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# Nasal fractures and anesthetic applications

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ABSTRACT

Objective: The aim of this study was to review and compare the demographic characteristics, radiological findings, pain scores and the level of satisfaction of patients who underwent nasal fracture reduction (NFR) under sedation anesthesia (SA), infiltrative anesthesia (IA) or topical anesthesia (TA).

Patients and Methods: Sixty patients were included in the study according to the types of anesthesia applied: SA group , IA group and TA group. Demographic data (age, gender, etiology, duration and time to NFR), radiological findings (presence of septal fracture, hematoma), pain scores, nasal patency and cosmetic satisfaction levels were analyzed.

Results: The mean age of patients was 23.8 ± 19.3. The mean age of females was 23 (38.3%) and mean age of males was 37 (61.7%). The mean age of the SA group was 6.1±4. The most common etiology was falls, (39 patients 65%). Duration of the operation was higher in patients (TA group) who had closed reduction. Pain score was lowest at 0 hour in the IA group (open reduction), while it was lowest at 48 hours in the TA group. Cosmetic satisfaction level was high in the SA group ($p<0.05$). Septal fracture was detected in 95% of the patients and septal hematoma in 36% of the patients in tomographic evaluation.

Conclusion: Sedation anesthesia was applied mostly to children, whereas, IA and TA were mostly applied to adult patients due to patient compliance. Short operation time and immediate pain control were advantages of IA.TA was preferred when cosmetic expectations were low in adults. Septal fracture and hematoma that cause nasal deformations, frequently seen in nasal fracture, may be missed by physical examination but can easily be detected by tomographic examination, but the risks of tomography should be noted.

Keywords: Demographic, Anesthesia, Pain, Fracture reduction, Satisfaction.

## 1. INTRODUCTION

Nasal Fracture (NF) is a frequently encountered emergency in daily clinical practice of the Ear, Nose Throat (ENT) and Plastic Surgery services [1], and it accounts for 39 to 45% of all facial bone fractures [2]. There are several different interventions utilized in nasal fracture reduction (NFR). These interventions are closed reduction (CR), which does not include any incision technique on one end of the spectrum, and the other one is open reduction (OR) at the other end, and this involves septoplasty and rhinoplasty techniques [3]. CR is usually carried out via blind techniques using manual manipulation or various instruments, such as the Asch and Walsham forceps. These interventions aim to fix the fractured segment of bone without direct view under the overlying mucoperichondrium [1, 4]. Although, CR generally provides acceptable outcomes, OR can facilitate better cosmetic and functional outcomes [5].

Since, NFR is a painful procedure, anesthesia is necessary regardless of CR or OR treatment [6]. Almost all types of anesthesia could be used in NFR, including general anesthesia (GA), sedation anesthesia (SA), infiltrative anesthesia (IA) and topical anesthesia (TA). These approaches result in different levels of sedation and anesthesia as a continuum from minimal sedation (anxiolysis) to moderate sedation, to deep sedation, and to complete GA [7] . In GA, the airway should be safely opened and complete loss of consciousness must be maintained;

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therefore, oropharyngeal bleeding and aspiration can be easily manipulated. In SA, intubation is not needed and there are some other advantages such as effective analgesia, adequate anxiolysis, short hospital stay and early awakening. Although, IA and TA allow to carry out surgery without the need for intubation or mechanical ventilation, anxiety-related to the procedure and the presence of some pain are their disadvantages [8]. The aim of this study was to provide an overview of NFR by examining demographic characteristics and radiological findings , pain scores and satisfaction levels in patients who underwent NFR with the use of SA, IA and TA.

## 2. PATIENTS and METHODS

Three hundred and twenty-five NF patients were evaluated in a secondary care hospital from 1st December 2018 to 1st August, 2020.The study was conducted in accordance with the ethical principles stated in the Declaration of Helsinki and was approved by the Ethics Committee for Clinical Research at Gazi Yasargil Education and Research Hospital (REF: 2019/392). Institutional ethics committee approval was obtained before commencing to collect the data. Informed consent was obtained from all participants before NFR.

