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The Relationship Between Orthognathic Surgery and Anesthesia-Related Complications: A Retrospective Study

Genel Anestezi Altındaki Ortognatik Cerrahi Prosedürlerinin Perioperatif Olarak Değerlendirilmesi: Retrospektif Bir Çalışma

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ABSTRACT Objective: The reconstruction of dentofacial deformities via orthognathic surgery is one of the procedures in oral and maxillofacial surgery. Several complications can occur-related to general anesthesia and prolonged operating time. The aim of this study was to investigate the effect of type of the skeletal deformity and the type of orthognathic surgery on anesthesia-related complications. Two hundred and two patients who underwent orthognathic surgery under general anesthesia were evaluated retrospectively. **Material and Methods:** According to inclusion criteria, 114 patients were included in the study. The patients were divided into two groups according to their surgical operations as single jaw (n=41) and double jaw (n=73) surgery. Ninety seven patients have skeletal Class 3 deformity and 17 patients have Class 2 deformity. The incidence of intraoperative surgical complications, duration of surgery, intubation difficulty, blood transfusion, postoperative intensive care and/or usage of additional medication were descriptively analyzed. Anesthesia-related complications were statistically compared between the groups. **Results: T**he most common surgery-related complication was bad split. The incidence of life-threatening complications such as extensive blood loss or pulmonary edema was slightly higher in skeletal Class 2 patients and in double jaw surgery group. Although there was no statistically significant difference between the groups, both Mallampati score and difficult intubation scores were higher in skeletal Class 2 groups. **Conclusion:** Surgeon should be aware of prolonged surgery time can increase the complication risk while anesthesiologist should be aware of the Class 2 skeletal deformity-related intubation difficulties.

Keywords: Orthognathic surgery; complication; general anesthesia; Mallampati score; Cormack Lehane score

ÖZET Amaç: Ortognatik cerrahi ile dentofasiyal deformitelerin rekonstrüksiyonu ağız diş ve çene cerrahisi bölümünde en sık uygulanan işlemlerden birisidir. Genel anestezi ve ameliyat süresinin uzamasına bağlı olarak çeşitli komplikasyonlar ortaya çıkabilir. Bu çalışmanın amacı, iskeletsel deformitenin tipi ve ortognatik cerrahi tipinin anesteziye bağlı komplikasyonlara etkisini araştırmaktır. Genel anestezi altında ortognatik cerrahi uygulanan 202 hasta retrospektif olarak değerlendirilmiştir. **Gereç ve Yöntemler:** Yüz on dört hasta çalışmaya dâhil edildi. Hastalar cerrahi operasyonlarına göre tek çene (n=41) ve çift çene (n=73) cerrahi olarak 2 gruba ayrıldı. Doksan yedi hastada iskeletsel Sınıf 3 deformite ve 17 hastada Sınıf 2 deformite vardı. İntraoperatif cerrahi komplikasyon insidansı, cerrahinin süresi, entübasyon zorluğu, kan transfüzyonu, postoperatif yoğun bakım ihtiyacı ve/veya ek ilaç kullanımı analiz edildi. Anesteziye bağlı komplikasyonlar, gruplar arasında istatistiksel olarak karşılaştırıldı. **Bulgular:** Cerrahiye bağlı en yaygın komplikasyon "bad" split olarak belirtilmiştir. Yaygın kan kaybı veya akciğer ödemi gibi hayatı tehdit eden komplikasyonların insidansı, iskeletsel Sınıf 2 hastalarda ve çift çene cerrahisi grubunda biraz daha yüksekti. Gruplar arasında istatistiksel olarak fark olmasa da hem Mallampati skoru hem de zor entübasyon skorları iskeletsel Sınıf 2 gruplarında daha yüksekti. **Sonuç:** Cerrah, uzamış ameliyat süresinin komplikasyon riskini artırabileceğinin farkında olurken, anestezi uzmanı ise Sınıf 2 iskeletsel deformiteye bağlı entübasyon zorluklarının farkında olmalıdır.

