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Closed reduction of nasoseptal fractures: key concepts for predictable results

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Abstract

Nasal complex injuries are the most common facial fracture encountered in the trauma population. Multiple surgical techniques for treatment of these fractures have been described with varying results. The goal of this study was to review the efficacy of closed reduction of nasal and septal fractures using a technique based upon several key concepts. We reviewed the records of patients who had undergone isolated nasal and/or septal fractures with closed reduction at our institution between January 2013 and November 2021. Inclusion criteria consisted of preoperative CT imaging, surgical treatment within fourteen days of initial injury, and follow up of at least one year. All patients were treated under general or deep sedation. The same surgical technique was applied with closed reduction of the septum and nasal bones with internal and external postoperative splints. Of the 232 records initially reviewed, 103 met inclusion criteria. Four patients had undergone revision septorhinoplasty (3.9%). Mean (range) follow up was 2.7 (1–8.2) years. Three patients had undergone revision nasal repair due to persistent airflow obstruction with complete resolution of symptoms after revision. The other patient received multiple revisions at another institution as a result of their dissatisfaction with cosmesis without improvement. Closed reduction of nasal and septal fractures can be a highly successful procedure and yield predictable results, limiting the need for post-traumatic open septorhinoplastic surgery. Five critical concepts of nasal fracture repair can help surgeons achieve predictable functional and cosmetic results: selection, timing, anaesthesia, reduction, and support.

Keywords: Trauma; Nasal fracture; Septal fracture; Anaesthesia

Introduction

The nasal complex is the most commonly injured craniofacial structure, with reconstructive challenges to achieve consistent aesthetic and functional outcomes.[1–3] Over the past 70 years, the literature reports persistently wide ranging post-traumatic nasal or septal deformity revision rates of 9%-62% after failed attempts at closed reduction.[4–6]

The concept of reducing the fractured nasal complex has been employed since the Edwin Smith Papyrus documented nasal manipulation over 3,500 years ago.[7] Modern nasal trauma management began with Maliniac's 1947 manuscript.[8] Many surgeons have since reported poor success with closed reduction, which has influenced surgeons to lower the threshold for open septal or nasal procedures. Various studies have investigated other factors in

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management, including the method of anaesthesia, role of the septum, and influence of CT imaging in operative planning.[2,9] Integrating the literature and surgeon experience can provide a reproducible guide for the treatment of nasal complex fractures.

The technique reviewed in this study is based upon five key concepts that have been distilled from the literature and can be used for the repair of simple, isolated nasoseptal fractures (Table 1):

(1) *Selection* – Case selection for closed reduction based upon comprehensive evaluation, including computed tomographic imaging.[10]
(2) *Timing* – Treatment completed within a 14-day window.[11,12]
(3) *Anaesthesia* – A controlled environment obtained with general anaesthesia.[5]
(4) *Reduction* – The septum, when involved, was addressed first during the procedure ensuring ideal reduction before addressing the nasal bones.[2,13]
(5) *Support* – Internal and external splints were used routinely.[14]

While none of these concepts are new to the literature individually, this review suggests that consistently combining these principles to isolated nasoseptal fractures may aid in the achievement predictable functional and cosmetic results.

Methods

Institutional review board approval was obtained. For continuity of technique and results, all cases were performed by the senior surgeon (D.P.) between January 2013 and November 2021. Patients with closed treatment of nasal bone and/or septal fractures during this time were included in this study. Inclusion criteria also involved the following:

(1) Closed or simple nasal fracture, including unilateral or bilateral nasal bones with or without septal fractures.
(2) Follow up of at least one year.
(3) Bones immediately adjacent to the fractured nasal bones were not fractured (frontal bone and maxilla).

Exclusion criteria:

(1) Concomitant naso-orbito-ethmoid (NOE) fractures or fracture of the frontal bone, maxilla, or nasofrontal disjunction.
(2) Age under 16 years.
(3) Open nasal fractures involving full-thickness lacerations.
(4) Nasal or septal fractures treated more than 14 days post-injury.
(5) Follow up of less than one year.