Inclusion criteria were: patients who had a computed tomography (CT) scan with head trauma or various suspicious trauma to head and face region, as well as having a radiologic evaluation only with isolated nasal trauma. Exclusion criteria were: those with additional maxillofacial trauma, those with major comorbidities (cancer, metabolic diseases, chronic diseases), those with elevated liver and kidney function tests and those with coagulation or blood disorders.

Sixty patients who underwent NFR were divided into three groups according to the types of anesthesia applied (SA, IA or TA). Each group consisted of 20 patients, and these were selected randomly. The pain scores and satisfaction levels in each group were assessed. In otolaryngological examination of 60 patients; 4 of the patients had epistaxis. Twelve patients had an overt nasal deformity and 44 patients had nasal obstruction due to deviated septum and blood clots in the nasal passages. NF type was classified with the Stranc-Robertson classification [9] (Table I). Other otolaryngological findings were found to be normal. Age, gender, cause of nasal fracture, duration of operation, reduction time, re-operation requirements were recorded from the clinical and operation notes of patients. The characteristics of the septal fracture and the presence/absence of septal hematoma were recorded by analyzing the CT of patients (Table II).

### *Anesthesia Procedures*

In the SA group, 1.5 L/min of oxygen was administered using an oral oxygen canula. The loading dose was intravenous (IV) ketamine (1-2 mg/kg), midazolam (0.05-0.1 mg/kg), fentanyl (1-2 mcg/kg) or propofol (0.5-1 mg/kg). This administration could be increased gradually by 0.5-mg/kg [10]. In patients with low pain levels, ketamine and fentanyl were preferred. During surgery, electrocardiogram, peripheral arterial oxygen saturation and blood pressure were monitored in the operating room. In case of a decrease in oxygen saturation below 95% during surgery, spontaneous respiration was triggered by manipulation of the anesthesiologist.

The IA group received 4-6 ml of lidocaine with 1:100.000 adrenaline. This volume of anesthetic was infiltrated percutaneously over the dorsum of the nose leading to bilateral blockage of the infraorbital, infratrochlear and external nasal nerves. The nasal septum was also infiltrated in the submucosal plane. Manipulation took place as soon as the patients lost sensation.

In the TA group, the skin of the nose, ranging from the upper limits of the eyebrows and extending laterally to a vertical line passing through the infraorbital foramen, was cleaned. Thereafter, 2 g of 5% lidocaine cream (lidocream, BDderm, Istanbul, Turkey) was applied topically to the inside and outside of the nose. After waiting for the patients to report loss of sensation in the nose (around 15-20 minutes), the surgery was initiated.

### *Surgical Procedures and Follow-up*

In the SA and IA groups, OR was applied. Hemitransfixion incision and endonasal intercartilaginous incision were carried out according to the site of fracture. Subperiosteal and subperichondrial dissections were carried out to better visualize the fractured bone or the cartilage. The septal fractures were reduced and broken nasal bones were elevated by an elevator under endoscope guidance. After reduction of septal and nasal fracture, the flaps were relocated to their original positions and incisions were sutured.

In the TA group, CR was performed. After the application of anesthesia, the nasal and septal fractures were reduced. The Walsham forceps and elevator were used as septoplasty equipment, and the handle of the scalpel was also used for manual manipulation [4]. A Doyle nasal splint was inserted to both nostrils after the operation and was removed on the third postoperative day [3]. A nasal cast was applied to keep the reduced bones intact, and the cast was removed on the eighth postoperative day.

All patients were followed up for 3 months after having NFR and contacted by telephone for the survey using a 4-point numerical scale. In follow-up visits, nasal patency and cosmetic satisfaction were evaluated by using the same 4-point numerical scale as follows 1: no or least improvement, 2: fair improvement, 3: moderate improvement and 4: maximum improvement.

### *Pain Assessment and Management*

Visual Analogue Scale (VAS) scores at 0, 12, 24 and 48 hours after surgery, and the amount of analgesic medication required were recorded on the first and fifth days postoperatively. Pain scores were measured for all participants using a VAS from 0 to 10 (0: no pain and 10: severe intolerable pain). Children younger than 7 years of age were graded with the help of their parents. Acetaminophen was prescribed to all patients with a VAS score of ≥4 during the first 24 hours after the surgery. The patients

were discharged on the next day, and amoxicillin/clavulanate and acetaminophen were prescribed.