Anahtar Kelimeler: Ortognatik cerrahi; komplikasyon; genel anestezi; Mallampati skoru; Cormack Lehane skoru

The principle of orthognathic surgery is the manipulation of the bones in order to reconstruct anatomical relationship and function.[1] Orthognathic surgery is indicated in patients who have moderate or severe skeletal problems that cannot be treated by only orthodontic treatment.[2-4] Functional and aesthetic problems, malocclusion or pain-related issues such as temporomandibular joint disorders are the main indications of orthognathic surgery procedures.[5-7]

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Complications related to orthognathic surgery can be listed as nerve injuries, unexpected bad fractures, excessive bleeding, soft tissue damage and exposure of the inferior alveolar nerve.[8] One of the most common intraoperative complications is bad split fracture of mandible during sagittal split ramus osteotomy and this complication leads to prolonged operating time.[9,10]

General anesthesia-related complications can be preventable such as maintaining respiratory control problems (aspiration of stomach contents, intubation problems, hypoventilation etc.), wrong drug administration, improper use of anesthesia device and leaks in the respiratory circuit; complication due to the equipment malfunctions such as respiratory system (oxygen cutoff, separation of circuit parts, gas pipes, endotracheal tube or foreign body in circuits, breakage or obstruction due to pressing on it), monitoring device, ventilator, anesthesia machine, laryngoscope; complications related to the patient's condition such as cardiovascular system, respiratory system, gastrointestinal system and neurological complications.[11]

Intraoperative or postoperative complications related to general anesthesia procedure and oral and maxillofacial surgery had been examined separately in the literature until today. The complications of general anesthesia and surgical implication, their relationship were examined according to the type of skeletal deformities, and type of surgeries in the present study. The purpose of the present study was to investigate the effect of the type of skeletal deformity and the type of orthognathic surgery (single jaw/double jaw) on anesthesia-related complications.

MATERIAL AND METHODS

This study was approved by Başkent University Institutional Review Board with project no: D-KA20/19 in 06.09.2020. A retrospective study was planned to evaluate the patient records who underwent orthognathic surgery at the Başkent University. The present study was executed in accordance with Declaration of Helsinki principles.

Records of 202 patients who were treated by the same surgical team between January 2014 and January 2018 were evaluated without being devided for gender and between the ages of 17 and 40. All included patients received a conventional orthosurgical treatment with the orthodontic treatment and preoperative dental preparation, orthognathic surgery, and orthodontic completion. Patients who underwent sagittal split ramus osteotomy, Le Fort 1 osteotomy and bimaxillary surgery were included in study. All the patients received maxillary first protocol in case of bimaxillary surgeries.

Patients who have maxillofacial syndrome underwent orthognatic procedures in addition to the present surgery (surgical assisted rapid palatal expansion, genioplasty etc.) and patients who had another surgery in the same area before were not included in the study.

The participants were evaluated before the operation and informed about the procedure. After 8 hours fasting period, patients were taken to the operating room without premedication. In the operating room, standard monitoring was applied to all patients including noninvasive blood pressure cuff, five lead electrocardiogram and pulse-oximetry. After maintaining intravenous access, 150 mL/hour crystalloid fluid was started. Institutional standardized anesthetic technique was applied to all patients with propofol, fentanyl, nondepolarizing neuromuscular blocker (rocuronium) and remifentanyl (0.03-0.1 mcg/kg/min). Antibiotic prophylaxis with cephazoline, methyl- prednisolone and ranitidine were given at the induction of anesthesia. After endotracheal intubation, patients were ventilated mechanically using volume-controlled mode, and respiratory rate (8-12/min) and tidal volume (6-8 mL/kg) were set to have oxygen saturation >95% and end-tidal carbondioxide pressure 32/38 mmHg. Anesthesia was maintained with sevoflurane (2%) in a mixture of 40% oxygen and 60% air. Four milliliters of lidocaine with adrenaline solution was applied per jaw before starting the surgery to obtain hemostasis.

