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Inferior Alveolar Nerve Damage Related to Mandibular Advancement by Sagittal Split Osteotomy

Behnaz Poorian[1*], Hasan Mohajerani[1]

[1] Department of Oral and Maxillofacial Surgery, Dental School, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

Abstract

Background and Objectives: Split sagittal osteotomy is a common operation that may induce inferior alveolar nerve (IAN) damage, potentially leading to sensory deficit, numbness, and pain. Investigations in Iran to evaluate the adverse effects of sagittal split osteotomy surgery are rare so questions have been raised about the success rate of operation and the frequency of unwilling outcome. To address these concerns, we conducted a prospective study evaluating the rate of IAN damage related to mandibular advancement by sagittal split osteotomy in Iranian population.

Methods: In this prospective study, 66 patients including 30 men (45.4%) and 36 women (54.5%) with class II malocclusion and mandibular retrognathism who were undergoing mandibular advancement surgery (SSO) were recruited during 2013-2015. All patients were followed for one year after surgery. Chi-square and Fisher exact tests were used to compare the categorical variables, and the numerical variables were compared by *t* test. $P<.05$ was considered as the significance level.

Findings: The study sample had a mean age 32.3 ± 12.04. The rate of nerve disturbance was 75.8%. Yet, 78.9% of the patients were satisfied with the results of the surgery.

Conclusions: Our study indicated that IAN disturbance after split sagittal surgery is frequent in Iran. This situation indicates the need for caution on considering split sagittal surgery as a safe medical technique.

Keywords: Inferior alveolar nerve (IAN), Sagittal split osteotomy, Neurosensory damage, Patient safety

Background and Objectives

Split sagittal osteotomy is a technique widely used to correct of mandibular deformities.[1] This technique was first introduced by Schuchardt in 1942 and was improved through further attempts.[2-5] It is commonly considered as a safe technique for improving the masticatory function and facial aesthetics, and reducing the temporomandibular joint (TMJ) pain.[1,2] Although most patients express satisfaction with the results of the technique,[3] some complications such as nerve damage, bleeding, suboptimal splits, and TMJ problems are possible to occur.[4,5] One of the most important complications is inferior alveolar nerve (IAN) damage.[6] IAN innervates teeth and skin of lip and chin.[6] Therefore, damage to the IAN may lead to temporary or permanent sensory deficit, which would results in altered sensation, numbness, and pain.[6,7] The damage may occur when IAN is stretched during the surgery.[8] The rate of damage to IAN can reach up to 95%.[9] Most of the complications may be resolved within 12 months after surgery; however, some of the postoperative symptoms could persist for two years or more.[10,11] Given that the adverse effects of sagittal split osteotomy surgery is rarely surveyed in Iran, the rate of successful operation and the frequency of unwilling outcome remains undetermined. To address this concern, we conducted a prospective study evaluating the rate of IAN damage related to mandibular advancement by sagittal split osteotomy in a sample of Iranian population.

*Corresponding Author: Behnaz Poorian, Department of Oral and Maxillofacial Surgery, Dental School, Shahid Beheshti University of Medical Sciences, Tehran, Iran, Tel: +98 21 22297696, Email: behnazpooriang@gmail.com

Methods

This prospective study was conducted at the Department of Maxillofacial Surgery, Taleghani hospital (Tehran, Iran) within 2012-2014. A sample of 66 patients including 30 men (45.4%) and 36 women (54.5%) with class II malocclusion and mandibular retrognathism who were undergoing mandibular advancement surgery (SSO) was recruited. All patients were followed up for one year post-surgery. The demographic data were collected from the patients' records. The surgery results were extracted from the surgeons' reports. Then intraoperative and postoperative variables were evaluated. The intraoperative variables were bleeding, split, and visible and non-visible injury to the IAN. On the other hand, postoperative variables included pain, sensory changes, TMJ complications and reoperation during one month after surgery. For measuring the possible post-operation sensory changes, we moved a cotton wisp across the skin until the patients expressed to have a normal sense in that region. The size of affected region was also measured. After surgery, the satisfaction of patients with the results was inquired by a simple question of "Are you satisfied with the results of surgery?," with the patients' answer of "yes" or "no." Split sagittal osteotomy is a routine procedure in the Maxillofacial Department of Taleghani hospital, and so the study did not require the Ethical Committee's approval.

Statistical Analyses

Categorical data are presented as numbers and percentages, and continuous data are presented as mean ± SD. Chi-square and Fisher exact tests were used to compare categorical variables and the numerical variables were compared by *t* test. $P<.05$ was considered as the statistical significance. Data were analyzed using the SPSS version 20 software package.

Results

The patients' age averaged 32.3 ± 12.04 years. While seven patients (10.6%) were subjected to suboptimal osteotomies, four cases (6%) bad split cases was recorded. In 102 sites (77.2%), there was no visible damage. Two patients (3%) were re-operated within 1 month.

During the 1-year follow-up, problems related to the TMJ were observed in 12 patients (18.5%). Area mapping showed that 19.2% of patients had normal sensory function while 80.8% experienced impaired sensory function (Table 1). In addition, the size of the area with persistent disturbed sensation averaged 9.3 ± 8.1 cm^2 for the total sample.