### Statistical Analysis

All analyses were performed with the SPSS v15 software (SPSS Inc., Chicago, IL, USA). The Shapiro-Wilk test was used to determine the compliance of variables to normal distribution. Number, percentage, mean, standard deviation (SD), median, minimum and maximum values were used in the depiction of descriptive data. Since, variables did not show normal distribution, continuous data were compared with the Kruskal-Wallis test between the three groups, and post-hoc corrections for pairwise comparisons were performed with the Bonferroni method. Categorical data were compared using Chi-squared test. The threshold for statistical significance was accepted as p-value of <0.05.

## 3. RESULTS

This study consisted of 23 (38.3%) females and 37 (61.7%) males. The ages of the patients ranged from 2 to 88 years old, with a mean ± SD value of 23.8 ± 19.3 years. The age was significantly lower in the SA group compared to the other two groups (p<0.001), and the age was similar in the IA and TA groups (Table I). Falls was the most common etiology in all three groups (p=0.001). The median duration of operation in the SA group was significantly higher than in the other two groups (p<0.001). The median reduction time in the SA group was significantly higher than in the IA group (p=0.034) (Table I). In radiological evaluation, the incidence of septal hematoma was significantly higher in the SA group compared to the other two groups (p<0.001) (Table II).

***Table I.*** *Demograpic characteristics of groups*

| Characteristics | | | | |
|---|---|---|---|---|
| | **Sedation anesthesia group (n=20)** | **Infiltrative anesthesia group (n=20)** | **Topical anesthesia group (n=20)** | **p** |
| **Age** | 6.1±4.0, 5 (2-17)[a] | 34.2±18.8, 27.5 (15.0-88.0)[b] | 31.2±17.0, 25.0 (15.0-81.0)[b] | **<0.001*** |
| **Gender** | | | | |
| Female | 7 (35.0) | 7 (35.0) | 9 (45.0) | 0.754 |
| Male | 13 (65.0) | 13 (65.0) | 11 (55.0) | |
| **Cause of nasal fracture** | | | | |
| Falls* | 20 (100.0) | 6 (30.0) | 13 (65.0) | **0.001*** |
| Assault* | 0 (0.0) | 9 (45.0) | 5 (25.0) | |
| Traffic accident | 0 (0.0) | 3 (15.0) | 0 (0.0) | |
| Sports | 0 (0.0) | 1 (5.0) | 0 (0.0) | |
| Work related | 0 (0.0) | 1 (5.0) | 2 (10.0) | |
| **Duration of operation** | 24.5±6.3, 25.0 (15.0-38.0)[a] | 12.7±3.3, 12.0 (9.0-20.0)[b] | 34.1±4,7, 34.5 (29.0-45.0)[b] | **<0.001*** |
| **Reduction time (day)** | 3.9±2.1, 4.0 (1.0-7.0)[a] | 2.3±1.4, 2.0 (1.0-5.0)[b] | 3.0±1.6, 3.0 (1.0-6.0)[ab] | **0.034*** |
| **Stranc-Robertson classification** | | | | |
| Frontal plane 1* | 10 (50.0) | 1 (5.0) | 4 (20.0) | **0.006*** |
| Frontal plane 2 | 4 (20.0) | 2 (10.0) | 2 (10.0) | |
| Frontal plane 3 | 0 (0.0) | 1 (5.0) | 0 (0.0) | |
| Lateral plane 1 | 4 (20.0) | 2 (10.0) | 5 (25.0) | |
| Lateral plane 2* | 2 (10.0) | 14 (70.0) | 9 (45.0) | |
| **Committed** | 0 | 3 | 0 | |

** lines that make up the statistical difference ( p<0.05)*
*All data are presented as mean (± Standard Deviation).*
*a, b: same letters depict the lack of significant difference between the denoted groups (columns) in pairwise comparisons.*

