



A new approach to nasoseptal fractures: Submucosal endoscopically assisted septoplasty and closed nasal reduction



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ABSTRACT

Background: Nasal bone fracture is the most common among facial bone fractures. The prevalence of concomitant septal and nasal bone fractures fluctuates between 34% and 96.2%. An adequate management of such fractures is essential to prevent complications such as post-traumatic nasal obstruction and nasoseptal deformities. The purpose of the present study is to introduce the submucosal endoscopically assisted septoplasty (SEAS) as an alternative approach for acute septal lesions and to report our experience and outcomes.

Methods: Retrospective review including patients with nasal fracture in association with septal fracture (nasoseptal fractures) who underwent to submucosal endoscopically assisted septoplasty and closed nasal reduction. The surgical technique is described and a video is presented.

Results: Ninety patients were included; 23% were female and 77% were male, with a mean age of 40 years. All the cases were workplace accidents or commuting accidents. The mean time elapsed between the accident and surgery was 15 days. There were no technique-related intraoperative complications. Three (3.3%) patients suffered a subsequent nasal obstruction and/or deviation of the nasal axis, requiring subsequent secondary open rhinoseptoplasty.

Conclusions: Submucosal endoscopically assisted septoplasty and closed nasal reduction for the treatment of nasoseptal fractures is a novel approach that reduces the rate of secondary rhinoseptoplasty as compared to other authors' reports. The technique described is reproducible, cost-effective and has very encouraging outcomes.

Level of evidence: IV Therapeutic.

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1. Introduction

Nasal bone fracture is the most common fracture of facial bones and the third most common of all body bone fractures (Andrades et al., 2012). Approximately 40% of the cases of facial trauma are related to nasal bone fractures (Reilly and Davidson, 2007). Concomitant nasal bone and septal fracture occur in between 34% and 96.2% of cases (Hwang et al., 2006; Rhee et al., 2004). According

to Harrison et al., the most common fracture line follows the path beginning at the quadrangular cartilage just posterior to the anterior nasal spine, extending posteriorly on the cartilage to within a few millimeters on the osseous–cartilaginous junction with the vomer. Subsequently, the line enters into the perpendicular plate heading to the cribriform plate of the ethmoid bone, to finally follow a curve and reenter the quadrangular cartilage (Harrison, 1979) (Fig. 1).

For correct management of nasoseptal fractures, a thorough preoperative assessment is required. The diagnosis of nasoseptal fracture is not easy and requires a high degree of suspicion. A nasoseptal fracture must be suspected when there is a high energy central face trauma with abundant epistaxis, nasal airway

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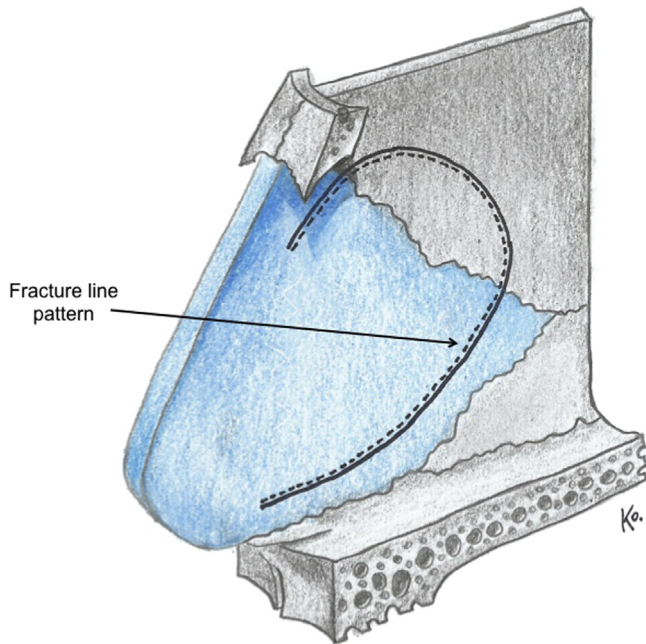


Fig. 1. Relationship of the fracture line to the remaining septum.

