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# Open Versus Closed Reduction for Isolated Nasal Fractures: Comparison between the Outcomes of both Techniques

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## INTRODUCTION

The nasal bones are the most commonly fractured bones in the face because of the projection of the nose on the face. The incidence is more common among males, aged between 15-30 years due to direct blow, motor vehicle accident, or falls. Adequate management of nasal fractures cannot be achieved without comprehensive knowledge to the nasal anatomy. The two nasal bone projects from the frontal processes of the maxilla, from the superior aspect from the nasal process of the frontal bone, and meets in the midline. The septal cartilage acts as an inferior scaffold to the nasal bones. The lateral nasal wall contains three pairs of small bones; the superior, middle, and inferior conchae, that contributes to the bony framework of the turbinates. Lateral to these lays the medial wall of the maxillary sinus **[1]**.

The area between the thicker proximal and thinner distal segments of the nasal bones contributes to more than 80% of the nasal fractures. Inspite of that the frontal impact can cause fracture of the nasal bones; still the side traumas are much more common. Such lateral impact injuries classically causes depression of one nasal bone and causes lateral displacement of the contralateral side **[2]**.

Accurate diagnosis together with an appropriate surgical intervention is the key points in the management of nasal fractures. Mismanagement of such fractures can lead to inadequate aesthetic and functional outcome.

Both History and physical examination are the keys for diagnosing most nasal fractures. History usually includes a pre-existing trauma, which may be followed by epistaxis. During clinical examination; usually there is a swelling over the nasal bridge with change in the appearance of the nose, an apparent lateral deviation of the nasal bones, and/or peri-orbital ecchymosis **[3]**. Plain radiographs is not of much help in the diagnosis, and nasal bone CT scan can be of help to diagnose other facial fractures **[4]**.

It is important to ask the patient how did the external shape of the nose has been changed since the fracture. This helps to plan what type of reduction the patient needs to restore the appearance of the Nose.

Because of the nasal prominent location and its functional and cosmetic importance, management of the nasal fracture presents a challenge to the surgeon aiming to restore both the anatomy and physiology back to the normal **[5]**.

The management of nasal fractures has been considered inadequate because of the poor understanding of the pathology of nasal fractures and that there is no adequate clinical or radiological classification of nasal fractures for management, as most classifications were pathological classifications **[6]**. Thus, there is an increasing need for radiological classification of nasal bone fractures using CT-scan that can be applied to clinical practice **[7]**. Nasal fractures can be classified into upper, middle, and lower level fractures.

Naso-septal injuries have been traditionally managed via closed reduction. But due to the high incidence of post-closed reduction deformities, that can reach up to 50% of nasal deformity **[8]**. Surgeons started to consider another alternative approaches to obtain better results **[9]**. In this study, it aimed to compare the simple closed reduction versus open reduction and internal fixation for

naso-septal fractures in regards to efficacy of reduction in the form of residual deformity and need of a secondary procedure (anatomical outcome), functional results (physiological outcome), cosmetic appearance (aesthetic outcome).

## PATIENTS AND METHODS

A prospective study was done on 100 patients with nasal fractures who received either closed treatment (50 patients) or open treatment (50 patients) between December 2013 and September 2017 in Cairo University Hospitals (Kasr Al-Aini) and other private clinics. Males represented 86% of patients with age range between 16-59 years, while females were 16% with age range between 19-53 years. Direct trauma assaults were 54% of causes, 35% due to motor car accidents, 7% falls, and 4% work-related accidents (Fig. 1).

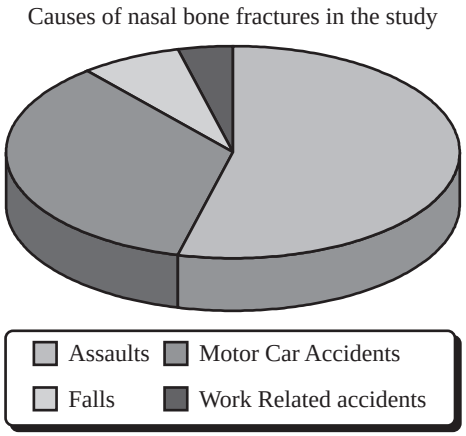



Fig. (1): Showing causes of nasal bone fractures in this study.

In the acute phase, treatment started with evaluating the injury, taking an accurate history and mode of trauma and assessment of the pre-injury appearance (ID card can be of help) and function before the injury. Full examination of the nose and other parts of the midface, the mandible and cervical spines should be done precisely. Imaging studies are necessary by plain-X-ray and the more important by CT-scan.

