



Contents lists available at ScienceDirect

## Journal of Cranio-Maxillo-Facial Surgery

journal homepage: [www.jcmfs.com](http://www.jcmfs.com)

## Recovery pattern following bimaxillary orthognathic surgery: Differences between sexes

In-Seok Song <sup>a,1</sup>, Jimi Choi <sup>b,1</sup>, Un-Bong Baik <sup>c</sup>, Jae-Jun Ryu <sup>d</sup>, Jong-Woo Lim <sup>e</sup>,  
Young-Jun Choi <sup>f,\*\*,2</sup>, Ui-Lyong Lee <sup>g,\*;2</sup>

<sup>a</sup> Department of Oral and Maxillofacial Surgery, Korea University Anam Hospital, Republic of Korea

<sup>b</sup> Department of Biostatistics, College of Medicine, Korea University, Republic of Korea

<sup>c</sup> WithSmile Dental Clinic, Seoul, Republic of Korea

<sup>d</sup> Department of Prosthodontics, Korea University Anam Hospital, Republic of Korea

<sup>e</sup> Department of Chemistry, Yonsei University, Seoul, Republic of Korea

<sup>f</sup> Department of Oral & Maxillofacial Surgery, College of Medicine, Chung-Ang University, Seoul, Republic of Korea

<sup>g</sup> Department of Oral & Maxillofacial Surgery, Dental Center, Chung-Ang University Hospital, Seoul, Republic of Korea

### ARTICLE INFO

#### Article history:

Paper received 20 August 2018

Accepted 2 November 2018

Available online 10 November 2018

#### Keywords:

Orthognathic surgery

Perioperative complication

Sexual difference

### ABSTRACT

The investigators hypothesized there would be differences between the sexes in recovery pattern following bimaxillary orthognathic surgery as measured by patient responses at 5 weeks postprocedure. A total of 378 participants underwent bimaxillary orthognathic surgery with or without adjunctive procedures. Participants received questionnaires 5 weeks postsurgery when they visited the outpatient clinic. The questionnaires include variances in surgical factors by sex, and postoperative symptoms which were most difficult to tolerate experiences by sex, respectively. Females were more likely to undergo malarplasty (zygoma reduction) than were male participants ( $P = <.001$ ), and they required larger maxillary setback than did male participants ( $P = .003$ ). Malarplasty was significantly correlated with ear fullness in total and female participants ( $p$ -value .018, .016, respectively). Snoring is significantly associated with malarplasty and segment osteotomy procedure without gender predominance ( $p$ -value = .026, .028, respectively). Over half of participants complained of nasal congestion (55.6%), followed by swelling (29.3%), pain (15.4%), breathing difficulty (10.6%). In conclusion, males and females showed different patterns of postoperative recovery following bimaxillary orthognathic surgery.

© 2018 European Association for Cranio-Maxillo-Facial Surgery. Published by Elsevier Ltd. All rights reserved.

### 1. Introduction

Orthognathic surgery has recently become popular in Asian countries. Class III malocclusion with skeletal discrepancy is common (Chang et al., 2014), and *V-line surgery* to construct a slimmer face is popular (Hsu et al., 2010; Song et al., 2017). Previous reports have highlighted that the orthognathic surgery rate among the

orthodontic patient population is 18.5%, and 70% of those in South Korea presented skeletal class III malocclusion (Piao et al., 2016).

Corrective jaw surgery improves functionality, psychological factors, and social relationships (Turker et al., 2008; Rustemeyer and Gregersen, 2012). However, increasing surgery rates also increase the risk of surgical complications (Robl et al., 2014). Complications can be divided into two categories: early complications during surgery and late postoperative complications (Kim and Park, 2007; Al-Nawas et al., 2014). Complications during surgery include bad splits, excessive bleeding events, soft tissue damage, delayed wound healing, and tooth damage (Wijbenga et al., 2009; Chrcanovic and Freire-Maia, 2012). Postoperative complications include sensory impairment still present over 1 year after surgery (Baas et al., 2010), temporomandibular joint dysfunction, and skeletal relapse (Kim and Park, 2007; Parton et al., 2011). Previous works focused mainly on the prevalence and treatment of these

\* Corresponding author. Chung-Ang University Hospital, 224-1 Heukseok-dong, Dongjak-ku, Seoul 06973, Republic of Korea. Fax: +82 2 6299 2880.