Data of patients such as age, gender, occurrence of surgical complications (such as bad split of mandibular corpus), difficult intubation assessment according to the Mallampati score, blood transfusion requirement during surgery, duration of surgery, intraoperative fluid administration, additional med-

ication requirements and extraordinary medication usage during the surgery and postoperative need for intensive care were evaluated from patients' records.

While evaluating difficult intubation, patients' airway patency was carefully and thoroughly examined, existing difficulties were identified and preliminary preparation is made preoperatively. During this evaluation, systemic diseases of patients, previous surgical and trauma stories, mouth, tooth and neck anatomy, possible local pathologies, deformities and functional disorders are examined using Mallampati scoring methods and guidelines.[12] If the Mallampati score was 1 or 2, intubation was thought to be easy, if it was 3 or 4, it was decided that it might be a difficult intubation. Cormack Lehane classification was used to evaluate difficult intubation intraoperatively.[13] According to this classification, score 1 was accepted as an easy intubation and score 4 was accepted as very difficult intubation.

Averages of age, operating time, and statistical differences according to the type of the skeletal deformity (Class 2 or 3) and the type of the operation (single or double jaw) groups were examined by t-test in independent groups. The relation of other variables was examined by chi-square analysis. The statistical analyzes were made with SPSS 20.0 software at 95% confidence level. Values of $p<0.05$ were accepted statistically significant.

RESULTS

DEMOGRAPHICS

Out of 202 patients who received double or single jaw surgery operations under general anesthesia, 114 participants were involved according to inclusion criterias in this retrospective study.

The gender distribution was 46 (40.3%) women and 68 (59.6%) men. Ninety seven (85%) patients had skeletal Class 3 deformity while 17 (14.9%) patients had skeletal Class 2 deformity. The patients were divided into two groups according to their surgical operations as single jaw (n=41, 35.9%) and double jaw (n=73, 64%).

In preoperative stage, 4 patients required an additional device for intubation. While 2 of these patients had Class 2 skeletal deformity and 2 of them had Class 3 skeletal deformity. Among these 4 patients, 3 patients had single jaw surgery while 1 patient had double jaw surgery.

In the intraoperative stage, bad split occurred in 4 patients while 8 patients had other procedures (additional graft material need to fill the osteotomy line, need for additional plate and screws to increase stabilization, nervus alveolaris inferior repair, hemorrhage, soft tissue revisions), so operating time was prolonged.

Two patients received erythrocyte suspension, 1 patient had fresh frozen plasma and 1 patient had erythrocyte suspension with gelofucin because of decreased haemoglobin value. All of these patients who received blood transfusion were in double jaw group, respectively.

In the postoperative stage, a life-threatening complication occurred only in 1 patient who had Class 3 skeletal deformity and received double jaw surgery was followed-up in the intensive care unit because of negative pressure pulmonary edema (NPPE).

COMPARISON OF GROUPS

Comparison of Single or Double Jaw Groups

The mean age of participants was 23.2 years in single jaw surgery group while 22.7 years in double jaw surgery group. There was not statistically significant difference between the groups ($p>0.05$) (Table 1).

The mean operating time was 211.7 minutes in single jaw group and 342.9 minutes in double jaw group. The mean of operating time in double jaw group was significantly higher than in single jaw surgery, respectively ($p<0.05$) (Table 1).

The mean amount of intraoperative fluid administration was 2390.2 mL in single jaw group and 3643.8 mL in double jaw group. The mean amount of administrated fluid in double jaw group was significantly higher than in single jaw surgery ($p<0.05$) (Table 1). In single jaw group, Mallampati score was 1 in 78.0%, 2 in 17.1%, 3 in 4.9%, and 4 in 0.0% of the samples. Mallampati score of double jaw group was 1 in 84.9%, 2 in 13.7%, 3 in the rest of 1.4% and none of the samples had score 4. Mallampati score 4 was not seen in both of the groups. Mallampati score

TABLE 1: Averages of age, operating time and intraoperative fluid administration, and statistical differences between the single and double jaw groups.