In our opinion, plain X-ray does not identify any cartilage disruption and not so helpful in describing details about the fracture disruption and displacement and hence not helpful in management. The obtained CT-scan axial view was then used as a reference for classification. The length from the cephalic end to the caudal end of the nasal bone was divided into upper, middle, and lower levels then the fracture location is identified, if the fracture exceeded more than one level, it was classified as the total level. Subsequently, the fracture was subclassified based on the fracture direction and pattern and the concurrent fracture.

Patients with cerebrospinal fluid rhinorrhea, malocclusion, or extra-occular movement defects were excluded and referred to other specialties if needed. Treatment in the primary care setting consists of evaluation, control of bleeding (epistaxis), pain control, tetanus, and antibiotic prophylaxis, in open wounds, copious irrigation and minimal judicial debridement if needed as soft tissue will be needed to cover the exposed bone and cartilage and pre-operative photos were taken. Consent for surgery was taken from all patients.

In regards the radiologic classification of our patients, nasal bone fracture was frequently found at the total (42%), middle (24%), upper (21%), and lower (13%) levels, in that order (Fig. 2).

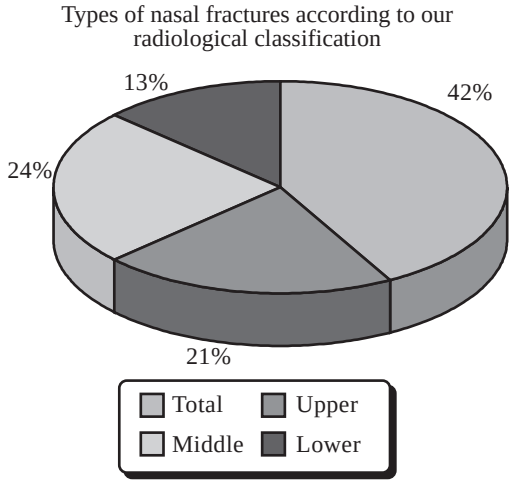



Fig. (2): Types of Nasal Fractures according to our radiological classification.

We classified the nasal fractures into; favorable and unfavorable. Unfavorable fractures include; dorsal nasal fracture, complex lateral fractures (more than one direction of displacement, more than 3 pieces). Favorable fractures include; simple lateral fractures (one direction of displacement, fracture 3 pieces or less).

*Closed reduction was done in these cases:* Simple fracture of the nasal bones or nasal-septal complex, nasal obstruction or airway compromise from deviated nasal bones, Fracture of the nasal-septal complex with nasal deviation less than one half the width of the nasal bridge, and reduction less than 3 hours after injury (if minimal edema is present). That was done in mild unilateral fractures, if not; close follow-up with head elevation, management of edema with ice-packs and alpha-chymotrypsin injection was arranged for about 3-4 days after the injury.

Open reduction was performed in the 1st week after the injury before the nasal bones start to fix. Open reduction was done in cases with; Severely comminuted nasal bones and septum, nasal pyramid deviation that exceeds more than one half the width of the nasal bridge, caudal septum fracture dislocation, open septal fractures, and fractures presented more than three weeks after the injury occurred.

Our target for treatment was to return to the pre-fracture state and restore the normal function. The decision regarding the surgical approach was based on the extent of injury, patient compliance, and the presence and degree of septal injury. The use of a closed or open approach depended on the extent of the injury and whether the fracture was favorable or unfavorable.

In case of closed reduction, it was done by several methods, including: Manual realignment or by the use of the Asch and/or the Walsham forceps to reduce the displaced septum and disimpact the fractured nasal bones. These instruments often were used inter-changeably.

In open reduction, the access-in was through laceration or 1cm dorsal transverse incision was performed for the narrowest cranial area at the root of the nose. Sub-periosteal exposure of bone was performed, then identification of the fractured bone fragments that was reduced and fixed using 1.2 micro-plates and 4mm screws. The first screw was fixed to the caudal fragment then the plate was pulled cranially for reduction. The second screw was placed to the cranial stable bone followed by another cranially placed screw. All the fragments that could bear 1-2 screws were fixed. The main target was nasal dorsal projection restoration. Lateral fractures were then reduced and fixed in the same manner. Multiple straight 3 or 4 hole-plates were used and x-plates were used also as per the fracture morphology. Care should be taken to keep the caudal attachment to the upper alar cartilage of the caudal fragments (not to get a bony-cartilaginous disjunction resulting in inverted "V" deformity. The small pieces of bone that was not possible to be fixed were placed in place supported by the fixed fragments. Closure of the incision was performed using absorbable 4/0 sutures, periosteum then muscle, then deep dermal sutures and lastly skin with 5/0 sutures.