Chart review was performed to evaluate patient demographics and injury characteristics. Patients' injuries were determined by computed tomographic (CT) facial scans interpreted using the senior author's clinical and radiographic evaluation. Long-term follow up of patients was obtained through the medical record or via telephone interviews assessing for postoperative symptoms and satisfaction.

Surgical technique

Initial evaluation was completed with a comprehensive history, including prior nasal surgery and trauma. Next, the external and internal nasal complex was evaluated using a

Table 1
Five Key Concepts for Nasal Complex Repair.

Selection	•History - Prior nasal trauma/surgery •Exam - Septal deviation, fullness, lacerations •Imaging - CT for best septal evaluation
Timing	•14-day window
Anaesthesia	•General anaesthesia - controlled environment allows as many attempts at ideal repositioning of the septum as needed
Reduction	•First reduce septum •Interval nasal speculum exam - reposition septum as needed •Reduce nasal bones
Support	•Internal splint (Nasopore vs Merocel) •Denver splint for external support

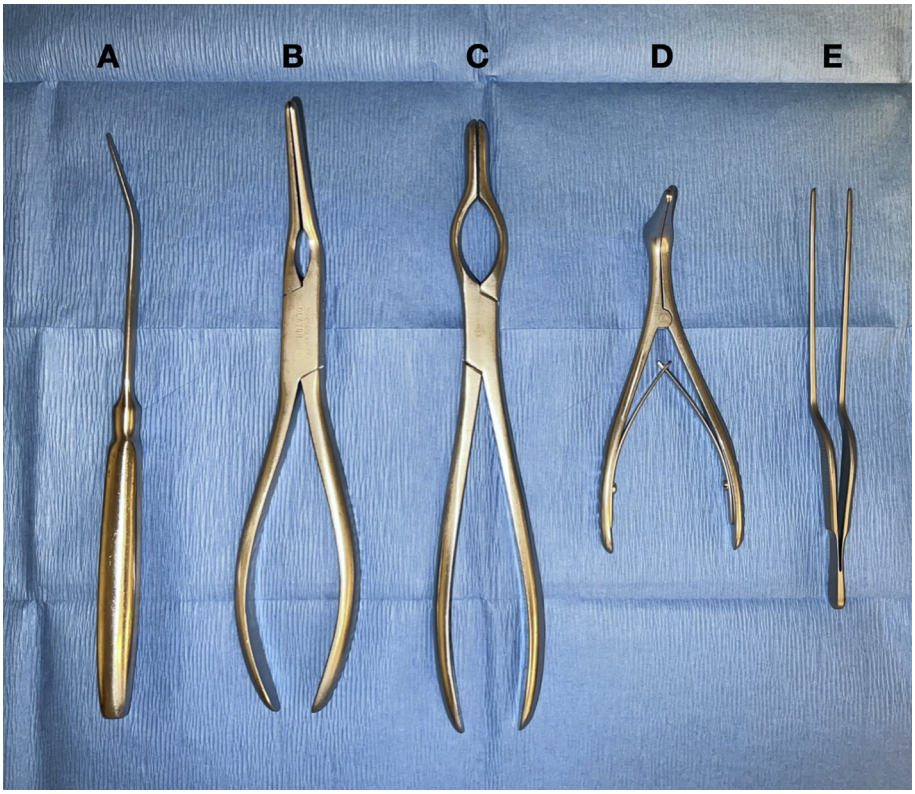

Fig. 1. Standard nasal fracture instrument tray including nasal speculum, Bayonet forceps, Asch forceps, Cottle-Walsham forceps, and angled Gillies elevator.

nasal speculum and a good light source. The overall morphology of the nasal septum was evaluated including the presence of a septal haematoma or lacerations, which would indicate a septal fracture.