\*\* Corresponding author. Chung-Ang University Hospital, 224-1 Heukseok-dong, Dongjak-ku, Seoul 06973, Republic of Korea. Fax: +82 2 6299 2880.

E-mail addresses: [oms@hanmail.net](mailto:oms@hanmail.net) (Y.-J. Choi), [davidjoy76@gmail.com](mailto:davidjoy76@gmail.com) (U.-L. Lee).

<sup>1</sup> In-Seok Song and Jimi Choi contributed equally to this work.

<sup>2</sup> Young-Jun Choi and Ui-Lyong Lee contributed equally to this work.

complications, rather than subjective findings during the recovery period as reported by patients. Most of the previous reports focused on either objective complications or psychological distress (Essick et al., 2009; Silvola et al., 2014). There are few studies on differences in postsurgery recovery pattern or discomforts between the sexes (Baas et al., 2010).

Therefore, the aim of this study was to investigate differences between the sexes in surgical factors and recovery pattern at 5 weeks postsurgery. The present study hypothesized that males and females may exhibit different patterns of postoperative recovery.

## 2. Materials and methods

### 2.1. Study design and sample

A total of 378 participants (250 females and 128 males) who underwent bimaxillary orthognathic surgery from 2013 through 2015 at a single oral and maxillofacial surgery clinic were included in this study. Two surgeons each performed half of the procedures in this study. Bimaxillary orthognathic surgeries were performed according to previously described protocols (Hunsuck, 1968; Obwegeser, 1969; Epker, 1977). Mean participant age was  $24.4 \pm 4.7$  years, in whom most of them ranged from late 10's and 20's (Table 1). A questionnaire was administered to participants who agreed to take part in the survey. The participants received questionnaires 5 weeks postsurgery when they visited the outpatient clinic. Sensory disturbance was examined by visual analogue scale from not at all to extremely severe. Degree of temporomandibular joint noise or pain, snoring, breathing difficulty, severity of ear fullness were measured by numerical score from 0 (no) to 4 (worst). The participants were asked subjective questions about symptoms that were most difficult to tolerate after operation.

The gender, age, weight, height, body-mass index (BMI), smoking experiences, systolic blood pressure (SBP), diastolic blood pressure (DBP), pulse rate, respiratory rate, body temperature, and pre-operative serum hemoglobin level were examined from the medical records retrospectively. Whether the participants underwent of malarplasty, genioplasty, angle reduction, segmental osteotomy, posterior or superior movement of maxilla segment, operation time, change of hemoglobin level were examined from surgical records and postoperative radiography.

Exclusion criteria were participants with problems related to osteogenesis, congenital malformations, or a history of maxillofacial trauma, who were weighed  $<45$  or  $>100$  kg; had an American Society of Anesthesiologists (ASA) grade  $>3$ ; had severe underlying

cardiovascular (especially atrioventricular block), renal, or hepatic disease; hypertension; arteriosclerosis; heart failure; hyperthyroidism; diabetes mellitus; or were allergic to local anesthetics, had received opioids or nonsteroidal anti-inflammatory drugs (NSAIDs) within the previous 1 week, or were taking these drugs chronically. All procedures involving human participants in studies were conducted in accordance with the ethical standards of the Ethics Committee of Chung-Ang University Hospital (IRB number: 1804-004-16161), and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The authors obtained informed written consent from all participants to publish analytic data from the study.

### 2.2. Statistical analysis

The SAS software (version 9.4, SAS Institute Inc., Cary, NC, USA) was used for statistical analyses. Results are presented as either mean  $\pm$  standard deviation, as number (%), or as median (IQR). Gender differences were assessed using Student's t-test or Mann–Whitney U-test for continuous variables, chi-square test or Fisher's exact test for categorical variables. *P*-values less than .05 were considered statistically significant.

## 3. Results

Table 1 shows general characteristics of study participants who underwent bimaxillary orthognathic surgery. Males showed more BMI and smoking pattern than females (all  $P < .001$ ). Male shows significantly higher systolic and diastolic blood pressure levels than females ( $P < .001$ ). A higher percent of male participants were obese than were female participants ( $P < .001$ ).