***Table II.*** *Septal fracture and septal hematoma in radiolographic evaluation*

| | **Sedation anesthesia group (n=20)** | **Infiltrative anesthesia group (n=20)** | **Topical anesthesia group (n=20)** | **p** |
|---|---|---|---|---|
| **Septal fracture** | | | | |
| Absent | 0 (0.0) | 2 (10.0) | 2 (10.0) | 0.343 |
| Present | 20 (100.0) | 18 (90.0) | 18 (90.0) | |
| **Septal hematoma** | | | | |
| Absent | 0 (0.0) | 18 (90.0) | 20 (100.0) | <0.001* |
| Present | 20 (100.0) | 2 (20.0) | 0 (0.0) | |

** lines that make up the statistical difference (p<0.05)*


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The immediate postoperative VAS scores (0 hrs) of the group that underwent NFR with IA was significantly lower than the other two groups (p=0.001). The median VAS scores immediately after surgery in the SA and TA groups were found to be similar. VAS scores at the 12th hour (p=0.004) and the 24th hour (p<0.001) were found to be significantly higher in the SA group compared to the other two groups. In contrast, the median VAS score at 48 hours was lower in the TA group compared to the other groups (p=0.016, Table III).

The SA, IA and TA groups were found to be similar in terms of perceived satisfaction with nasal patency (p = 0.073) (Table IV).

Cosmetic satisfaction levels of the three groups differed significantly (p<0.001). Satisfaction was highest in the SA group, followed by the IA group (Table V).

***Table III.*** *Comparison of VAS pain scores between groups immediately after surgery, at 12 hours, 24 hours and 48 hours*

| | Sedation anesthesia Mean±SD Median (Min-Max) | Infiltrative anesthesia Mean±SD Median (Min-Max) | Topical anesthesia Mean±SD Median (Min-Max) | p |
|---|---|---|---|---|
| Postoperative at 0 hour (at PACU) | 2.6±1.1<br>2.5 (1.0-6.0)[a] | 1.5±0.8<br>2.0 (0.0-3.0)[b] | 2.2±0.6<br>2.0 (1.0-3.0)[a] | **0.001*** |
| Postoperative at 12 hours | 6.8±0.7<br>7.0 (6.0-8.0)[a] | 6.1±1.1<br>6.0 (4.0-9.0)[b] | 6.0±0.8<br>6.0 (4.0-7.0)[b] | **0.004*** |
| Postoperative at 24 hours | 6.9±0.6<br>7.0 (6.0-8.0)[a] | 5.7±0.8<br>6.0 (4.0-7.0)[a] | 5.2±0.8<br>5.0 (3.0-6.0)[b] | **<0.001*** |
| Postoperative at 48 hours | 4.8±0.8<br>5.0 (3.0-6.0)[a] | 4.9±1.0<br>5.0 (3.0-6.0)[a] | 4.1±0.8<br>4.0 (3.0-6.0)[b] | **0.016*** |

*PACU: Postanesthetic Care Unit, VAS: Visual Analogue Scale*
** lines that make up the statistical difference (p<0.05)*
*a, b: same letters depict the lack of significant difference between the denoted groups (columns) in pairwise comparisons.*

**Table IV.** *Distribution of satisfaction levels of nasal patency among anesthesia groups*

| | Sedation anesthesia group n (%) | Infiltrative anesthesia group n (%) | Topical anesthesia group n (%) | p |
|---|---|---|---|---|
| No or least improvement | 2 (10.0) | 1 (5.0) | 1 (5.0) | 0.073 |
| Fair improvement | 0 (0.0) | 2 (10.0) | 5 (25.0) | |
| Moderate improvement | 3 (15.0) | 3 (15.0) | 7 (35.0) | |
| Maximum improvement | 15 (75.0) | 14 (70.0) | 7 (35.0) | |

** lines that make up the statistical difference (p<0.05)*

***Table V.*** *Distribution of cosmetic satisfaction levels among anesthesia groups*

| | Sedation anesthesia group n (%) | Infiltrative anesthesia group n (%) | Topical anesthesia group n (%) | p |
|---|---|---|---|---|
| No or least improvement | 2 (10.0) | 1 (5.0) | 1 (5.0) | **<0.001*** |
| Fair improvement* | 0 (0.0) | 1 (5.0) | 6 (30.0) | |
| Moderate improvement | 4 (20.0) | 6 (30.0) | 8 (40.0) | |
| Maximum improvement* | 14 (70.0) | 12 (60.0) | 5 (25.0) | |

