Original Article

Emergence from Anesthesia: A Comparison between Isolated Mandibular Setback and Bimaxillary Orthognathic Surgeries in Skeletal Class III Patients

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ABSTRACT

Background: We aimed to compare the emergence from anesthesia between the isolated mandibular setback and bimaxillary orthognathic surgeries in Skeletal Class III Patients.

Methods: All healthy patients with skeletal class III deformity admitted to Mashhad Dental School, Mashhad, Iran from the years 2017 to 2018 were included in this study. They were candidates for either bimaxillary orthognathic surgery (Bimax surgery) through a combination of mandibular setback surgery plus maxillary advancement or isolated mandibular setback (Monomax surgery). The predictor variable was the type of jaw displacement and anesthesia duration, while the outcome variable was the duration of emergence from general anesthesia. The duration of emergence from anesthesia was calculated from the time the patient was transported to the recovery room until the time of safely discharging from the recovery room. For statistical analysis, the significance level was set at 0.05 using SPSS 21.

Results: A total of 81 consecutive patients, comprising 45 (55.6%) males and 36 (44.4%) females, with an average age of 23.15±4.58 years were recruited. Among the participating patients, 56 (69.1%) underwent bimaxillary surgery while the other 25 (30.9%) were treated with Monomax surgery. Regardless of the type of performed surgery, the duration of general anesthesia was the only factor to be significantly correlated to the length of emergence from anesthesia (P= 0.001).

Conclusion: Increased exposure time to general anesthesia might result in a longer emergence from anesthesia, despite the type of performed orthognathic surgery. Further clinical trials are needed to support the relevancy.

Keywords: Emergence of anesthesia; Orthognathic surgery; Skeletal class III

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INTRODUCTION

Orthognathic surgery is a well-known and versatile surgery, which entails correcting skeletal discrepancies, phonetics, mastication function, and esthetic concerns in candidate patients; improving their overall quality of life [1, 2]. This type of major surgery is typically followed by hospitalization in aims of postoperative patient management, consisting of monitoring recovery and emergence from general anesthesia, hemostasis, pain control, airway stabilization or immediately resolving any unpredicted complications and morbidity relevant to orthognathic surgery [3-5].

Orthognathic surgery has evolved over the past 20 years [6-9]. This type of surgery has gradually developed into a widely-performed and routine surgical procedure with minimal complications [3]. With the adoption of new orthognathic surgical techniques, the introduction of modified surgical and fixation tools, along with the widened field of its indication; have all contributed to a higher level of surgeon expertise in performing orthognathic surgeries which renders this procedure to be much less time consuming and much more reliable and accurate [10-12]. On the other hand, intraoperative complications can always be a problem and cause prolonged operation duration [9, 13].

Specific criteria should be assessed in order to confirm the patient's eligibility for hospital discharge, but some general guidelines apply for all [11, 12]. Patients are to be monitored until they are no longer at risk for ventilation incompetence and have also returned to their normal mental GCS (Glascow Coma Scale) status [14]. The length of inpatient hospitalization stay depends on multiple factors, such as the complexity of the surgical procedure, the type of employed fixation and the duration of anesthesia [4, 15, 16]. Although patient hospitalization after major surgeries, including orthognathic surgeries, is strongly advocated in order to make sure the patient has a safe recovery process with minimal risks and does not experience any unexpected postoperative complications; but on the other hand the increasing expenses for hospitalization and the need for experienced and trained healthcare workers make this process much more difficult, hence the length of hospital stay has become shorter over the past years [6-8].

The authors hypothesized that the emergence from general anesthesia was the same in different types of orthognathic surgeries in skeletal class III patients. Given the importance of this issue in orthognathic patients, we aimed to compare the emergence from general anesthesia between the isolated Mandibular Setback and Bimaxillary Orthognathic Surgeries in Skeletal Class III Patients.

MATERIALS AND METHODS

The protocol of this cohort study was approved by the Research and Ethics Committee of Mashhad University of Medical Sciences (IR.mums.sd.1394.248). Guidelines of the declaration of Helsinki statement were followed in this research and patients were recruited only after obtaining fully informed consent.

The study population consists of patients with skeletal class III malocclusion which were candidates for either bimaxillary orthognathic surgery (Bimax surgery) through a combination of mandibular setback surgery by bilateral sagittal split osteotomy (BSSO) plus maxillary advancement using LeFort 1 osteotomy or isolated mandibular setback by BSSO (Monomax surgery), admitted to Mashhad Dental School, Mashhad, Iran from the years 2017 to 2018. Patients with at least 18 years of age and an ASA physical status score I or II, were enrolled. In cases of any intraoperative complications which resulted in prolonged operation duration, such as arterial bleeding, need for blood transfusion, or bad split osteotomy fractures; the patient was to be excluded from the study. All surgeries were performed under the same general anesthesia protocol and this was accomplished by the same anesthesiologist for each and every patient, to eliminate any possible confounding factor which could possibly affect the patient's emergence from anesthesia and recovery time.