Although external nasal exam may be limited due to oedema, the operation was scheduled to be completed within 14 days from injury if the patient elected repair. All cases were scheduled in the operating room under general anaesthesia or deep sedation to allow for a controlled environment in which multiple attempts at reduction could be accomplished. Frequently, the patient was kept on the surgical gurney, with laryngeal mask airway used for airway management. After induction of anaesthesia, lidocaine with epinephrine was injected for perinasal regional nerve blocks and infiltration for haemostasis. Appropriate preoperative antibiotics were initiated. Oxymetazoline-soaked nasal pledgets were placed in the patient's nares, remaining undisturbed for 10 minutes to establish haemostasis. Asch or Cottle-Walsham forceps were placed intranasally to manually reduce the grossly distorted nasal septum in a midline position along the crest of the maxilla (Figs. 1, 2). Intranasal examination with a nasal speculum confirmed the septum position and verified the lack of development of a septal haematoma. An angled Gillies zygoma elevator was then sequentially placed in the bilateral nasal aperture, and the nasal bone fracture was manually reduced into an anatomically stable position. The use of the Gillies elevator is preferable to a Boies nasal fracture elevator (a.k.a. 'butter knife') as the position of the angle at the nasal ala corresponds almost exactly with the confluence of the nasal bones to the frontal junction (Fig. 3).

For moderate to severe septal injuries, Doyle Combo splints® (Boston Medical Products Inc) or Pope Merocel® Sponges (Medtronic) were preferentially used for more robust septal support. Boston Medical recently ceased manufacturing the Doyle Combo splint®, but numerous independent vendors have inventory available. If minor septal repositioning is needed, NasoPore® (Stryker), a resorbable material was utilised. A Denver® external nasal splint (Summit Medical) was secured to the skin of the nasal dorsum over Steri-Strips™ (3M). The Denver® splint provides structural support for the reduction, and AP projection of the nasal complex comes from the internal packing and application of compressive and posterior pressure to the nasal complex, such as for adaptation of a thermoplastic splint, is counterintuitive and appears to result in alteration of the reduction.

Results

Two hundred and thirty-two patients were initially reviewed based on the included CPT codes. One hundred and three patients met inclusion criteria, and 129 patients were excluded based on exclusion criteria. Patient demographics are depicted in Table 2. The cohort included 53 men and 50 women with an average age of 40.9 years. As determined by preoperative CT facial bones, 36.9% of the patients had a unilateral nasal bone fracture, whereas the remainder were bilateral. Sixty-three patients, or 61.2%, had concomitant

Fig. 2. Reduction of nasal septum with Asch forceps. Depending on the degree/location of the nasal septal injury, Cottle-Walsham forceps may be preferable.

Fig. 3. Positioning of angled Gillies elevator for nasal bone reduction. The use of the Gillies elevator is preferable to a Boies nasal fracture elevator (a.k.a. 'butter knife') as the position of the angle at the nasal ala corresponds almost exactly with the confluence of the nasal bones to the frontal junction.

septal fractures. In addition, nearly all patients (94.2%) had a visual deformity, whereas only 49.5% reported functional obstruction.

From injury to the operating room, the average time between injury and surgery was 8.3 days (Table 3). Unilateral or bilateral nasal bones were addressed according to the fracture pattern in every case, and the septum was closed reduced in 81 out of 103 cases. There were no cases in which either the nasal septum or the nasal bones were surgically exposed, or opened, to perform the reduction. External and internal splints were applied to treated patients for structural support. All fractures of the nasal septum were managed with closed reduction only. Simultaneous internal packing with resorbable or non-resorbable sponges was placed to stabilise the osseocartilaginous septal reduction and prevent formation of a septal haematoma.