** lines that make up the statistical difference (p<0.05)*

## 4. DISCUSSION

The demographic characteristics of patients with NF vary according to many factors, including geographic region, culture, religion and economic status [11]. Statistically, there was no gender-based difference in the distribution of NF. However, there was a male dominance in our study overall, similar to that reported by Chadha et al., who had a male-to-female ratio greater than 2:1. The highest incidences were seen in two age groups, in patients aged 15–30 years and in the elderly, in relation to the incidence of falls. The majority of nasal fractures in young adults were due to assault, sports and motor vehicle accidents [12]. In the hospital, which is in the South-Eastern region of Turkey, falls were the most common etiology in patients who underwent SA and TA; whereas assault was the most common cause in the IA group. In prior studies, it had been reported that assault and motor accident-related cases were more common in adults, while falls were more common in children [13]. In our study, operation time was longer in the SA group with a


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Marmara Med J 2022;35(1): 107-114

Marmara Medical Journal
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mean±standard deviation of 24.5±6.3 min because of the longer duration of anesthesia and duration of OR. In a study conducted by Kyung CR, duration of operation was 17.06 mins with SA and 20.29 mins in GA [8]. In Cook et al.'s study, either IA or blocks of the intraorbital/infratrochlear nerves, the CR surgeries took between 15-30 mins [14] and time between injury and operation was longer in the SA than IA and TA with 3.9±2.1 days in this study ($p<0.05$). The time between injury and operation was 6.8 days, according to Kim et al. [15].

Physical examination is not adequate to diagnose the complexity and details of NF. 25% of NFs that require surgery are negative in radiologic investigations. Although, CT scan can precisely show anatomic details of nasal bone and soft tissue, it carries risk for the lens of the eye especially in children [16]. In this study, CT images of the patients with NFs were evaluated in order to rule out other indications such as brain trauma as well as eye and skull trauma. Septal fractures are generally unrecognized and untreated in most of NF cases. Rhee et al., diagnosed septal fracture in 96.2% of NFs by CT examination [17]. In this study, septal fractures were present in 100% of the SA group, in 90% of the IA group and in 90% of the TA group, as determined by CT examination (Fig 1). Nasal septal hematoma (Fig 2), seen in 0.8–1.6% of NF cases is particularly more common in the pediatric population because the mucoperichondrium is loosely adherent to the underlying cartilage. Septal hematoma without any sequelae was mentioned by Alverez et al., similar to the results of the current study. We observed tomographic evidence of septal hematoma without any physical finding. It has been demonstrated that medical intervention is necessary in the presence of septal hematoma diagnosed by physical examination [18]. In this study, hematomas observed in 2 patients on physical examination were aspirated after performing a hemitransfixion incision under SA. As a result, advantages and disadvantages of performing CT should be carefully evaluated by the physician.

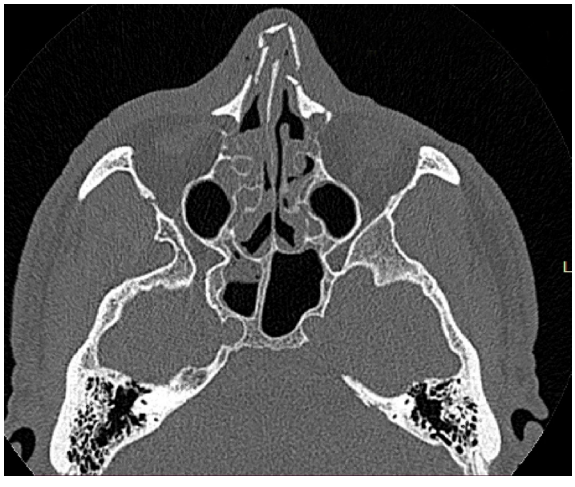

***Figure 1.*** *CT image of a 55-year-old man after physical assault. Note nasal septal fracture and nasal bone fracture; Stranc-Robertson classification C treated under infiltration anesthesia*