Table 2 presents differences in surgical factors between sexes. Females were more likely to undergo malarplasty (zygoma reduction) than were male participants ( $P = <.001$ ), and they required larger maxillary setback than did male participants ( $P = .003$ ). However, neither the mean operation time ( $2.4 \pm 0.5$  hours for both;  $P = .958$ ) nor hemoglobin change ( $-2.0 \pm 0.9$  mg/dL for females and  $-2.1 \pm 1.0$  mg/dL for males;  $P = .673$ ) were statistically different between the sexes. There was no difference in prevalence of doing both genioplasty and angle reduction between sexes ( $P = 0.705$ ), although male participants were more likely to perform genioplasty alone compared to female participants with marginal significance ( $P = 0.052$ ).

As for the ear fullness and snoring, subgroup analysis was performed according to the amount and type of surgery (Table 3).

**Table 1**  
General characteristics of participants.

Characteristic	Total n = 378	Females n = 250	Males n = 128	<i>P</i> -value, females versus males*
Gender, n (%)	378 (100.0%)	250 (66.1%)	128 (33.9%)	—
Age, y	24.4 $\pm$ 4.7	24.4 $\pm$ 4.7	24.5 $\pm$ 4.9	.863
Weight, kg	60.3 $\pm$ 11.3	55.4 $\pm$ 8.1	70.1 $\pm$ 10.4	<.001
Height (cm)	167.1 $\pm$ 8.4	162.5 $\pm$ 5.6	176.0 $\pm$ 5.4	<.001
BMI (kg/m <sup>2</sup> )	21.5 $\pm$ 3.1	21.0 $\pm$ 2.9	22.6 $\pm$ 3.0	<.001
Smoking, n (%)				<.001
Nonsmoker	325 (86.2%)	237 (95.2%)	88 (68.8%)	
Ex-smoker	14 (3.7%)	3 (1.2%)	11 (8.6%)	
Current smoker	38 (10.1%)	9 (3.6%)	29 (22.7%)	
SBP, mm Hg	109.2 $\pm$ 9.8	106.1 $\pm$ 8.6	115.2 $\pm$ 9.2	<.001
DBP, mm/Hg	69.2 $\pm$ 8.0	67.0 $\pm$ 7.5	73.5 $\pm$ 7.4	<.001
Pulse rate, per min	75.0 $\pm$ 6.8	74.6 $\pm$ 6.8	75.9 $\pm$ 6.7	.079
Respiratory rate, per min	19.9 $\pm$ 0.5	19.9 $\pm$ 0.5	19.9 $\pm$ 0.6	.971
Body temperature, °C	36.6 $\pm$ 0.3	36.6 $\pm$ 0.3	36.6 $\pm$ 0.3	.203
Pre-op Hb (mg/dL)	14.1 $\pm$ 1.5	13.2 $\pm$ 0.9	15.7 $\pm$ 0.8	<.001

Notes: Data are presented as either mean  $\pm$  standard deviation, as n (%), or as median (IQR). The results are based on an analysis of the available data for each variable. \**P*-values were obtained by Student's t-tests for continuous variables and chi-square tests for categorical variables. Abbreviations: BMI, body mass index; Hb, hemoglobin; DBP, diastolic blood pressure; SBP, systolic blood pressure.

**Table 2**  
Variances in surgical factors, by sex of participants.

	Total n = 378	Females n = 250	Males n = 128	P-value, females versus males*
Malarplasty (Yes)	30 (7.9%)	29 (11.6%)	1 (0.8%)	<.001
Genioplasty (Yes)	219 (57.9%)	136 (54.4%)	83 (64.8%)	.052
Genioplasty + angle reduction (Yes)	111 (29.4%)	75 (30%)	36 (28.1%)	.705
Segment (Yes)	23 (6.1%)	14 (5.6%)	9 (7.1%)	.575
Maxilla	18	12	6	
Mandible	5	2	3	
Mx. S.B (mm)	1.7 ± 1.8	1.9 ± 1.7	1.3 ± 1.8	.003
Mx. upward (mm)	0.8 ± 1.8	0.9 ± 1.8	0.6 ± 1.6	.068
Operation time (hour)	2.4 ± 0.5	2.4 ± 0.5	2.4 ± 0.5	.958
Postoperative Hb, mg/dL	12 ± 1.5	11.2 ± 1.0	13.6 ± 1.0	<.001
Hb change (postop – preop), mg/dL	–2.1 ± 0.9	–2.0 ± 0.9	–2.1 ± 1.0	.673

Notes: Data are presented as either mean (standard deviation), or as number (%).