obstruction not previously present, severe nasal pyramid deviation, pain when mobilizing the caudal septum and nasal spine, presence of a septal hematoma, or observation of an endonasal mucosal tear with protruding cartilage or bone through it. After clinical and simple X-ray evaluation, if a displaced nasal bone fracture is suspected, a diagnostic test must be used to assess the nasal septum. The most commonly used imaging techniques for preoperative septal assessment are computed tomography (CT) and preoperative endoscopy. These techniques provide information about the type of septal deviation, location and extent of the fracture, and presence of other lesions. With all of these data, the diagnosis of septal fracture is made, and a treatment plan must be developed.

A septal fracture has an unfavorable impact on nasal bone alignment and airway permeability after the scarring process. Thus, timely detection and adequate management of nasal and septal fractures are imperative to prevent complications such as post-traumatic nasoseptal deformities and nasal obstruction (Rhee et al., 2004). The following are the classical indications for nasoseptal surgery: 1) the presence of a septal hematoma; 2) a septal deviation with partial or total airway obstruction; and 3) bone or cartilaginous tissue severely damaged or protruding through the septal mucosa demonstrated clinically or radiologically (Shumrick and Chadwell, 2012). Treatment of displaced septal fractures may be with a closed or an open approach. Actually, the literature supports the fact that in severe fractures, an open septoplasty approach with preservation of septal cartilage and removal of comminuted bone gives the most predictable results (Rhee et al., 2004; Shumrick and Chadwell, 2012; Mondin et al., 2005).

Endoscopic septoplasty is a widely described technique for the approach of long-standing septal deviations (Getz and Hwang, 2008; Park et al., 1998; Bothra and Mathur, 2009; Paradis and Rotenberg, 2011; Thomassin et al., 2014). However, there is no literature available addressing the use of such a technique in the acute management of nasoseptal fractures. Since direct observation of the fractured septum is fundamental for adequate treatment and for obtaining improved outcomes, the introduction of endoscopy into the traumatized nose seems crucial in achieving those objectives. Consequently, the purpose of the present work is to introduce

the submucosal endoscopically assisted septoplasty (SEAS) technique as an alternative approach to manage acute septal lesions and additionally to present our experience with this novel technique.

2. Materials and methods

2.1. Patients and design

A retrospective and descriptive study was conducted with the medical records of all patients who underwent surgery by the maxillofacial surgery team between January 2010 and April 2014, at the Hospital del Trabajador de Santiago, Chile. A total of 2304 surgeries were performed over the above-mentioned period, of which 690 were surgical procedures related to nasal trauma. The medical records of such nasal trauma surgical procedures were thoroughly reviewed, and 90 patients with concomitant nasal and septal fractures (nasoseptal fractures) were identified. All of these patients underwent closed nasal reduction together with submucosal endoscopically assisted septoplasty (SEAS) (Fig. 2). Patient demographic data, history of trauma, surgical technique, time elapsed between the accident and surgery, hospital stay, complications, and reoperations were reviewed.

2.2. Surgical technique

The surgical technique of closed nasal reduction and SEAS is demonstrated in Video 1. Briefly, a unilateral retrocolumelar incision is first made followed by a limited subperichondrial dissection of both sides of the most caudal cartilaginous septum. Then, the endoscope is introduced under the elevated mucosa (0° optics), and dissection of the osseous–cartilaginous septum is completed under direct visualization. The procedure is repeated on the contralateral side of the septum, preserving the muco-perichondrial integrity bilaterally. If the mucosa is lacerated due to the original trauma or the surgical technique, special care must be taken to avoid extending the laceration or creating another laceration in the opposing mucosa. Under endoscopic assistance, the fracture is identified, and a septal window is created including the fractured cartilage or bone fragments. At septal frame of at least 1 cm is preserved for nasal support. Other endoscopic assisted maneuvers may be performed if necessary, such as suturing the nasal mucosa, scoring a deviated cartilage, or placing spreader or support cartilage grafts. Following septoplasty, a traditional closed nasal reduction is performed using an elevator. A straight nasal axis with adequate nasal support and permeability of nasal airway must be obtained after this procedure. The mucosa is sutured, and endonasal plastic splints are placed and fixed with trans-septal sutures. Finally, nasal packages are placed for 5 days, and the nose is draped with tape and an external thermoplastic splint for 7 days.