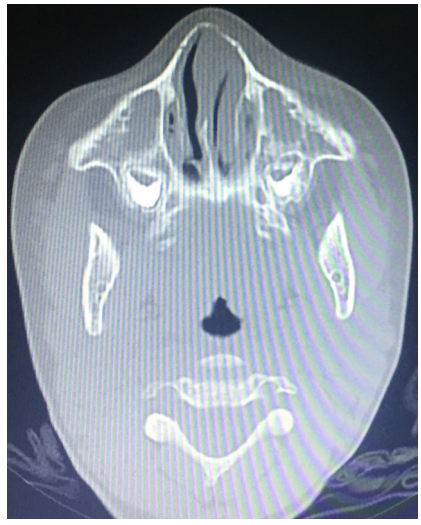

***Figure 2.*** *CT image of a 5-year-old boy who fell down. Note septal fracture, minimal septal hematoma and nasal bone fracture. Stranc-Robertson classification F2*

Nasal fracture reduction procedures cause pain during and after surgery [19]. Atighechi et al., in their comparative study of CR procedures found that mean pain score was 2.35 in TA group, 2.47 in IA group, and 1.9 in GA group, and these were statistically nonsignificant among the groups [20]. In this current study, immediate postoperative VAS scores were lowest in the IA group (1.5±0.8). VAS scores at 12 hours were (6.8±0.7) and at 24 hours it was (6.9±0.6). These scores were found to be significantly higher than those in the SA group because OR of NF was carried out in SA group and this was expected to be more painful. In OR, septoplasty or rhinoplasty were performed to reach the septum or nasal bones for direct visualization [3]. VAS scores at 48 hours showed that pain was lowest in the TA group (4.1±0.8) as the TA group had CR. Sclafani et al,, in their study of postoperative pain in septoplasty and rhinoplasty, found that the pain reported for septoplasty was 0-78 and pain reported for rhinoplasty was 0-88 on scale of 100 by VAS scale [21]. According to a study, less pain was felt by using general lidocaine anesthesia than using topical lidocaine and lidocaine infiltration at 6 hours in CR [22].

Perceived satisfaction in NF can be affected by the type of treatment and anesthesia choice. In the past studies, satisfaction with NF performed by CR is reported as 90% [20]. Satisfaction level was 98%, 100%, and 71% in studies conducted by Ridder et al., Ondik et al., Hung et al., respectively [23,5,24]. In a study by Murray and Marran, failure rate was 32.5% and Yılmaz et al., found that satisfaction level after 6 month of CR was 65% [25]. Atighechi et al., in their comparative study of GA, IA and TA+IA in NFs, found that satisfaction among groups were statistically similar [20]. In this study, nasal patency satisfaction was similar among all groups ($p>0.05$) with maximum improvement of 75% in SA, 70% in IA and 35% in TA. In contrast, cosmetic satisfaction was significantly different between groups ($p<0.01$). Cosmetic satisfaction with maximum improvement was 70% in SA, 60%



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in IA and 25% in TA group. In a study by Rajapakse et al., there was no statistical significance between TA+IA and GA groups in terms of cosmetic satisfaction and nasal function. The study also found 86% satisfaction with nasal patency, 84% in cosmesis in either GA or TA+IA [26]. In CR under LA 78% functional satisfaction and 69.5% cosmetic satisfaction were found by Vilela et al. [27]. In this current study more favorable results in both nasal patency and cosmetic satisfaction were found in SA group because of OR (Figures 3A, 3B, 3C).