After a thorough clinical examination, cephalometric analysis and evaluating the obtained intraoral and extraoral photographs, a surgical model was prepared for each patient and only then a comprehensive orthodontic treatment plan was developed prior to surgery. All required paraclinical tests were conducted, the results were carefully evaluated and the patient was referred to a medical internist if necessary. The preoperative assessment of patients undergoing orthognathic surgery was directed at evaluating the patient's overall health status and therefore careful patient selection with the aims of reducing the risk for

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intraoperative complications. According to the clinical and radiographic analysis, our enrolled skeletal class III participants were categorized into two groups: candidates for monomaxillary surgery, undergoing isolated mandibular setback by BSSO and candidates for bimaxillary surgery, receiving a combination of mandibular setback with BSSO and maxillary advancement through Lefort I Osteotomy. All patients were treated by the same oral and maxillofacial surgeon. Patients were subjected to general anesthesia under the following protocol: 5 minutes of preoxygenation using FIO2 100%, premedication with intranasal 0.5 µg/kg midazolam and 0.2 µg/kg sufentanil, anesthesia induction with intravenous 2-2.5 mg/kg propofol followed by 0.5 mg/kg atracurium, 3 minutes of ventilation, administration of intravenous 1-1.5 mg/kg lidocaine in order to prevent any possible sympathetic responses to laryngoscopy and then nasal intubation. Anesthesia was then maintained with propofol at 50µg/kg/min and remifentanil at 0.1 µg/kg/min.

The time between anesthesia induction and complete extubation was considered as the length of anesthesia. The exact time of intubation and extubation was carefully recorded by an anesthetic technician; the period between these two times was defined as the duration of general anesthesia exposure. The duration of emergence from anesthesia was calculated in minutes from the time the patient was transported to the recovery room until the time he/she was eligible to be safely discharged from the recovery room.

The predictor variable was the type of jaw displacement and aesthesia duration, while the outcome variable was the duration of emergence from general anesthesia. Other factors such as the patient's age and gender, were also investigated.

All collected data were subjected to statistical analysis using SPSS V.21 (IBM Corp., Armonk, NY, USA) independent *t*-test, Spearman's rank correlation, and multiple linear regression analyses were also employed. As for descriptive analysis, appropriate charts and tables were used to display the central tendency and dispersion indexes.

RESULTS

A total of 81 consecutive patients, comprising 45 (55.6%) males and 36 (44.4%) females, with an average age of 23.15±4.58 years and an age range of 18 to 36 years, were recruited. Among the participating patients, 56 (69.1%) underwent bimaxillary surgery (Bimax), which was a combination of mandibular setback plus maxillary advancement. While the other 25 (30.9%) were treated with isolated mandibular setback surgery (Monomax). Their mean age was 23.55±4.47 and 22.24±4.77 years, respectively. There was no statistically significant difference between the patient's ages in the two surgery groups, regarding Mann-Whitney test (P=0.149).

The chi-square test showed no statistical difference in gender distribution between the study groups (P= 0.476). The range of each jaw movement was 1 to 4 mm. The amount of jaw discrepancy was not significantly different between Monomax and Bimax surgery candidates, regarding Mann-Whitney test (P=0.265).

Although male patients (45.64 minutes) tended to have a slightly shorter emergence from general anesthesia compared to female patients (48.89 minutes), Mann-Whitney test showed that this difference was not statistically significant (P=0.270). Regardless of the type of performed surgery, the duration of general anesthesia was directly proportional to the duration of emergence form anesthesia; however this relationship was only proven to be statistically significant among cases who underwent Bimax surgery. Table 1 displays this matter in great detail (Table1). Moreover, we also realized that the patient's age was directly proportional to the length of emergence from anesthesia, but this relationship was not considered statistically significant (P= 0.729).

Multiple linear regression analysis revealed that the duration of general anesthesia was the only factor to

Table 1: Spearman's Rank Correlation between Duration of General Anesthesia and Length of Emergence from General Anesthesia.

Type of Surgery	Monomaxilary Surgery (Monomax)	Bimaxillary Surgery (Bimax)	Total
Spearman's Rank Correlation	0.285	0.360	0.56
p-value	0.167	0.006	<0.001
Number	25	56	81

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Table 2: Regression analysis to analyze the effect of the Patient's Age, Gender and Duration of General Anesthesia; on the Duration of Emergence from General Anesthesia.

Model	Standardized Regression Coefficients (Beta)	t	p-value	95% Confidence Interval for Beta	
				Lower Bounds	Upper Bounds
Fixed Value		2.984	.004	10.139	50.854
Age	.012	.110	.912	-.662	.740
Treatment Plan	-.079	-.469	.641	-13.86	8.58
Duration of General Anesthesia	.590	3.441	.001	.055	.206
Gender	-.015	-.141	.888	-6.785	5.887

be significantly correlated to the length of emergence from anesthesia (P= 0.001), and other analyzed variables, such as the patient's age and gender did not have a significant association with the duration of emergence from general anesthesia (Table 2).

