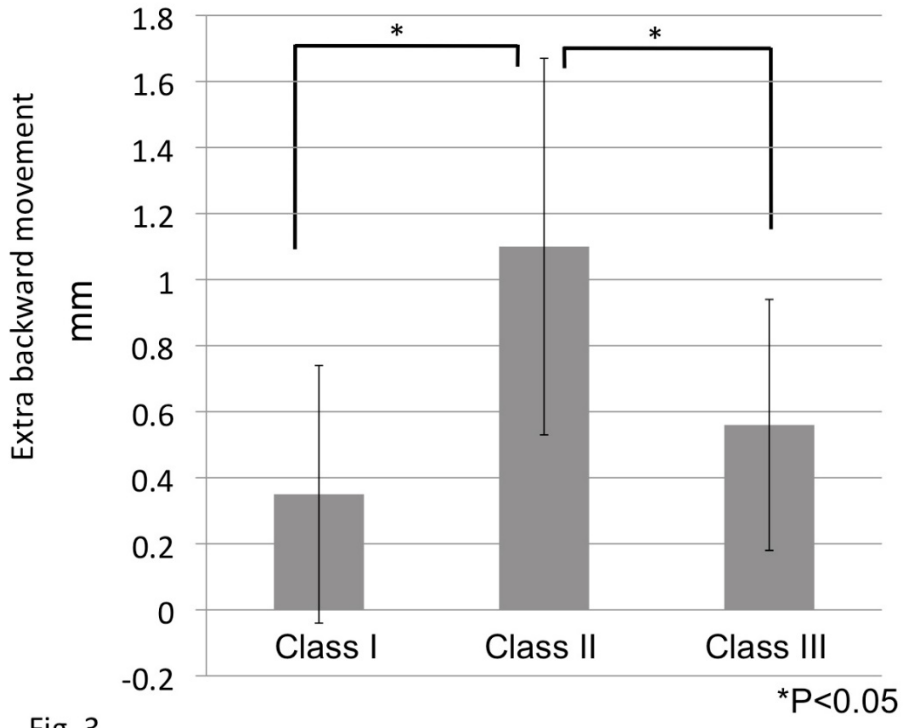
Extra backward movement
mm
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
*
*
Class I
Class II
Class III
*P<0.05

Fig. 3

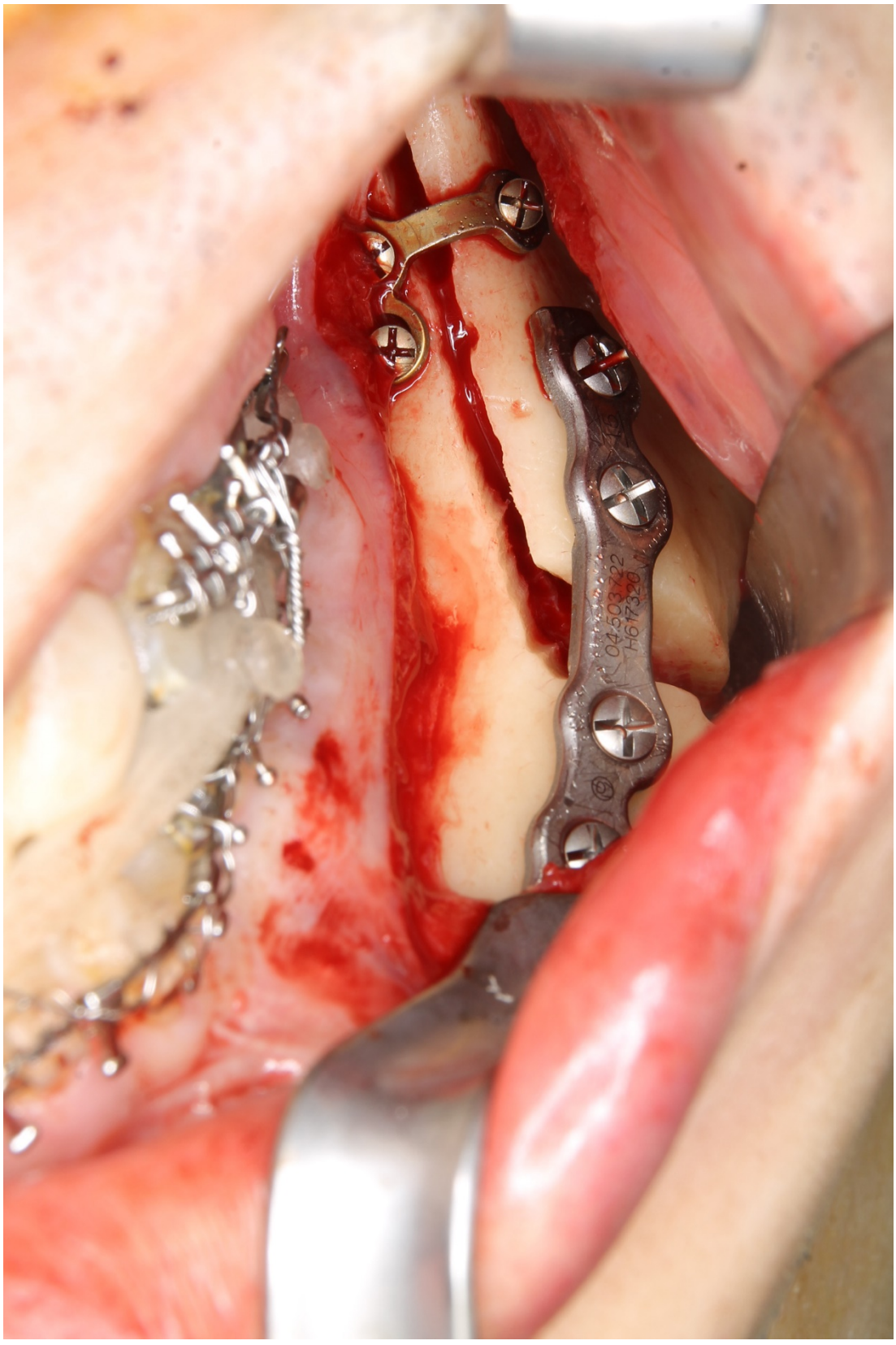

Fig. 4