Supplementary video related to this article can be found at <http://dx.doi.org/10.1016/j.jcms.2016.07.004>.

2.3. Statistical analysis

Continuous variables are described as mean and standard deviation; ordinal variables as mean and interquartile range; and categorical variables as percentages. A univariate analysis of the relationship between postoperative nasal obstruction and/or deviation of the nasal axis, requiring subsequent secondary open rhinoseptoplasty and the prognostic variables was performed using the χ^2 or Fisher exact test when the sample was small ($n < 5$) for categorical variables; and a t test for continuous variables. For the multivariate analysis, a logistic regression model was used to explore the prognostic role of the variables considered to have clinical relevance and to estimate the odds ratio for the occurrence

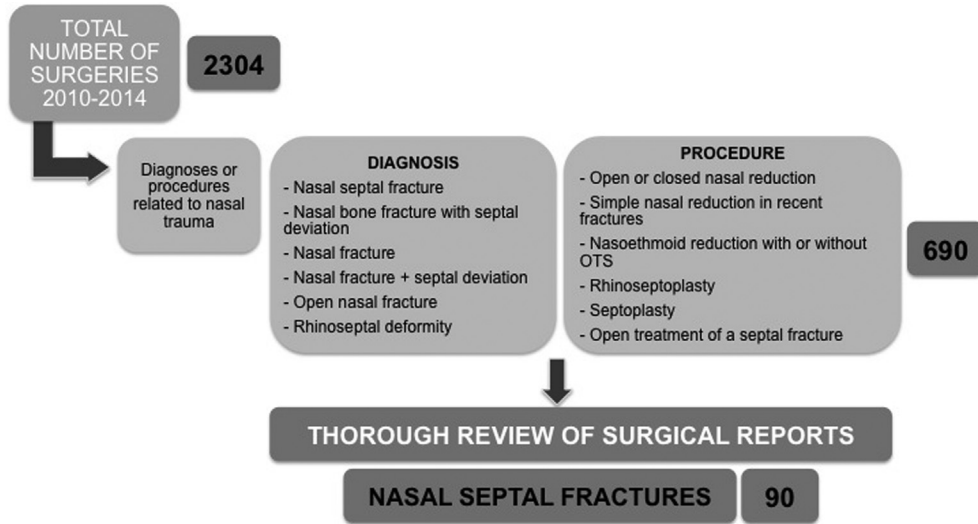


Fig. 2. Strategy for the review of medical records of surgeries performed by the Maxillofacial Surgery Team between January 2010 and April 2014.

of postoperative nasal obstruction and/or deviation of the nasal axis, requiring subsequent secondary open rhinoseptoplasty. A two-tailed *p* value of <0.05 was considered statistically significant, and all confidence intervals are reported in the 95% range. All calculations were performed using SPSS for Windows, Version 14.0 (SPSS Inc., Chicago, IL, USA).

3. Results

A total of 90 patients underwent surgery for nasoseptal fracture with the SEAS approach over the study period. Of these, 23% were female and 77% were male, and their mean age was 40.1 years (range 20–84 years). Comorbidity was present in 21% of patients (8 had high blood pressure, 6 had diabetes mellitus, and 4 were smokers), with no history of previous trauma. All of the cases were a consequence of workplace accidents or commuting accidents.

Most accidents involved blows with blunt objects (33%) and ground-level falls (23%) (Fig. 3).