Single or double jaw		n	Mean	SD	t value	p value
Age	Single	41	23.2	5.1	0.507	0.613
	Double	73	22.7	5.7		
Operating time	Single	41	211.7	59.8	-10.862	0.000*
	Double	73	342.9	63.1		
Intraoperative fluid	Single	41	2390.2	702.8	-7.330	0.000*
	Double	73	3643.8	959.2		

*p<0.05; SD: Standard deviation.

TABLE 2: Mallampati score, difficult intubation, bad split, additional device need, blood transfusion and colloid and statistical differences between the single and double jaw groups.

			Single/double jaw		Total
			Single	Double	
Mallampati score	1	n (%)	32 (78.0%)	62 (84.9%)	94 (82.5%)
	2	n (%)	7 (17.1%)	10 (13.7%)	17 (14.9%)
	3	n (%)	2 (4.9%)	1 (1.4%)	3 (2.6%)
	4	n (%)	0 (0%)	0 (0%)	0 (0%)
Total (chi-square=1.579; p=0.454)		n (%)	41(100.0%)	73 (100.0%)	114 (100.0%)
Difficult intubation	1	n (%)	36 (87.8%)	67 (91.8%)	103 (90.4%)
	2	n (%)	3 (7.3%)	5 (6.8%)	8 (7.0%)
	3	n (%)	1 (2.4%)	0 (0.0%)	1 (0.9%)
	4	n (%)	1 (2.4%)	1 (1.4%)	2 (1.8%)
Total (chi-square=2.006; p=0.571)		n (%)	41 (100.0%)	73 (100.0%)	114 (100.0%)
Bad split	-	n (%)	40 (97.6%)	70 (95.9%)	110 (96.5%)
	+	n (%)	1 (2.4%)	3 (4.1%)	4 (3.5%)
Total (chi-square=0.216; p=0.545)		n (%)	41 (100.0%)	73 (100.0%)	114 (100.0%)
Additional device need	-	n (%)	38 (92.7%)	72 (98.6%)	110 (96.5%)
	+	n (%)	3 (7.3%)	1 (1.4%)	4 (3.5%)
Total (chi-square=2.743; p=0.132)		n (%)	41 (100.0%)	73 (100.0%)	114 (100.0%)
Blood transfusion	-	n (%)	41 (100.0%)	69 (94.5%)	110 (96.5%)
	+	n (%)	0 (0.0%)	4 (5.5%)	4 (3.5%)
Total (chi-square=2.328; p=0.163)		n (%)	41 (100.0%)	73(100.0%)	114 (100.0%)
Colloid	-	n (%)	41 (100.0%)	68 (93.2%)	109 (95.6%)
	+	n (%)	0 (0.0%)	5 (6.8%)	5 (4.4%)
Total (chi-square=2.937; p=0.102)		n (%)	41 (100.0%)	73(100.0%)	114 (100.0%)

1 was higher in double jaw group even there was not significant relationship between the groups (p>0.05) (Table 2).

In single jaw group, difficult intubation score was 1 in 87.8%, 2 in 7.3%, 3 in 2.4% and 4 in 2.4% of the samples. Difficult intubation score of double jaw group was 1 in 91.8%, 2 in 6.8%, 3 in 0.0% and 4 in the rest of 1.4%. Difficult intubation score 4 in single jaw group was slightly higher in double jaw group even the relationship was not significant between groups (p>0.05) (Table 2).

Of single jaw group, 7.3% needed additional device usage for nasotracheal intubation while 1.4% of double jaw group needed additional device. Addi-

tional devices were used for more patients in single jaw group than double jaw group during intubation even there was not a significant relationship between groups (p>0.05) (Table 2).