Table 1. Operation Outcomes

Variable	No.	%
Split		
Successful split	59	89.4
Suboptimal split, unilateral	3	4.5
Suboptimal split, bilateral	1	0.8
Bad split, unilateral	4	5.3
Nerve injury (sites)		
No	102	77.3
Uncertain	12	9.1
Visible	18	13.6
Infection		
No	57	86.4
Unilateral	8	11.4
Bilateral	1	1.5
Sensation disturbance size (cm)		
Normal sensation	12	19.2
< 4	9	13.8
4–16	29	45.4
≥ 16	14	21.5
Sensation		
Normal	16	242
Not normal	50	75.8

Normal sensibility was reported by 24.2% of the subjects, while the remaining expressed some disturbances (Table 1). Eight subjects (12.1%) expressed dissatisfaction with the treatment result. The rate of satisfaction was significantly lower among the patients with distress caused by altering sensation ($P=.020$) (Table 2). Of the eight dissatisfied patients, five reported TMJ problems ($P=.000$). The remaining seven patients who reported TMJ problems were satisfied with the treatment. The mean area in the patients with impaired sensation was 10.1 ± 6.3 cm^2, which is significantly higher than that in patients with normal sensation, 1.1 ± 2.9 cm^2 ($P=.000$).

Registration of visible nerve injury during surgery was significantly reflected in the clinically assessed

Table 2. The Relationship Between Satisfaction and Distress

Variables	No.	%
Satisfied		
No/minor distress/not relevant	90.6	53
Distress	66.7	5
Total	87.9	58
Dissatisfied		
No/minor distress/not relevant	9.4	5
Distress	33.3	3
Total	12.1	8
Total		
No/minor distress/not relevant	58	100
Distress	8	100
Total	66	100

Fisher exact test: *P* = .020

Table 3. The Relationship Between Nerve Injury and Sensation

Variables	No.	%
Sensation		
No visible injury	26	31.7
Visible injury/uncertain	6	12.0
Total	32	24.2
Not normal sensation		
No visible injury	56	68.3
Visible injury/uncertain	44	88.0
Total	100	75.8
Total		
No visible injury	82	100.0
Visible injury / uncertain	50	100.0
Total	132	100.0

Chi-square = 6.568, df = 1, *P* = .010.

(*P* = 0.018) and subjectively reported sensation (*P* = .01) (Table 3). The visible nerve injury was, however, not resulted in any increased dissatisfaction.

Discussion

The neurosensory deficit may occur during and after the osteotomy surgery. The IAN may be injured by direct injury or compression due to rigid fixation.[12,13] Moreover neurosensory deficit may occur after surgery because of hematoma or edema.[14] The present survey showed that 75% of the patients experience neurosensory distribution in different levels after split sagittal surgery. Previous studies have reported a wide range of neurosensory disturbance up to 75%.[15] The reason for such discrepancy is currently unclear; however, it may be related to different methodologies and different definitions of neurosensory disturbances. Furthermore, the objective and subjective evaluation has yielded different results in previous reports.[16-20] In our observations, the frequency of objective neurosensory disturbance was significantly higher than that of the subjective evaluation (80.8% vs. 75.8%, *P* = .001). A systematic review of 61 studies in 2015 by Agbaje et al revealed that 26% of the studies did not record any nerve injury. However, the incidence of neurosensory deficit has been reported in 77% of the studies. The most common evaluating method in these studies had been subjective.[21] The rate of visible nerve injury in our study was 13.6%, which is lower than that in the study of Ylikontiola et al who reported an incidence rate of around 40%.[22] It is supposed that bad split is one of the possible reasons of sensory deficit. In our study, bad splits occurred in 5.3% of the patients that was higher than the corresponding values reported by Martis (1.93%),[23] Panula et al (2%),[24] and Bothur and Blomqvist (1.3%).[9]

In the present survey, 87.9% of the patients were found to be satisfied with sagittal split osteotomy results. This satisfaction rate is close to some previous reports,[3,22] but was lower than that of another study reporting satisfaction rate of 93% among the patients who were followed up for 3 years post-surgery.[23] Moreover we found the rate of dissatisfaction to be significantly higher among the patients who reported distress due to sensation alteration (*P* = .020). This finding is supported by the study of Maurer et al.[25]

Study Limitations

The main limitations of our study are the relatively small sample size and the short duration of follow-up (one year) which restricts generalization of the results. Therefore, further investigations with longer follow-up duration are required for achieving firm conclusions.

Conclusions

Our study indicated that despite the high rate of subjective satisfaction with sagittal split osteotomy results, IAN disturbance after split sagittal surgery is frequent among Iranian patients. This indicates the need for caution on considering split sagittal surgery as a safe medical technique.

Abbreviations

(IAN): Inferior Alveolar Nerve; (TMJ): temporomandibular joint.

Competing Interests

The authors declare that there are no conflicts of interest.

Authors' Contributions

The authors contributed equally to this study.

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