Of the patients, 85 had isolated nasoseptal fractures (94.4%), and the remainder had an associated lesion or other fracture (zygomatic fracture 1.1%, Le Fort I 1.1%, Le Fort II 1.1%, orbital fracture 1.1%, degloving foot injury 1.1%). A clinical case of an isolated nasoseptal fracture is shown in Fig. 4. The mean time elapsed between the accident and SEAS was 15 days (range 2–42 days), with a mean postoperative hospitalization duration of 1.75 days (range 1–8 days). The surgical team has gradually adopted the SEAS technique, initially used by only one surgeon (P.A.) who developed and applied the technique in 8 cases in 2010. In the subsequent years, the number of cases increased when a second surgeon started using the technique, completing 16 cases in 2012. At present, there are three surgeons performing the procedure in approximately 40 cases per year, with an average operating time of less than 60 min (Fig. 5).

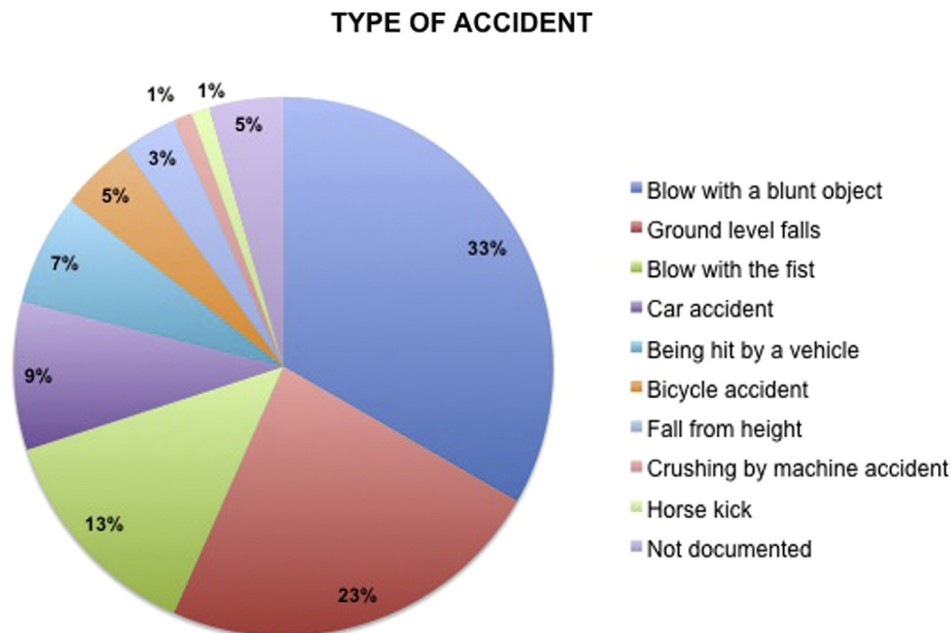


Fig. 3. Distribution of causes of nasoseptal fracture related to nasal trauma.