Bad split occurred in 2.4% of single jaw group while in 4.1% of double jaw group. Bad split occurred in more patients in double jaw group than single jaw group even there was not a significant relationship between groups (p>0.05) (Table 2).

Of patients in double jaw group, 5.5% had blood transfusion while any patients did not need in single jaw group. When the rate of blood transfusion is considered; the difference was not significant between the groups (p>0.05) (Table 2), 6.8% of patients in double jaw group had colloid during the operation while none of the patients had colloid in single jaw group. There was no statistically significant difference between groups (p>0.05) (Table 2).

Comparison of Skeletal Class 2 and Class 3 Patients

The mean age of the participants in Class 2 group was 22.6 and 22.9 in Class 3 group. There was no statistically significant difference between the groups (p>0.05) (Table 3).

Mean operating time was 269.1 min in Class 2 group and 300.4 min in Class 3 group. The mean operating time in Class 3 group was slightly higher than in Class 2 group even there was not difference between the groups (p>0.05) (Table 3).

The mean intraoperative fluid administration was 3294.1 mL in Class 2 group and 3175.3 mL in Class 2 group. There was not difference between groups (p>0.05) (Table 3).

In Class 2 group, Mallampati score was 1 in 82.4%, 2 in 11.8%, 3 in 5.9% and 4 in 0.0% of the samples. Mallampati score of Class 3 group was 1 in 82.5%, 2 in 15.5%, 3 in 2.1% and 4 in 0.0%. Mallampati score 4 was not seen in both of the groups. Mallampati score 3 in Class 2 group was slightly higher in Class 3 group even there was not statistically significant relationship between groups (p>0.05) (Table 4).

In Class 2 group, difficult intubation score was 1 in 82.4%, 2 in 5.9%, 3 in 5.9% and 4 in 5.9% of the samples. Difficult intubation score of Class 3 group was 1 in 91.8%, 2 in 7.2%, 3 in 0.0% and 4 in the rest of 1.0%. Difficult intubation score 4 in Class 2 group was slightly higher in Class 3 group even there was not significant relationship between groups (p>0.05) (Table 4).

Of Class 2 group, 11.8% needed additional device for general anesthesia while 2.1% of Class 3 group needed additional device. All included patients had classic laryngoscopy in the current study. Fiberoptic bronchoscopy was required in 3 patients and guide was used in 1 patient. Mallampati score was 4 in all patients who had fiberoptic bronchoscopy. There was not a statistically significant difference between groups (p>0.05) (Table 4).

Bad split occurred in 5.9% of Class 2 group while in 3.1% of Class 3 group. There wasn't a difference between groups (p>0.05) (Table 4).

Of patients in Class 2 group, 11.8% had blood transfusion while 2.1% of patients had blood transfusion in Class 3 group. There was not a significant relationship between groups (p>0.05) (Table 4).

TABLE 3: Averages of age, operating time, intraoperative fluid administration and statistical differences between the Class 2 and Class 3 groups.

Class		n	Mean	SD	t value	p value
Age	2	17	22.6	6.1	-0.249	0.804
	3	97	22.9	5.4		
Operation time	2	17	269.1	115.0	-1.353	0.179
	3	97	300.4	82.6		
Intraoperative fluid	2	17	3,294.1	1,436.8	0.424	0.672
	3	97	3,175.3	989.6		

*p<0.05; SD: Standard deviation.

TABLE 4: Mallampati score, difficult intubation, bad split, additional device need, blood transfusion, colloid, more than 5 mm movement and statistical differences between Class 2 and Class 3 groups.