The mean (range) duration of follow up was 2.72 (1–8.2) years. Ninety six percent of patients experienced complete symptom resolution. Of those with persistent or recurrent functional symptoms or cosmetic concerns, only four patients underwent revision rhinoplasty (3.9% revision rate). The three patients with functional obstruction had complete resolution of symptoms following open revision surgery. The patient with persistent cosmetic deformity was initially treated for a minimally displaced isolated nasal bone fracture without septal involvement. She has since undergone two revision operations at another institution to treat persistent cosmetic concerns.

Discussion

Surgeons have been treating nasal injuries since at least the Surgical Papyrus of Edwin Smith (circa 1600 BCE), describing the use of intranasal splints formed with grease and honey-lined linen.[7] Hippocrates advanced this method in the 5th century BCE, as noted in his manuscript *On Joints*, with a technique strikingly familiar to our modern method of 'closed reduction' – using bimanual digital manipulation to reposition the nasal complex. Significant contributions have been made within the past 40 years, particularly with surgeons identifying specific sources of residual nasal and septal deformity. The technique utilised in this study is based upon critical concepts distilled from their contributions.

Selection – Proper case selection is critical for successful closed reduction, given that some injuries involving the nasal complex require open approaches. Case selection begins

Table 2
Patient demographics. Data are number (%) unless otherwise stated.

Characteristic	Number
Total patients	103
Sex:	
Male	53 (48.5)
Female	50 (51.5)
Mean (range) age, years	40.9 (16-82)
Race:	
White	64 (62.1)
Black	24 (23.3)
Hispanic	9 (8.7)
Other or not listed	6 (5.9)
Mechanism of injury:	
MVC	17 (16.5)
Fall	28 (27.2)
Assault	18 (17.5)
Other	40 (38.8)
Fracture pattern*:	
Unilateral nasal bone	38 (36.9)
Bilateral nasal bone	65 (63.1)
Septal fracture	63 (61.2)
Fracture severity*:	
Non-displaced	8 (7.8)
Mildly displaced	47 (45.6)
Moderately displaced	15 (14.6)
Comminuted	33 (32.0)
Preoperative symptoms:	
Visual deformity present	97 (94.2)
Nasal obstruction present	51 (49.5)

MVC = motor vehicle collision
* Determined by preoperative CT scan

Table 3
Operative and postoperative results. Data are number (%) unless otherwise stated.

Characteristic	Number
Mean (range) time from injury to OR (days)	8.3 (0–14)
Procedure performed:	
Closed reduction of unilateral nasal bone	38 (36.9)
Closed reduction of bilateral nasal bone	65 (63.1)
Closed septal reduction	81 (78.6)
Mean (range) follow up (years)	2.72 (1–8.1)
Resolution of symptoms	99 (96.1)
Persistent symptoms postoperatively	4 (3.9)
Revision surgery	4 (3.9)
Functional symptoms	3 (2.9)
Cosmetic concerns	1 (0.9)

with a thorough initial evaluation, including a history of nasal surgery and trauma and a thorough exam of external and internal nasal structures. The overall morphology and integrity of the nasal septum can be noted, with the presence of a septal haematoma or lacerations indicating septal involvement. In every case, CT imaging was obtained to assist in evaluating the septum. The utility of CT imaging in nasal fractures has shown improved sensitivity compared to plain films in diagnosing septal fractures. Studies have shown septal involvement in nasal fractures as high as 42%-96%.[2,15,16] Given this incidence, routinely addressing the septum in nasal bone reductions is a reasonable approach.

Timing – The significance of the early repair principle is important to obtain consistent outcomes. Osseous healing and physiology principles dictate that acute nasal fractures are more easily treated within 14 days.[7] While nasal fractures can sometimes be manipulated after the two-week mark, with percutaneous osteotomies performed to assist with reduction, treatment within 14 days has optimal results for closed reduction.[11,17] The surgeon must not forget about the septum when considering scar tissue formation. If the septum cannot be easily reduced, the likelihood of functional or cosmetic failure increases. The benefit of nasal and septal mobility outweighs the liability of persistent nasal oedema, limiting the evaluation of the straight nose.