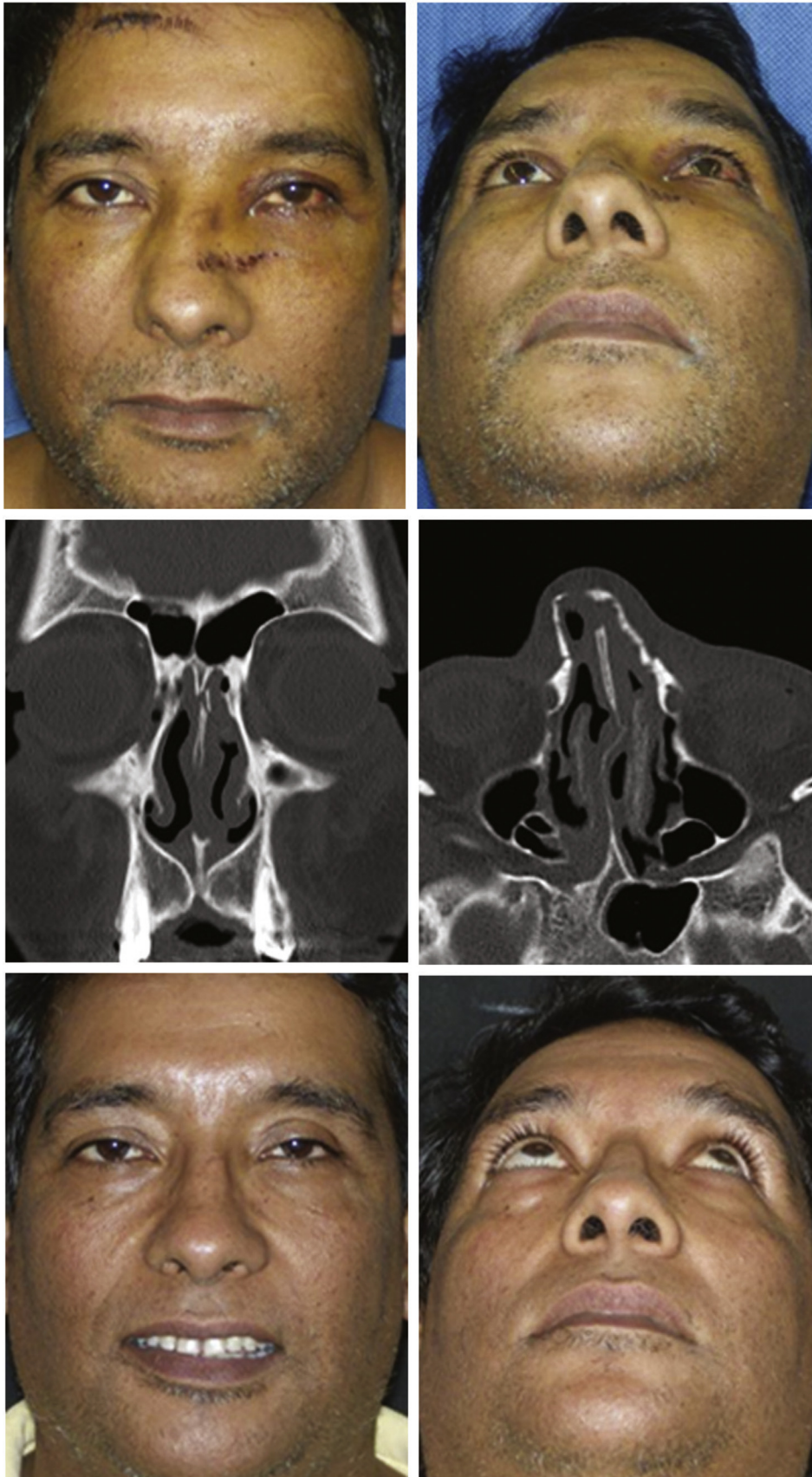


Fig. 4. Patient with isolated nasoseptal fracture. Preoperatively (above), Maxillofacial CT scan showing the fracture (center); Ten months postoperatively (below).

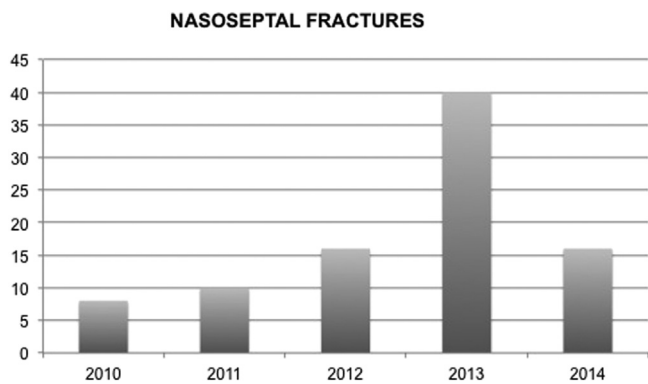


Fig. 5. Number of cases per year of patients with nasoseptal fractures treated with SEAS technique. The figure shows a gradual incorporation of the technique by the Maxillofacial Surgery Team between January 2010 and April 2014. *Number above the bar means the number of surgeons using SEAS.