			Class		
			2	3	Total
Mallampati score	1	n (%)	14 (82.4%)	80 (82.5%)	94 (82.5%)
	2	n (%)	2 (11.8%)	15 (15.5%)	17 (14.9%)
	3	n (%)	1 (5.9%)	2 (2.1%)	3 (2.6%)
	4	n (%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Total (chi-square=0.935; p=0.627)		n (%)	17 (100.0%)	97 (100.0%)	114 (100.0)
Difficult intubation	1.0	n (%)	14 (82.4%)	89 (91.8%)	103 (90.4%)
	2.0	n (%)	1 (5.9%)	7 (7.2%)	8 (7.0%)
	3.0	n (%)	1 (5.9%)	0 (0.0%)	1 (0.9%)
	4.0	n (%)	1 (5.9%)	1 (1.0%)	2 (1.8%)
Total (chi-square=7.825; p=0.050)		n (%)	17 (100.0%)	97 (100.0%)	114 (100.0%)
Additional device need	-	n (%)	15 (88.2%)	95 (97.9%)	110 (96.5%)
	+	n (%)	2 (11.8%)	2 (2.1%)	4 (3.5%)
Total (chi-square=4.022; p=0.105)		n (%)	17 (100.0%)	97 (100.0%)	114 (100.0%)
Bad split	-	n (%)	16 (94.1%)	94 (96.9%)	110 (96.5%)
	+	n (%)	1 (5.9%)	3 (3.1%)	4 (3.5%)
Total (chi-square=0.332; p=0.481)		n (%)	17 (100.0%)	97 (100.0%)	114 (100.0%)
Blood transfusion	-	n (%)	15 (88.2%)	95 (97.9%)	110 (96.5%)
	+	n (%)	2 (11.8%)	2 (2.1%)	4 (3.5%)
Total (chi-square=4.022; p=0.105)		n (%)	17 (100.0%)	97 (100.0%)	114 (100.0%)
Colloid	-	n (%)	16 (94.1%)	93 (95.9%)	109 (95.6%)
	+	n (%)	1 (5.9%)	4 (4.1%)	5 (4.4%)
Total (chi-square=0.107; p=0.561)		n (%)	17 (100.0%)	97 (100.0%)	114 (100.0%)
More than 5 mm movement	-	n (%)	4 (40.0%)	10 (32.3%)	14 (34.1%)
	+	n (%)	6 (60.0%)	21 (67.7%)	27 (65.9%)
Total (chi-square=0.202; p=0.465)		n (%)	10 (100.0%)	31 (100.0%)	41 (100.0%)

Of patients in Class 2 group, 5.9% had colloid during the operation while 4.1% of the patients had colloid in Class 3 group. There was not a difference between the groups (p>0.05) (Table 4).

DISCUSSION

Although life threatening complication (intraoperative and postoperative) rate of orthognathic surgery is accepted as very low, some complications such as hematoma (2.03%), secondary hemorrhage (1.92%), arteriovenous fistula (0.1%) and cavernous sinus thrombosis (0.1%) can occur.[14] The most common complications of orthognathic surgery can be listed as nerve injury (50%), temporomandibular joint disorders (14%), hemorrhage (9%), problems in hearing (7%), infections (7%), risk of relapse (4%) and/or bad split/segment fracture (2.3%).[14]

Orthognathic surgery procedures should be carried out under general anesthesia. Therefore, there is always a risk for general anesthesia-related complications. These life-threatening complications can be listed as neuropathy (19%), pulmonary edema (18%), weakness syndrome (16%), myopathy (11%), blood loss (7%), cardiac arrest (3.4%), dyspnea (2.8%), respiratory arrest (1.7%), and arrythmia (1.7%).[15,16] In the present study, 2 patients received erythrocyte suspension (1%), 1 patient had fresh frozen plasma (0.8%) and 1 patient had erythrocyte suspension with gelofucin because of decreased haemoglobin value (0.8%) in double jaw group. In the postoperative

stage, anesthesia-related complication was confirmed in 1 patient who had double jaw surgery. This patient was followed-up in the intensive care unit because of acute NPPE (0.8%).