\*P-values were obtained by Student's t-test or chi-square test.

Abbreviations: Hb; hemoglobin, Mx. SB; maxillary setback movement, Mx. Upward; maxillary upward movement; SD, standard deviation.

**Table 3**  
Association between surgical factors and ear fullness/snoring.

	Ear fullness		p-value	Snoring		p-value
	Yes	No		Yes	No	
<i>Total</i>	n = 269	n = 109		n = 54	n = 318	
Malarplasty, n (%)	27 (10.0)	3 (2.8)	.018	9 (16.7)	21 (6.6)	.026
Genioplasty, n (%)	152 (56.5)	67 (61.5)	.376	32 (59.3)	183 (57.6)	.814
Genioplasty + Angle Reduction, n (%)	81 (30.1)	30 (27.5)	.617	15 (27.8)	95 (29.9)	.755
Segment, n (%)	16 (6.0)	7 (6.4)	.875	7 (13.0)	15 (4.8)	.028
Mx. S.B, mean (SD)	1.8 (1.6)	1.5 (2.2)	.269	2.1 (1.7)	1.6 (1.8)	.080
Mx. Upward, mean (SD)	.9 (1.8)	.6 (1.8)	.124	.8 (2.0)	.8 (1.8)	.790
<i>Female</i>	n = 187	n = 63		n = 39	n = 207	
Malarplasty, n (%)	27 (14.4)	2 (3.2)	.016	8 (20.5)	21 (10.1)	.099
Genioplasty, n (%)	102 (54.6)	34 (54.0)	.937	23 (59.0)	111 (53.6)	.538
Genioplasty + Angle Reduction, n (%)	57(30.5)	18(28.6)	.775	12(30.8)	62(30.0)	.919
Segment, n (%)	11 (5.9)	3 (4.8)	1.000	4 (10.3)	9 (4.4)	.134
Mx. S.B, mean (SD)	1.9 (1.6)	1.9 (2.1)	.859	2.3 (1.8)	1.8 (1.7)	.171
Mx. Upward, mean (SD)	1.0 (1.8)	.6 (2.0)	.080	.9 (2.0)	.9 (1.8)	.792
<i>Male</i>	n = 82	n = 46		n = 15	n = 111	
Malarplasty, n (%)	0(0.0)	1(2.2)	.359	1(6.7)	0(0.0)	.119
Genioplasty, n (%)	50 (61.0)	33 (71.7)	.221	9 (60.0)	72 (64.9)	.712
Genioplasty + Angle Reduction, n (%)	24 (29.3)	12 (26.1)	.701	3 (20.0)	33 (29.7)	.552
Segment, n (%)	5 (6.2)	4 (8.7)	.722	3 (20.0)	6 (5.5)	.076
Mx. S.B, mean (SD)	1.5 (1.6)	1.0 (2.2)	.253	1.7 (1.7)	1.3 (1.8)	.379
Mx. Upward, mean (SD)	.6 (1.7)	.6 (1.5)	.915	.5 (1.9)	.6 (1.6)	.785

\* P-value by chi-square test, Fisher's exact test or Student's t-test.

Malarplasty was significantly correlated with ear fullness in total and female participants (p-value .018, .016, respectively). Snoring was significantly associated with malarplasty and segment osteotomy procedure without gender predominance (p-value = .026, .028, respectively).

The participants' reports of the worst symptoms which were most difficult to tolerate postsurgery are presented in Table 4. Over half of participants complained of nasal congestion, followed by swelling (29.3%), pain (15.4%), breathing difficulty (10.6%), eating difficulty (8.7%), and sleep disorder (3.5%). Other miscellaneous symptoms include swallowing pills, constipation, hunger, lethargy, conversation, loneliness, boring, dryness of mouth, tooth pain, bruise, tooth brushing, sore throat, burning sensation. Females were more likely than males to express difficulty with post-operative swelling, but reported significantly less difficulty eating ( $P = .052$  and  $P = .013$ , respectively).