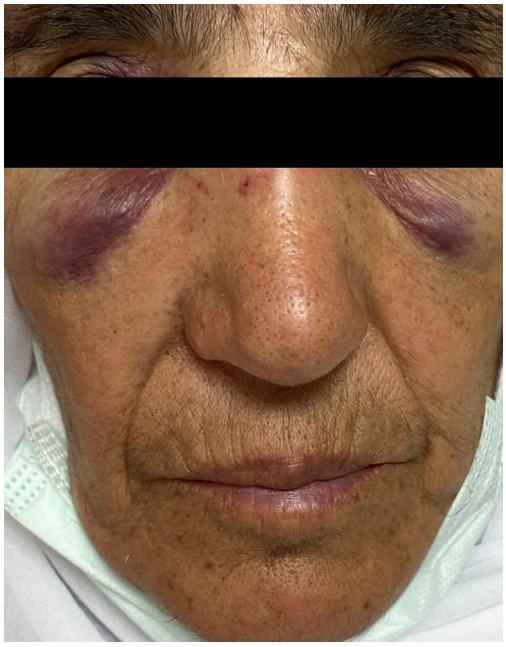

***Figure 3A.*** *A 63-year-old female who fell down. Nasal axis deviation before she underwent CR (closed reduction) under local anesthesia*

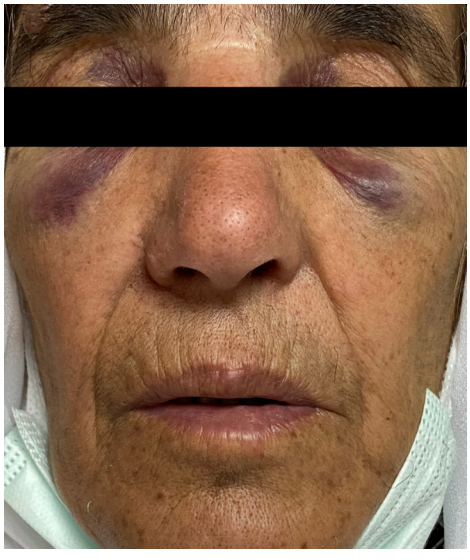

***Figure 3B.*** *Following CR, disapperance of axis deviation*

***Figure 3C.*** *CT image with nasal axis deviation to the left before CR. Stranc-Robertson classification L2*

This current study is a descriptive study that provides an overview of daily practice in ENT clinic about NF, the demographic characteristics, level of pain and satisfaction of patients and the radiologic details of fractures. Small sample size, lack of standardization in terms of age and treatment options (CR/OR) among groups and assessment of pain and satisfaction of children by parents were limitations of this study. Although, this study provides an idea about the level of pain and satisfaction, exact evaluation of pain and satisfaction was not obtained from the results. We performed OR in the SA and IA groups, while CR was utilized in the TA group. Also, there are methodological difficulties in comparing pain and satisfaction between patients receiving TA, IA and SA. For instance, SA recipients will be unconscious during the procedure, and therefore, only post procedural pain can truly be assessed. There may also be a tendency for patients to attribute surrogate outcomes to their SA, such as pain on insertion of intravenous cannulae, splints, post-operative nausea or vomiting, or other post-operative symptoms. In accepting these limitations, we decided to provide an overview of NF treatments; OR vs CR and the level of pain and satisfaction among two treatment options with SA, IA and TA groups. However, it is rather evident that anesthesia approach and type of reduction surgeries may vary in different hospital settings, patient characteristics, and the surgeons. Other studies should be conducted with the inclusion of different settings and different properties.


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## Conclusion

Nasal fractures can be efficiently and comfortably treated with SA in children. IA and TA are mostly applied in adults. Tomographic evaluation of NF provides detailed assessment especially in septal fracture and hematoma, mostly seen in children which requires surgical intervention but radiation hazards should be kept in mind. Additionally, although immediate effects on pain appear to be insufficient with TA, later pain results show favorable effects and is ideal preference when cosmetic expectation is low; whereas, immediate pain alleviation is better with IA. Cosmetic satisfaction was highest with SA in which OR was performed in our study. Although, choice of anesthesia and treatment are multifactorial depending on surgeon preference, hospital circumstances and patient characteristics, additional studies are needed to enrich the literature about NF to reach more standardized applications in anesthesia.

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**Compliance with Ethical Standards**

**Ethical Approval**: The study was conducted in accordance with the ethical principles stated in the Declaration of Helsinki and was approved by the Ethics Committee for Clinical Research at Gazi Yasargil Education and Research Hospital (protocol no: 2019/392). Institutional ethics committee approval was obtained before commencing to collect the data. Written informed consent was obtained from all participants before NFR. Patients also gave their consent for images relating to their cases to be reported in a medical publication.

**Conflict of Interest** The author declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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