Bad split of mandible in sagittal split ramus osteotomy commonly occurs depending on incomplete osteotomies and/or presence of third molars.[5,17] Robl et al. reported that 3.9% cases had bad split in osteotomy line and similarly Kim and Park showed that bad split occured in 3.7% of their cases.[8,9] Results of the present study show that 4 (3%) cases had bad splits in the sagittal split osteotomy line, which is comparable to previous reports. The possible reasons for bad split occurrence was mandibular hypoplasia, decreased mandibular buccolingual width and bone density in the present study. According to the results of the current study, it can be reported that the type of the skeletal deformity and the type of the surgical operation did not affect bad split occurrence.

The Mallampati score is simple, reproducible, reliable and used as clinical pre-anaesthetic airway evaluation tests for the assessment of difficult endotracheal intubation frequently. The score is determined by visibility of uvula, lateral plica glossoepiglottica, plica glossoepiglottica mediana, and soft palate.[17,18] The results of the present study showed that Mallampati score 3 in Class 2 group was slightly higher than in Class 3 group even there was no significant relationship between the groups. According to this result, it can be concluded that Mallampati score could be higher in participants who had Class 2 deformity.

According to Tabrizi et al., participants were divided into 2 groups: Group 1 patients had Class 3 skeletal deformity and received double jaw surgery while patients had Class 2 skeletal deformity and received double jaw surgery in Group 2. Eight (5.1%) participants in Group 1 and 13 (14.4%) participants in Group 2 had difficult intubation and they reported a significant difference between the groups.[19] Similarly, difficult intubation score was higher in skeletal Class 2 groups even there was not a significant difference between the groups in the current study.

Bacos et al. reported that total operating time was 208.37 minutes in combined procedures, 154.65 minutes for bilateral sagittal split osteotomy only and 176.59 minutes for Le Fort 1 only, in their study.[20] Correlatively, total operation time was 259.23 minutes in double jaw group, 152.14 minutes in bilateral sagittal split osteotomy only and 172.85 minutes in Le Fort 1 only in the present study.

Orthognathic surgery procedures used for the treatment of facial deformities could be associated with significant bleeding. For this purpose, hypotensive anesthesia should be used intraoperatively to reduce the risk of blood loss.[21,22] In the literature, reductions in blood loss up to 40% intraoperatively have been reported with the usage of hypotensive techniques.[23] However, sometimes great amount of bleeding can be observed during the operation. In the study of Faverani et al. which included 45 procedures, 2 patients required blood transfusion.[23,24] In our study, 2 patients received erythrocyte suspension, 1 patient had fresh frozen plasma while 1 patient had erythrocyte suspension with gelofucin. All patients who required blood transfusion underwent bimaxillary surgery.

NPPE following orthognathic surgery is a very rare reported complication in the literature.[25-27] Mitral valve stenosis was considered as a possible reason for ventricular failure leading to pulmonary edema.[28] One of the major risk factors that lead to NPPE is known as oral surgeries. In the postoperative stage, 1 patient who had double jaw surgery was followed-up in the intensive care unit because of NPPE in our clinic.

CONCLUSION

Life-threatening complications such as extensive blood loss or pulmonary edema may be seen even after orthognathic surgery. These complications are slightly higher in skeletal 2 patients or in double jaw procedures. Surgeon should be aware of prolonged surgery time increase the risk of complications while anesthesiologist should be aware of the Class 2 skeletal deformity-related intubation difficulties during the intubation.

Source of Finance

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Sıdaka Akdeniz, Burak Bayram;* ***Design:*** *Sıdıka Akdeniz;* ***Control/Supervision:*** *Sıdıka Akdeniz;* ***Data Collection and/ or Processing:*** *Pelin Aydın, Coşkun Araz;* ***Analysis and/or Interpretation:*** *Pelin Aydın, Coşkun Araz;* ***Literature Review:*** *Pelin Aydın;* ***Writing the Article:*** *Pelin Aydın;* ***Critical Review:*** *Sıdıka Akdeniz, Burak Bayram;* ***References and Fundings:*** *Sıdıka Akdeniz, Coşkun Araz, Burak Bayram;* ***Materials:*** *Pelin Aydın, Coşkun Araz.*

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