Aluminum splint for protection and limitation of edema plus internal pack with anti–staphylococcal chemotherapeutic ointment (fucithalmic acid intertulle for 48 hours) then fucithalmic acid ointment was used postoperatively to provide support for 7-10 days.

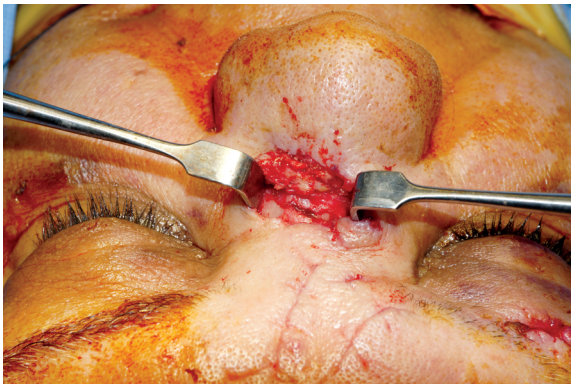
Evaluation was done based upon efficacy of reduction in the form of residual deformity and need of a secondary procedure (anatomical outcome), functional results (physiological outcome), cosmetic appearance (aesthetic outcome) and patient satisfaction rate. Postoperative CT-scan was done to evaluate the outcome radiologically. Preoperative and postoperative photographs were taken and evaluated, and patients were interviewed about aesthetic, functional results, and quality of life issues related to surgical treatment.

*Data recorded included:* age, sex, mechanism of injury, time to repair, need for revision, intraoperative details, and duration of follow-up (ranged from 6 months to 2 years. Need for revision was defined as the need of performing a revision surgery or as scheduled for revision surgery in the future.

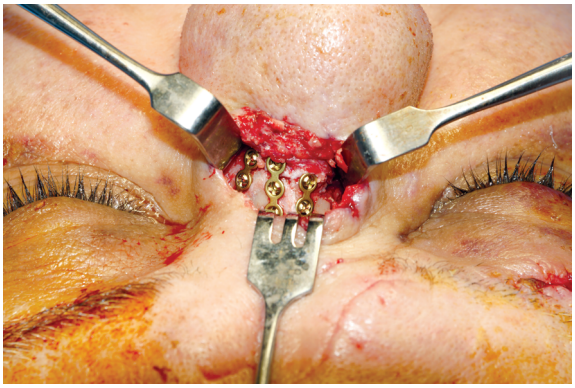
The need for surgical revision was noted in 20 cases, 14 patients who were treated by closed reduction and 6 patients who were treated by ORIF, reasons for revision were for cosmetic reasons in 10 patients (8 from closed reduction group and 2 from open reduction group), for inadequate breathing in 6 patients (4 from closed reduction group and 2 from open reduction group), or as a combination of both in 4 patients (2 from closed reduction group and 2 from open reduction group). The time to revision surgery ranged from 9 to 17 months. Follow-up after revision surgery ranged from 1month to 1 year.

When reviewing the overall post-reduction complication rate in relation to the radiological classification; the nasal bone fractures at the upper level showed lower frequencies of complication and re-operation (1 out of 21 cases), whereas nasal bone fractures at the total level showed the highest frequencies of complication and reoperation (13 out of 42 cases).

As per the patient questionnaire, the overall satisfaction among the group who performed open reduction was better than the group who performed the closed reduction as the overall satisfaction in closed reduction group was 72% while it was 90% in the open reduction group in review to both aesthetic and functional aspects although there was some concerns in the patients where a small 1cm incision was done about the scarring especially in darker skin types.



