

A comparison of postoperative hypoesthesia between two types of sagittal split ramus osteotomy and intraoral vertical ramus osteotomy, using the trigeminal somatosensory-evoked potential method

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| 著者 | Takazakura Daisuke, Ueki Koichiro, Nakagawa Kiyomasa, Marukawa Kohei, Shimada Mayumi, Shamiula Alam, Yamamoto Etsuhide |
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A comparison of postoperative hypoesthesia with trigeminal somatosensory-evoked potential between 2 types of sagittal split ramus osteotomy and intra-oral vertical ramus osteotomy

Daisuke Takazakura¹, Koichiro Ueki¹, Kiyomasa Nakagawa¹, Kohei Marukawa¹, Mayumi Shimada¹, Alam Shamiul¹, and Etsuhide Yamamoto¹

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

Key words:

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Osteotomy

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

The purpose of this study was to evaluate hypoesthesia of the lower lip with trigeminal somatosensory-evoked potential following 2 types of sagittal split ramus osteotomy and intra-oral vertical ramus osteotomy.

The subjects consisted of 30 patients with mandibular prognathism with and without asymmetry, who were divided into three groups: the Obwegeser method group, the Obwegeser-Dal Pont method group, and the intra-oral vertical ramus osteotomy group. Trigeminal somatosensory-evoked potential was recorded in the region of the lower lip and evaluated preoperatively and postoperatively.

The average recovery periods from lower lip hypoesthesia in the intra-oral vertical ramus osteotomy group and the Obwegeser method group were significantly shorter than in the Obwegeser-Dal Pont method group ($P < 0.05$).

In conclusion, this study proved that intra-oral vertical ramus osteotomy showed the earliest recovery from hypoesthesia or an absence of hypoesthesia and that lower lip hypoesthesia was less by the Obwegeser method than by the Obwegeser-Dal Pont method.

Orthognathic surgery procedures have been extensively described, along with the usually good results of various treatments.² Regarding mandibular osteotomies for mandibular prognathism, two surgical procedures dominate: sagittal split ramus osteotomy (SSRO)¹⁸ and intra-oral vertical ramus osteotomy (IVRO).² The SSRO technique was first been described by Trauner and Obwegeser.¹⁸ There have been many modifications to the technique, all designed to minimize morbidity and maximize the stability of the procedure. These include the variations described by Dal Pont,⁴ Hunsuck,⁸ and Epker.⁶ Generally, it is recognized that the vertical buccal cut of the Obwegeser-Dal Pont method is more anterior than that in the Obwegeser method. Therefore, we supposed there would be a difference between the Obwegeser method and the Obwegeser-Dal Pont method in neurosensory healing, even if the two procedures are included in same SSRO.

The incidence of neurosensory dysfunction was reportedly lower after IVRO than after SSRO.^{2,7,19,23} However, the results from various reports are difficult to compare because of their wide variations both in follow-up times and in the assessment of nerve function. No objective comparison study regarding inferior alveolar nerve hypoesthesia after SSRO and IVRO was found.

On the other hand, standard sensory testing modalities include the following: threshold to light touch, 2-point discrimination threshold, temperature sensibility,¹¹ and trigeminal somatosensory-evoked

potentials.^{5,9,12,13,14} The trigeminal somatosensory-evoked potential (TSEP) method is noninvasive, highly objective, and extremely reliable so that it can be used to investigate the causal factors of trigeminal sensory hypoesthesia after SSRO.^{3,12-15,22}

The purpose of this study was to compare objectively the differences in hypoesthesia of the lower lip with TSEP following the Obwegeser method, the Obwegeser-Dal Pont method, and IVRO.

Materials and methods

We studied 30 patients (8 men and 22 women; age range, 15-33 years; average age, 21.5 years; standard deviation, 4.9 years) who had mandibular prognathism with and without asymmetry. These patients were divided into three groups: 10 patients (3 men and 7 women) underwent the Obwegeser method (Ob group: average age, 21.2 years; standard deviation, 5.4 years); 10 patients (5 men and 5 women) underwent the Obwegeser-Dal Pont method (ODP group: average age, 20.5 years; standard deviation, 3.4 years); and 10 patients (all women) underwent IVRO (IVRO group: average age, 22.9 years; standard deviation, 5.7 years). Before surgery, lateral, frontal, and S-V cephalograms were obtained as described previously. The groups were then randomized to show similar distribution in preoperative SNB with lateral cephalogram analysis. The purpose of this study was explained to all patients before the operation and their informed consent was obtained for the TSEP

measurements.