DISCUSSION

Orthognathic surgery has now standardized into a well-known and low-risk surgical procedure whilst improving surgical techniques and postoperative fixation methods [1, 3, 8, 9, 13]. Over the past few years, patients have become much more aware and concerned about their facial esthetics, leading to a dramatic rise in interest worldwide [1, 8, 9, 15]. Due to the complex nature of orthognathic surgery, treating under general anesthesia followed by hospitalization is definitely deemed necessary [11, 15, 17]. The present study intended to evaluate the association between the patient's general anesthesia exposure and the duration of emergence from anesthesia in skeletal class III patients undergoing orthognathic surgery. The obtained results reveal that the duration of general anesthesia is directly proportional to the duration of emergence from anesthesia; the longer the patient is anesthetized, the longer the emergence from general anesthesia will take.

Emergence from general anesthesia is defined as a passive process that entails the patient regaining consciousness after the administration of anesthesia and adjuvant agents has been discontinued when the surgical procedure has come to an end [18].

According to the obtained results, the type of performed surgery and duration of operating time, were positively correlated to the length of hospital stay, while other factors such as age and gender were not. This was in line with some [19, 9 ,15].

A retrospective study conducted by Jarab et al analyzed patients who underwent orthognathic surgery at Jordan University Hospital from the years 2005 to 2009 [16]. The type of surgical operation that was performed, the operating time, number of days spent in the ICU and the year in which the surgery was performed; were all found to be significantly correlated to LHS (length of hospital stay) [16]. In the present study, by dividing patients into bimax and monomax surgery groups, it was possible to assess the correlation between the complexity of the procedure as well as the operating time, and duration of emergence from anesthesia. Jarab et.al concluded that the complexity of the surgical procedure and operating time strongly correlated to the length of hospital stay. This was in accordance with the findings of our study.

both the length of time under general anesthesia and the duration of the operation, were significantly correlated to surgical outcomes, postoperative morbidity and the need for subsequent inpatient care [20].

A study by Hauman et al investigates the potential influential factors affecting the length of hospital stay in patients undergoing orthognathic surgery [15]. A number of 627 patients at Massachusetts Hospital were retrospectively enrolled from the years 1994 to 2006 [15]. By the year 2006, the average length of hospital stay had decreased from 2.3 days to 1.3 days; this may be rationalized by the advancement of employed professional surgical techniques, fixation appliances, and the higher level of surgeon expertise [15]. The present study was carried out through a shorter period of time; therefore it was not feasible to assess how the improvement of surgical techniques and appliances can affect the final outcomes. Human et.al state that the type of fixation, the complexity of the surgical procedure, and operating time, were

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significantly associated with the patient's length of hospital stay [15]. It was also established that operating under low-pressure induction anesthesia, the use of rigid fixation and administering preoperative corticosteroids all resulted in a shorter LHS [15]. The patients participating in the present study were all subjected to low-pressure induction anesthesia and rigid fixation. Although the current study was dedicated to evaluating the length of emergence from general anesthesia, the correlation between the complexities of the surgical procedure and operating time was similar to the findings of Human et.al study. In other words, a complex surgical procedure with a prolonged operating time and longer anesthesia duration; lead to an extended stay at the hospital. Other studies [21,22] also corroborate this finding.

Lombardo et al. [23] as well as Dolan and White [17], have previously revealed a procedure-based LHS pattern, reporting the longest LHS after bimaxiallary surgeries, followed by LeFort 1 maxillary osteotomy procedures and mandibular BSSO (bilateral sagittal split osteotomy), respectively. Other studies [15, 17] also confirm the fact that the complexity of the procedure is directly related to the length of emergence from anesthesia.

In cases of intraoperative blood infusion, the patient was excluded from our study; however the relationship between operating time and intraoperative hemorrhage in patients undergoing orthognathic surgery was evaluated through a study conducted by Yu et al. Participating patients were subjected to low-pressure induction general anesthesia [24]. The findings of this study claim that an intraoperative hemorrhage exceeding 500 ml is responsible for cardiopulmonary responses and causes a prolonged operating time and emergence from general anesthesia [24].

Suggestions and Limitations

Since this study was carried out through a small population, it would be best if similar studies with a multicenter population were conducted across the country. The results of this study also suggest that further evaluation and investigation of other influential factors such as the amount of intraoperative blood transfusion, surgical complexities, method of fixation, and long-lasting anesthesia while focusing on how they can potentially affect the patient's hospitalization, would also be beneficial.

CONCLUSION

Increased exposure to general anesthesia results in a longer emergence from anesthesia, in spite of the type of performed orthognathic surgery. However, this matter merits further research with a larger study population for more relevancy.

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CONFLICTS OF INTEREST

The authors have no conflict of interest to disclose.

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