(A)



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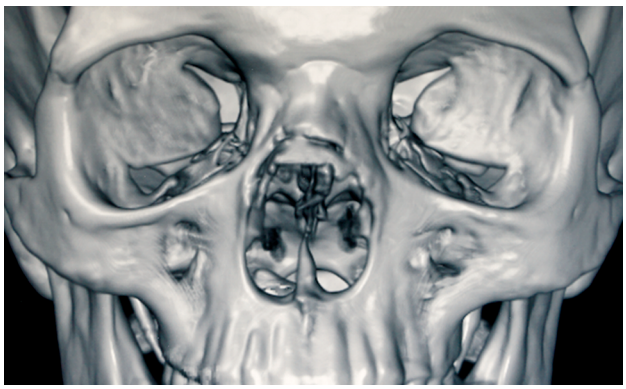

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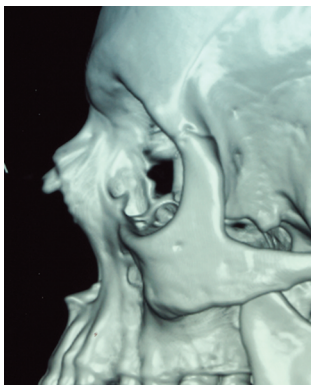

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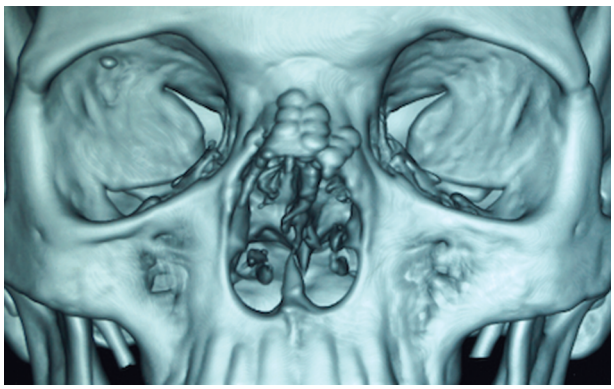

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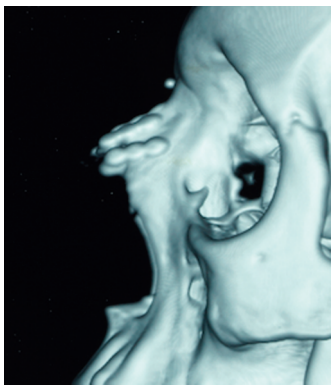
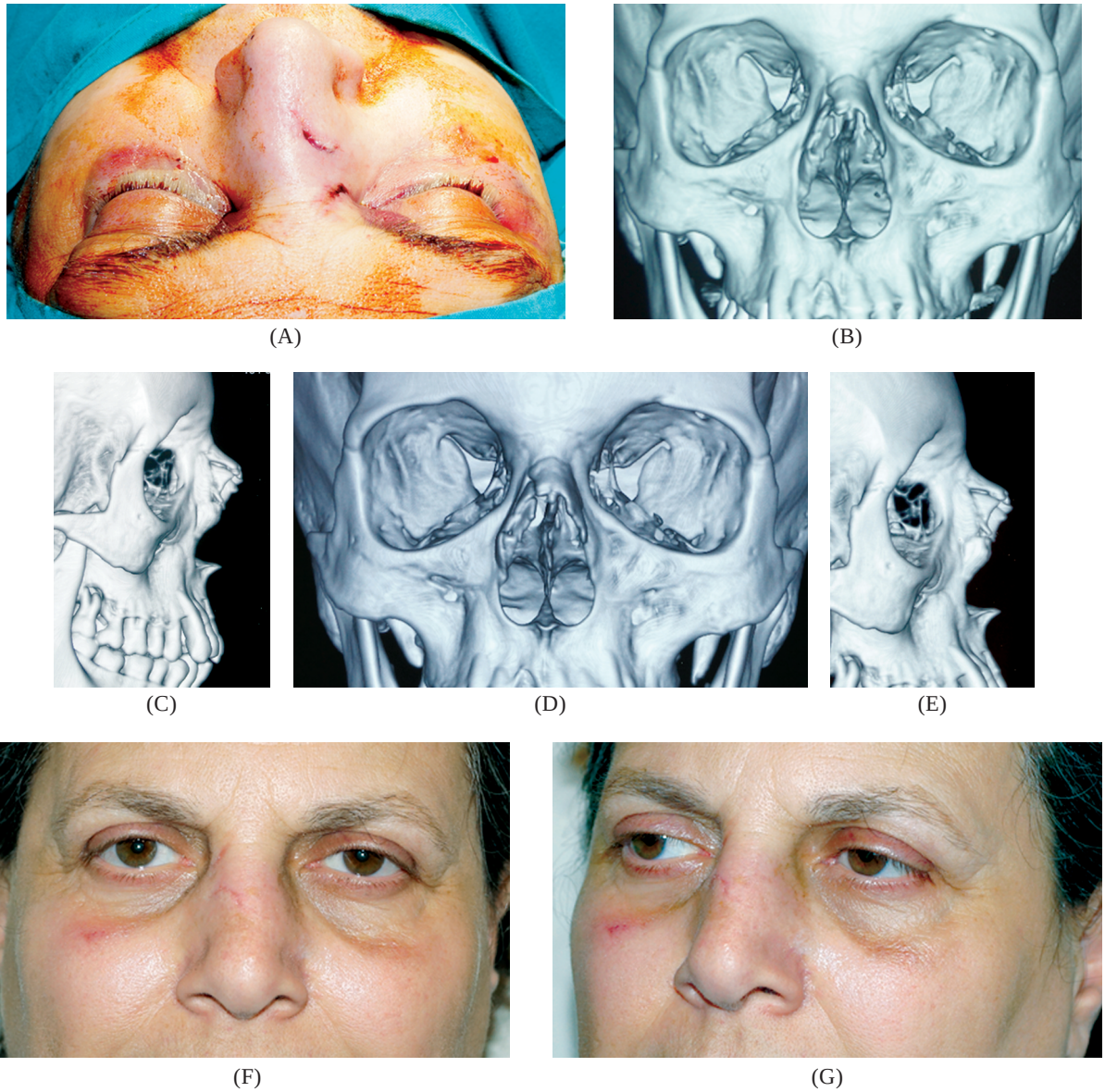