All patients underwent setback surgery performed by the same surgeons' team. Sagittal split ramus osteotomy was performed according to the Obwegeser method and the Obwegeser-Dal Pont method (Fig. 1). To protect the inferior alveolar neurovascular bundle proximal to the lingual side from injury, medial periosteal dissection was carefully performed so that the bundle was not directly visualized. At the time of fixation in SSRO, a long mini-plate (4 holes / 8-mm bur, 0.55-mm thickness) and 4 screws (2×7 mm) (Würzburg titanium miniplate system, Leibinger Co., Freiburg, Germany) were placed monocortically. In the IVRO group, IVRO was performed according to the Bell method without intersegmental fixation. Although, all patients have orthodontic appliances, a total of 4 IMF screws® (2×8 mm) (Stryker Leibinger, Freiburg, Germany) were implanted between lateral incisors and canines at the region of anterior alveolar bone in the maxilla and mandible. After postoperative intermaxillary fixation using 0.4 mm wires and IMF screws was maintained for 1-7 days in the SSRO groups and 1-2 weeks in the IVRO group, intermaxillary elastic traction was performed with orthodontic appliances in all patients.

Trigeminal nerve hypoesthesia was assessed bilaterally by the TSEP method. The methodology and values of the TSEP have been previously described in a preliminary study.¹² An electroencephalograph recording system (Neuropack Sigma™; Nihon Koden Corp., Tokyo, Japan) was used

to analyze the potentials. Right and left sides were measured separately so that a total of 60 sides could be assessed. Each patient was evaluated preoperatively and then postoperatively at 1 week, 2 weeks, 1 month, 3 months, 6 months, and 1 year.

Trigeminal hypoesthesia was assessed by the latency of P1 and N2 in the recorded TSEP spectra because these peaks produce an accurate figure and have a tendency of higher reproducibility among healthy volunteers. Measurable periods of TSEP were defined as those periods before the peaks of N1(N13), P1(P17), N2(N27), P2(P36) and N3(N46) were identified clearly on early components of the TSEP wave (Fig. 2).

Data were statistically analyzed with StatView™ version 4.5 software (ABACUS Concepts, Inc., Berkeley, CA, USA). Differences between groups were analyzed using the Kruskal-Wallis test. Differences were considered significant at $P < 0.05$.

Results

There were no complications such as fracture of the proximal segments or abnormal bleeding during surgery. After surgery, no patient had wound infection or dehiscence, bone instability or non-union, or long-term malocclusion. The mean amount and standard deviation of setback was 7.2 ± 1.5 mm on the right and 5.5 ± 3.0 mm on the left in the Ob group, 6.8 ± 3.4 mm on the right and 5.9 ± 3.9 mm on the left in the ODP

group, and 5.2 ± 3.7 mm on the right and 4.0 ± 2.6 mm on the left in the IVRO group. There were no significant differences among these groups.

The average measurable period and standard deviation of TSEP was 1.6 ± 2.5 weeks in the Ob group, 16.6 ± 19.6 weeks in the ODP group, and 1.0 ± 0.0 weeks in the IVRO group. There were significant differences among these groups. The measurable period in the IVRO group was significantly shorter than those in the Ob group and the ODP group ($P<0.05$) (Table 1). There were no significant differences between right and left sides in all groups.

Twenty sides (100%) in the IVRO group, 18 sides (90%) in the Ob group, and 8 sides (40%) in the ODP group recovered within 1 week or did not show any hypoesthesia. On the other hand, no side in the IVRO group, 1 side (5%) in the Ob group, and 13 sides (65%) in the ODP group showed the hypoesthesia at 3 months postoperatively. There was no permanent hypoesthesia on any side. Hypoesthesia lasted the longest on one side in the ODP group who continued to be follow up with TSEP particularly and it recovered at 1.5 years postoperatively (Table.2).