Anaesthesia – The authors of this study prefer closed reduction to be completed under general anaesthesia or deep sedation with airway protection for the most predictable and controlled results. While effective nasal local anaesthetic infiltration, perinasal nerve blocks, and vasoconstrictive nasal packings are effective for perioperative pain control and haemostasis, general anaesthesia allows for a low-stress environment for both the surgeon and patient.[9,18–23] In addition, this setting allows multiple attempts at septal reduction, which is not likely to be fully accomplished in a single attempt on a fully conscious patient.

Waldron et al compared two consecutive groups of 50 patients who underwent closed reduction using general and local anaesthetic and found similar outcomes.[9] However, both of these cohorts had reported failure rates greater than 40%. The technique described does not address the nasal septum, which is likely to have contributed to the higher revision rates in both groups. These findings cannot be generalised to other techniques.

While operating room expense is high, closed nasal reduction takes approximately fifteen minutes. Open nasal or septal procedures require more operative time and expense and subject the patients to a second operation. A brief general anaesthetic possibly reduces expense, but more importantly, patients prefer the likelihood of requiring only a straightforward operative procedure when given a choice.

Reduction – The septum is one of the main factors in achieving functional and cosmetic success; it is reduced first after injecting local anaesthetic for perinasal blocks and infiltration. The authors of this study find the Asch forceps for septal reduction, or the Cottle-Walsham forceps, which is particularly useful for repositioning posterior septal fractures, septovomerine disjunction, as well as restoring projection of an impacted nasal complex. Rohrich and Adams reported at that time the lowest revision rate of 9%, attributing their success to the combination of proper evaluation and diagnosis of the septum, in particular, combined with appropriate treatment of septal injuries.[3]

Failure to properly identify and treat septal fractures can lead to both cosmetic and functional deformities necessitating secondary revision, highlighted by the classic quote of Maurice Cottle – "*as the septum goes, so goes the nose*".[24] For these reasons, the septal deformity is addressed first during the procedure. The cosmetic deformity is often improved

with septal manipulation alone, and the residual bony defect can quickly be addressed.

Support – Nasal packing is shown to stabilise the cartilaginous septum, prevent hematoma formation, minimise persistent or recurrent septal deformity post-septoplasty.[25] Although nasal packing was re-introduced into the modern literature in 1951 by Stevens et al, it was also used anciently by Hippocrates, Edwin Smith, and many others.[7,26] For moderate to severe septal injuries, Merocel® or Doyle splints® are used for more robust septal support. After minor repositioning of the septum, NasoPore® appears to provide adequate septal support and mucosal healing. Because it is absorbable, NasoPore® often does not need to be removed, and when it does need to be removed, it is better tolerated by patients in terms of pain and bleeding compared with Merocel®.[27,28] A meta-analysis by Wang et al found that Nasopore® is superior in terms of patient perception and equal concerning mucosal or septal healing.[29] Indeed, situations such as a posterior nasal bleed in which Merocel® or another product with greater length than NasoPore® would be indicated. However, in our experience, NasoPore® is often sufficient after minor or moderate septal reduction.

Conclusion

The results of this study suggest that closed treatment can successfully manage nasal and septal fractures. Limitations present within this study include that there is only one single treatment group and given that one senior surgeon treated all nasal complex fractures with the same approach, a direct cohort comparison could not be performed. Additionally, the threshold for recommending a revision operation varies between surgeons. Success is typically measured based upon the rate of revision surgery needed after closed treatment. Predictable results with closed treatment of the nasal complex depend upon thorough evaluation and proper case selection, prioritising nasal septum reduction, and performing the treatment in a controlled environment utilising general anaesthesia. The high failure rates reported broadly in the literature can likely be traced back to a breakdown in one or more of these five fundamental principles.

Conflict of interest

We have no conflicts of interest.

Ethics statement/confirmation of patient permission

Ethics approval not applicable. Patient permission obtained.

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