Technique-related intraoperative complications were not observed. Nine patients developed postoperative complications (10%): 5 patients with nasal dorsum irregularities (5.5%), 1 patient with septal fistula (1.1%), 1 patient with nasal obstruction (1.1%), 1 patient with deviation of the nasal axis (1.1%), and 1 patient with nasal obstruction and deviation of the nasal axis (1.1%). Nasal dorsum irregularities were rasped under local anesthesia in 3 cases, treated with facial filler in 1 case, and given no further treatment in the remaining case. The septal fistula, which was found intraoperatively and could not be attributed to the technique, was treated conservatively. Patients who developed nasal obstruction and/or deviation of the nasal axis (3.3%) after a 1-year follow-up required subsequent secondary open rhinoseptoplasty. Patient age, sex, comorbidity, time elapsed between the accident and surgery, and number of hospital days were no different between secondary rhinoseptoplasty patients and those with no nasal obstruction and/or deviation of the nasal axis (Table 1). The multiple regression analysis did not show significant risk factors for complications.

4. Discussion

In this study, we demonstrate a novel technique for the treatment of nasoseptal fractures involving introduction of the endoscope under the mucosa of the septum for better visualization and control. Closed nasal reduction and SEAS is an effective technique with a low intra- and postoperative complication rate. The postoperative nasal deformity and nasal obstruction rate in our series was 3.3%, comparing favorably with previous reports in the

Table 1

Comparison between patients with no nasal obstruction and/or deviation of the nasal axis (no complications) versus secondary rhinoseptoplasty patients after Submucosal endoscopically assisted septoplasty (SEAS).

	No complications ^a	Secondary rhinoseptoplasty	p
n	87	3	
Age (years)	40	38.3	0.831
Male sex	77.01%	66.6%	0.17
Comorbidity	21.83%	0	0.83
Time A–S (days)	15	12.33	0.5572
Hospital days	2	1.66	0.9155

Time A–S denotes time elapsed between the accident and surgery. Multiple regression analysis did not show significant risk factors for complications (not shown).

p ≤ 0.05 is statistically significant.

^a No nasal obstruction and/or deviation of the nasal axis.

literature in which these complications required secondary rhinoplasty in a range between 15% and 50% (Rohrich and Adams, 2000; Waldron et al., 1989; Murray and Maran, 1980; Crowther and O'Donoghue, 1987). It is also a reproducible technique, because we have been able to teach it to younger surgeons while maintaining reduced operative times and adequate outcomes. No complications attributed to the sole use of the endoscope were observed in our study. These results attest that the procedure is safe, simple, and effective in treating patients with nasoseptal fractures and should be considered as another alternative for these types of lesions.

Using techniques similar to the ones used by Henry LeFort for maxillary fracture classification (Tessier, 1972), Murray et al. studied the pathogenesis of nasal trauma. Nondisplaced nasal bone fractures were the result of mild lateral forces (24–50 kPa) or greater frontal forces (350 kPa). On the other hand, displaced nasal bone fractures were the result of a combination of lateral forces (16–66 kPa) and frontal forces (144–314 kPa). These authors also observed that if the displacement is at least as large as the width of the nasal bridge, a C-shaped fracture may occur on the osseous–cartilaginous septum (Fig. 1). After analyzing these results and the close relationship between the bony and the cartilaginous portions of the nose and the septum, they concluded that usually both structures are fractured together during trauma (Murray et al., 1984). Because of this association, many authors have suggested primary septoplasty in selected cases of nasal fracture with septal deviation (Kapoor et al., 2002). However, in many countries, almost all nasal bone fractures are still treated with closed nasal reduction alone (Watson et al., 1988).

Unfortunately, septal fractures are not commonly suspected, and for that reason they are not diagnosed and treated, a circumstance that results in a high post-traumatic nasal deformity (Rohrich and Adams, 2000; Waldron et al., 1989; Murray and Maran, 1980; Crowther and O'Donoghue, 1987). A complete assessment of the nasal septum is the single most important step in determining esthetic and functional outcomes in nasal fractures (Rohrich and Adams, 2000; Fry, 1967). To reduce post-traumatic nasal deformity and the need for secondary rhinoseptoplasty, it is not enough to make an appropriate diagnosis, but it is also necessary to treat the septal defect adequately. Murray et al. (1984) conducted a study in which patients with nasoseptal fractures were treated either with a closed nasal reduction or with nasal reduction plus resection of the septal cartilage (open septoplasty). They concluded that the open management technique had less short- and long-term complications than the closed technique. The need to open the fractured septum has been emphasized by many authors. Nowadays, it is accepted that acute open reduction with submucosal septal resection, reconstruction, or repositioning of nasoseptal fractures results in an improved long-term cosmetic and functional outcome (Rhee et al., 2004; Mondin et al., 2005).