#### 4. Discussion

This study reveals differences of recovery pattern by sexes in relation to surgical and patients' factors following orthognathic

surgery. Female participants were significantly more likely than males to undergo malarplasty. While females had a significantly larger mean maxillary setback movement than males, a higher percentage of males had maxillary setback surgery performed (98.4% of males and 96% of females). Malarplasty was significantly correlated with ear fullness in total and female participants. Snoring was significantly associated with malarplasty and segment osteotomy procedure without gender predominance. Nasal congestion, swelling, and pain were the chief complaints following surgery in both male and female participants.

The present study found that female participants required greater setback of the maxilla than did male participants, and more females underwent malarplasty than did male participants. Protrusion of the zygoma is common in the Asian population, along with anterior and lateral protrusion (Chen et al., 2011; Gao et al., 2013). The protrusive appearance is considered rough, masculine, and unattractive, especially for women (Gao et al., 2013). Therefore, corrective zygomatic arch and body surgery is popular among east Asian women, and this tendency to reduce this remarkable malar on female predilection (Male 0.8%, Female 11.6%) was also found in this study.

**Table 4**

The postoperative symptom(s) which were most difficult to tolerate by participants.

Symptoms	Total n = 369	Females n = 246	Males n = 123	P-value, females versus males*
Nasal congestion	205 (55.6%)	141 (57.3%)	64 (52.0%)	.336
Swelling	108 (29.3%)	80 (32.5%)	28 (22.8%)	.052
Pain	57 (15.4%)	38 (15.4%)	19 (15.4%)	1.00
Breathing	39 (10.6%)	26 (10.6%)	13 (10.6%)	1.00
Eating difficulty	32 (8.7%)	15 (6.1%)	17 (13.8%)	.013
Sleep disorder	13 (3.5%)	10 (4.1%)	3 (2.4%)	.557
IMF	7 (1.9%)	3 (1.2%)	4 (3.3%)	.228
Sputum	5 (1.4%)	4 (1.6%)	1 (.8%)	.669
Neurosensory disturbance	4 (1.1%)	4 (1.6%)	0 (0%)	.306
Phonation disorder	4 (1.1%)	3 (1.2%)	1 (.8%)	1.00
Nausea	4 (1.1%)	4 (1.6%)	0 (0%)	.306
Wafer	4 (1.1%)	3 (1.2%)	1 (.8%)	1.00
Nosebleed	4 (1.1%)	3 (1.2%)	1 (.8%)	1.00
Ear pain	3 (.8%)	2 (.8%)	1 (.8%)	1.00
Ear fullness	2 (.5%)	2 (.8%)	0 (0%)	.554
Cough	2 (.5%)	1 (.4%)	1 (.8%)	1.00
Fever	2 (.5%)	1 (.4%)	1 (.8%)	1.00

Note: Data are presented as number (percent). Some participants chose more than one symptom characterized as the worst symptom(s) they experienced.

\*P-values were obtained by chi-square test or Fisher's exact test.

Abbreviation: IMF, intermaxillary fixation.

The symptoms most frequently reported by participants in this study as the most difficult to tolerate were nasal congestion, swelling, pain in both male and female participants (in descending order). The breathing difficulty and eating difficulty were switched in prevalence between sexes. Previous surveys regarding satisfaction scores showed breathing difficulty and swelling after surgery (Khattak et al., 2012). The researchers reported that a majority of patients who experienced breathing difficulties underwent Le Fort I maxillary osteotomy. These breathing difficulties may be closely linked to nasal congestion since a maxillary operation can injure the nasal mucosa, thereby inducing nasal bleeding and swelling. Nasal inhalation was suggested for enhancement of nasal breathing after orthognathic surgery (Khattak et al., 2012).