Discussion

The known causal factors of postoperative trigeminal nerve hypoesthesia include medial periosteal dissection, exposure of the alveolar nerve during the split, compression injury at the time of fixation, and postoperative swelling.^{1,10} Takeuchi et al.¹⁶ reported that in SSRO setback

cases, the distance between the mental foramen and the mandibular ramus always decreased; this change may cause trigeminal nerve hypoesthesia by compression of the nerve trunk due to posterior shifting of the distal segments. To prevent the compression, a slight space was made between the proximal and distal segments using a flexible miniplate.²⁰

Our previous study suggested that the distance between the mandibular canal and the split surface strongly correlated with TSEP latency recovery, as shown by horizontal imaging with computed tomography.¹⁴ In this study, the Ob group showed earlier recovery from hypoesthesia than the ODP group. The fixation method was same so that it could not be considered to affect a difference in TSEP. The difference between the two methods was the difference in the area of the split. In other words, the area of the split surface in the region anterior to the mandibular foramen was related to the latency period of TSEP. However, in the region posterior to the mandibular foramen, the area of the split surface might be not related to the latency period, judging from the results of the IVRO group. The wide bony contact in SSRO was rather disadvantageous regarding hypoesthesia of the lower lip, although it was advantageous during segmental fixation. The inferior alveolar nerve was not damaged so that the branches were presumably widely distributed in the mandibular bone in the region anterior to the mandibular foramen. The osteotomy and split might injure not only the inferior alveolar nerve but also the branches. In other words, damage to branches of the inferior alveolar nerve may give a

more comprehensive injury to the mental nerve distribution. The inferior alveolar nerve could be protected by careful surgical technique; however, injury to the branches could not be avoided.

On the other hand, our previous study showed that prolonged latency of TSEP was initiated after medial periosteal dissection and was extended further after sagittal bone split and fixation.¹³ Teerijoki-Oksa et al.¹⁷ stated that low corpus height and location of the mandibular canal near the inferior border of the mandible might increase the risk of inferior alveolar nerve injury.

However, Upton et al.²¹ also evaluated the influence of concomitant surgical procedures on the incidence of postoperative nerve alteration and did not find a higher percentage of deficits with multiple procedures.

In fact, when bony contact area between segments is considered, IVRO is unsuitable for mandibular advancement surgery. The subjects of this study were mandibular prognathia patients for setback surgery, so that it would be difficult to apply these results to mandibular retrognathic patients for advancement surgery.

In conclusion, this study objectively proved that IVRO showed the earliest recovery of hypoesthesia or an absence of hypoesthesia and that lower lip hypoesthesia was less by the Ob method than by the ODP method. Nevertheless, the ODP method is also a very useful procedure, so surgeons should select a procedure after considering each case carefully and after explaining the advantages and disadvantages of each method to the patients.

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Figure Legends

Figure 1. The osteotomy line, determined by the Obwegeser-Dal Pont method (1), the Obwegeser method (2), and intraoral vertical ramus osteotomy (3).

Figure 2. A typical wave of trigeminal somatosensory-evoked potential. Five peaks were identified: N1(N13), P1(P17), N2(N27), P2(P36), and N3(N46).

Table 1. Average measurable periods of trigeminal somatosensory-evoked potential and their standard deviations. A significant difference was found with the Kruskal-Wallis test.

Table 2. Measurable cases in each period

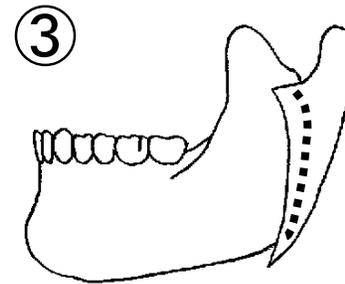
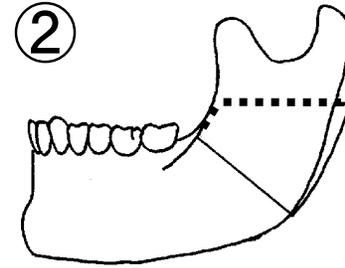
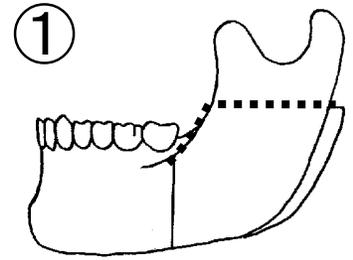
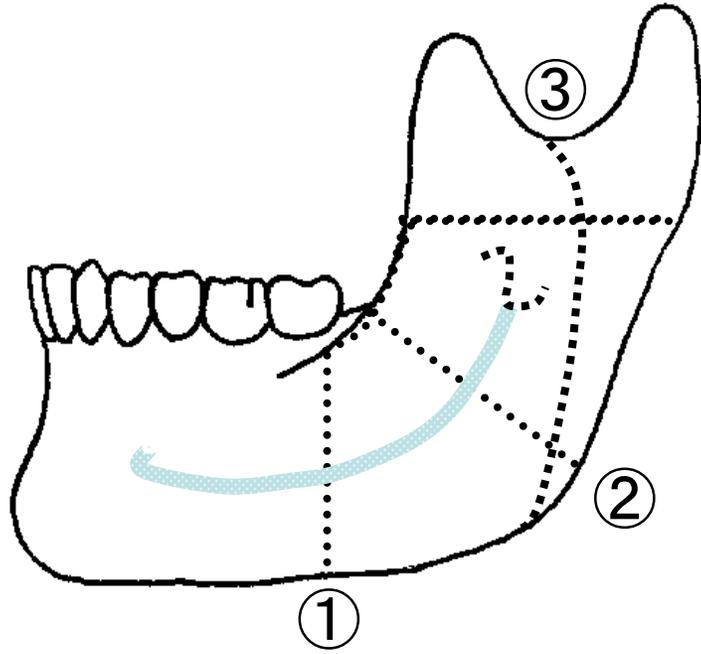