In our experience, changing from the closed to the open approach has significantly decreased the post-nasal reduction deformity and the need for post-reduction secondary rhinoplasty. Unfortunately, the open approach allows good visualization of the most anterior and caudal septum only. In this technique, the posterior septum, where more severe fractures occurred, remains poorly visualized. This problem may dramatically affect the treatment options in this area of the septum, because all of the maneuvers are usually performed blindly, resulting in an incomplete and poor repair. The introduction of a better visualization modality and the identification of patients at higher risk for postoperative complications are crucial to improve outcomes a step further. Preoperative and intraoperative visualization of the nasal septum are fundamental in order to improve results after nasal bone fracture (Rohrich and Adams, 2000; Fry, 1967; Murray et al., 1984). In

the preoperative period, visualizing the septum allows a better diagnosis and surgical planning, and in the intraoperative period, allows a better treatment by facilitating surgical maneuvers.

Endoscopic septoplasty is widely described in the literature for the management of chronic septal deviations (Getz and Hwang, 2008; Park et al., 1998; Bothra and Mathur, 2009; Paradis and Rotenberg, 2011). The endoscopic technique has demonstrated similar functional results compared to the open technique, but with lower operating time, higher patient satisfaction, and lower complication rates (Bothra and Mathur, 2009; Paradis and Rotenberg, 2011). There is no literature available regarding endoscopic assistance for the sub-mucosal management of acute septal injury. The SEAS is not a difficult technique, but many crucial points must be taken into consideration while performing this procedure. Submucosal dissection should be performed carefully to avoid a mucosal tear. If there is a mucosal perforation due to trauma or surgery, it can be repaired by placing an absorbable running suture. Care must be taken to prevent a mucosal tear on both the right and left mucosa and to create a fistula. Dissection of one side of the septum, leaving the other side attached to the mucosa, may prevent fistula formation, optimize control of the various fracture fragments and preserve bone and cartilage nutrition. We propose a resection approach for naso-septal fracture management, because the nasal septum is almost never straight before trauma, and reduction alone is very difficult and will end up with a deviated septum. We recommend a small septal harvest that includes most of the fractured and deviated fragments, leaving as much septum as possible for eventual secondary procedures. The remaining septum must be aligned in order to have good esthetic and functional outcomes. Consequently, all maneuvers that make the septum straight should be performed, including scoring, grafting, packaging, and splinting if needed.

In this study, we report the use of nasal bone reduction plus SEAS as an excellent alternative for the treatment of nasoseptal fractures. The contribution of endoscopy to this pathological condition enables the amplification of the visual field during septal treatment and closed direct visualization of the anatomy. Endoscopy allows the surgeon to achieve a perforation-free exposure by performing a meticulous subpericondral and subperiosteal dissection of the complete septum. It also allows the surgeon to reach areas that are usually not visible, such as the most posterior regions of the septum, which are very difficult to visualize during the open conventional approach. This technique is readily available at most health institutions; it involves a short learning curve; and video connection permits easy training of residents and colleagues. Moreover, it enables direct manipulation of injuries and fragments, makes treatment maneuvers easier and more effective, and facilitates attainment of better esthetic and functional outcome.

5. Conclusions

The use of closed nasal reduction and submucosal endoscopically assisted septoplasty (SEAS) for nasoseptal fractures treatment constitutes an innovation and a contribution to the approach of such lesions. This is supported by the low rate of secondary rhinoseptoplasty observed as compared to those in other authors' reports. The present work represents the first report in the medical literature regarding this technique, which is reproducible, cost-effective, and has very promising results.

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