There have been some reports that focused on differences in postoperative neurosensory disturbance between sexes. One study reported that 28.5% of male and 17% of female patients experienced sensory deficit at least 1 year after bilateral sagittal split ramus osteotomy (Baas et al., 2010). However, another study found no association between neurosensory disturbance and sex (Khattak et al., 2012). Meanwhile, a previous study showed that patients younger than 30 years had more neurosensory disturbance following orthognathic surgery than patients over 40 (Nesari et al., 2005). The present study also found no age- or sex-related differences in neurosensory deficit after bimaxillary orthognathic surgery, although the age range was confined to late 10s and 20s. Further clinical study regarding neurosensory deficit following several orthognathic surgeries will be required according to different age groups and sexes.

Interestingly, this study found that only a few female patients (n = 4, 1.6%) expressed the difficulty of neurosensory disturbance, Table 4. No male patients reported this symptom as the most difficult to tolerate. Neurosensory deficit around the chin has been reported by 80–100% of patients immediately after surgery (Phillips et al., 2009; Wijbenga et al., 2009), and normal recovery of lip sensation may take up to 9 months (Jokic et al., 2012). Previous 2-year follow-up reports showed that altered lower lip sensation after orthognathic surgery was associated with emotional distress in everyday life, although few patients were angry or upset (Lee et al., 2011). This study had a short follow-up period, and participants might consider the sensory deficiency as a minor problem compared to other difficulties such as nasal congestion, swelling, or pain. Some of the scores were still at 9 (with responses to 10) at 5 weeks postsurgery. Further long-term follow up study will be

required later to elucidate recovery pattern of neurosensory function.

The present study has some limitations. This study was confined to participants who underwent bimaxillary orthognathic surgery. Further studies will be required on other surgical procedures, including chin or mandible-only orthognathic surgery, which would show different patterns of recovery. This survey was confined to 5 weeks postsurgery, which was a relatively short follow-up for late complications. Long-term follow-up surveys are required to elucidate differences between sexes in long-term complications. In addition, there were no preoperative baseline data available for the comparison of pre- and postoperative results. However, this study provides beneficial information, enabling surgeons to tailor their attention to patient discomfort by patient sex. This clinical study also provides information on patient discomfort that is often overshadowed by clinicians' surgical goals.

## 5. Conclusion

This study found that males and females exhibited different patterns of recovery following bimaxillary orthognathic surgery. The differences of recovery pattern according to the sexes should be considered by the clinicians for adequate patient management according to the sexes. Discomfort from ear fullness should be considered when malarplasty is planned. Also, active use of nasal decongestant or inhalation agents as well as consultation to otolaryngologists is recommended to solve nasal congestion, which is the most difficult to tolerate.

## Source of funding

There was no funding related to this study.

## Conflicts of interest

There is no conflict of interest for this study.

## Research involving human participants and/or animals

All procedures involving human participants in studies were conducted in accordance with the ethical standards of the Ethics Committee of Chung-Ang University Hospital (IRB number: 1804-004-16161), and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

## Informed consent

Informed consent was obtained from all individual participants included in the study.

## Acknowledgement

None.