Fig. 1

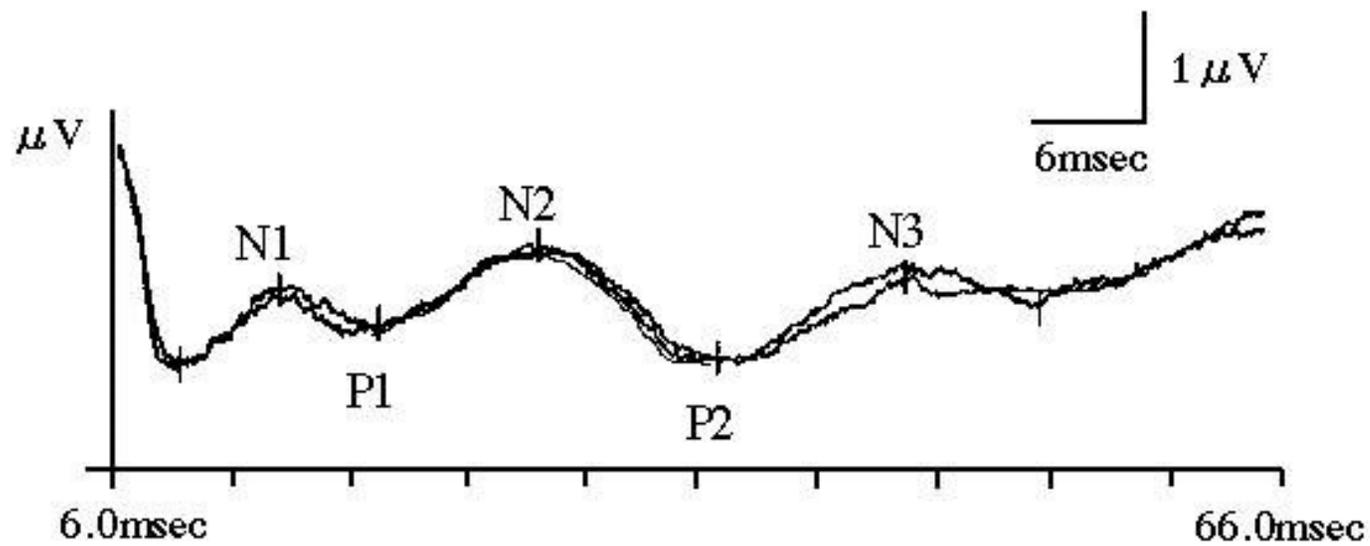


Fig. 2

| Procedures | Measurable periods (weeks) |
|----------------------------------|----------------------------|
| Obwegeser-Dal Pont method (n=20) | 16.6 ± 19.6 |
| Obwegeser method (n=20) | 1.6 ± 2.5 |
| IVRO (n=20) | 1.0 ± 0.0 |

Table 1.

| | 1week | 2weeks | 1month | 3months | 6months | 1year | (1.5years) |
|---------------------------|----------|--------|--------|---------|---------|--------|------------|
| Obwegwser-Dal Pont Method | 8(40%) | 0 | 0 | 5(25%) | 4(20%) | 2(10%) | 1(5%) |
| Obwegwser Method | 18(90%) | 1(5%) | 0 | 1(5%) | 0 | 0 | |
| IVRO | 20(100%) | 0 | 0 | 0 | 0 | 0 | |

Table 2.