## References

- Al-Nawas B, Kammerer PW, Hoffmann C, Moergel M, Koch FP, Wriedt S, Walter C: Influence of osteotomy procedure and surgical experience on early complications after orthognathic surgery in the mandible. *J Craniomaxillofac Surg* 42: e284–e288, 2014
- Baas EM, de Lange J, Horsthuis RB: Evaluation of alveolar nerve function after surgical lengthening of the mandible by a bilateral sagittal split osteotomy or distraction osteogenesis. *Int J Oral Maxillofac Surg* 39: 529–533, 2010
- Chang HP, Liu PH, Tseng YC, Yang YH, Pan CY, Chou ST: Morphometric analysis of the cranial base in Asians. *Odontology* 102: 81–88, 2014
- Chen T, Hsu Y, Li J, Hu J, Khadka A, Wang Q, Wang D: Correction of zygoma and zygomatic arch protrusion in East Asian individuals. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 112: 307–314, 2011
- Chrcanovic BR, Freire-Maia B: Risk factors and prevention of bad splits during sagittal split osteotomy. *Oral Maxillofac Surg* 16: 19–27, 2012
- Epker BN: Modifications in the sagittal osteotomy of the mandible. *J Oral Surg* 35: 157–159, 1977
- Essick GK, Phillips C, Kim SH, Zuniga J: Sensory retraining following orthognathic surgery: effect on threshold measures of sensory function. *J Oral Rehabil* 36: 415–426, 2009
- Gao ZW, Wang WG, Zeng G, Lu H, Ma HH: A modified reduction malarplasty utilizing 2 oblique osteotomies for prominent zygomatic body and arch. *J Craniofac Surg* 24: 812–817, 2013
- Hsu YC, Li JH, Hu J, Luo E, Hsu MS, Zhu SS: Correction of square jaw with low angles using mandibular "V-line" ostectomy combined with outer cortex ostectomy. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 109: 197–202, 2010
- Hunsuck EE: A modified intraoral sagittal splitting technic for correction of mandibular prognathism. *J Oral Surg* 26: 250–253, 1968
- Jokic D, Jokic D, Uglesic V, Knezevic P, Macan D: Altered light-touch sensation after bilateral sagittal-split osteotomy: a prospective study of 50 patients. *Angle Orthod* 82: 1029–1032, 2012
- Khattak ZG, Benington PC, Khambay BS, Green L, Walker F, Ayoub AF: An assessment of the quality of care provided to orthognathic surgery patients through a multidisciplinary clinic. *J Craniomaxillofac Surg* 40: 243–247, 2012
- Kim SG, Park SS: Incidence of complications and problems related to orthognathic surgery. *J Oral Maxillofac Surg* 65: 2438–2444, 2007
- Lee EG, Ryan FS, Shute J, Cunningham SJ: The impact of altered sensation affecting the lower lip after orthognathic treatment. *J Oral Maxillofac Surg* 69: e431–e445, 2011
- Nesari S, Kahnberg KE, Rasmusson L: Neurosensory function of the inferior alveolar nerve after bilateral sagittal ramus osteotomy: a retrospective study of 68 patients. *Int J Oral Maxillofac Surg* 34: 495–498, 2005
- Obwegeser HL: Surgical correction of small or retrodisplaced maxillae. The "dish-face" deformity. *Plast Reconstr Surg* 43: 351–365, 1969
- Parton AL, Tong DC, De Silva HL, Farella M, De Silva RK: A nine-year review of orthognathic surgery at the University of Otago. *N Z Dent J* 107: 117–120, 2011
- Phillips C, Kim SH, Essick G, Tucker M, Turvey TA: Sensory retraining after orthognathic surgery: effect on patient report of altered sensations. *Am J Orthod Dentofacial Orthop* 136: 788–794, 2009
- Piao Y, Kim SJ, Yu HS, Cha JY, Baik HS: Five-year investigation of a large orthodontic patient population at a dental hospital in South Korea. *Kor J Orthod* 46: 137–145, 2016
- Robl MT, Farrell BB, Tucker MR: Complications in orthognathic surgery: a report of 1,000 cases. *Oral Maxillofac Surg Clin North Am* 26: 599–609, 2014
- Rustemeyer J, Gregersen J: Quality of Life in orthognathic surgery patients: post-surgical improvements in aesthetics and self-confidence. *J Craniomaxillofac Surg* 40: 400–404, 2012
- Silvola AS, Varimo M, Tolvanen M, Rusanen J, Lahti S, Pirttiniemi P: Dental esthetics and quality of life in adults with severe malocclusion before and after treatment. *Angle Orthod* 84: 594–599, 2014
- Song I-S, Kwon J-S, Choi Y-J, Ryu J-J, Lee U-L: Occlusion-fit V-line guide and gooseneck saw for safe and accurate mandibuloplasty in Asians. *Aesthet Plast Surg* 41: 930–937, 2017
- Turker N, Varol A, Ogel K, Basa S: Perceptions of preoperative expectations and postoperative outcomes from orthognathic surgery: part I: Turkish female patients. *Int J Oral Maxillofac Surg* 37: 710–715, 2008
- Wijbenga JG, Verlinden CR, Jansma J, Becking AG, Stegenga B: Long-lasting neurosensory disturbance following advancement of the retrognathic mandible: distraction osteogenesis versus bilateral sagittal split osteotomy. *Int J Oral Maxillofac Surg* 38: 719–725, 2009