(F)

(G)

(H)

Fig. (3): A 53 years old female patient who presented in a RTA with an open middle nasal fracture. (A&B) showing intra-operative exposure to the fracture and after fixation, (C&D) showing pre-operative 3D CT Scan of the Fracture, (E&F) showing post-operative 3D CT Scan after fixation with 1.2 microplates, (G&H) showing the same patient three months post-operatively, anterior and oblique views.



(A) (B)

(C) (D) (E)

(F) (G)

Fig. (4): A 40 years old male patient who presented a direct blow causing Rt. Nasal bone fracture. (A) shows the pre-operative deformity after the blow with deviation to the left, (B&C) showing pre-operative 3D CT Scan of the Fracture, (D&E) showing post-operative 3D CT Scan with non-anatomical thus acceptable result, (F&G) showing the same patient three weeks post-operatively, anterior and oblique views.

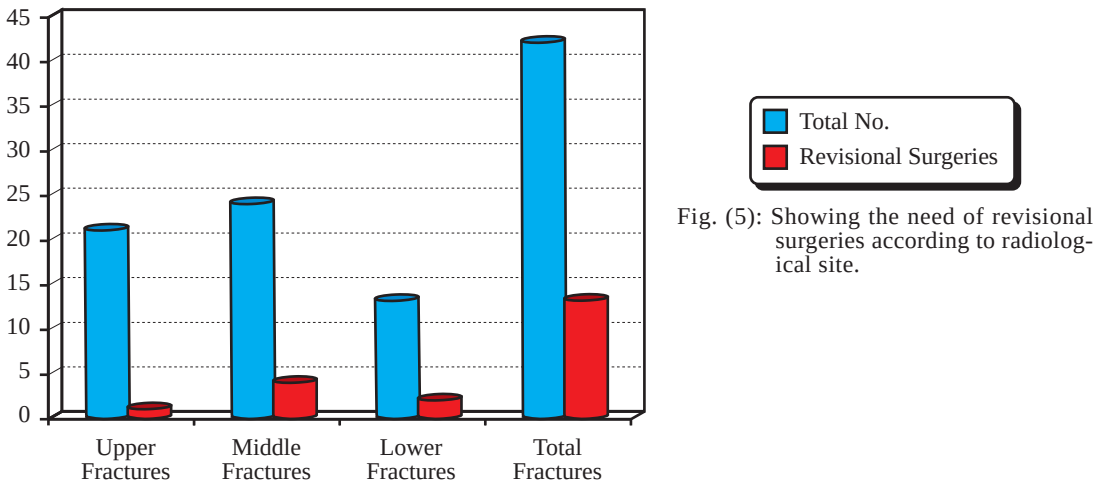



Fig. (5): Showing the need of revisional surgeries according to radiological site.

Table (1): Showing the total number of revisional surgeries needed in both groups.

| | Total No. of cases | Total number of Revisions | Revision for aesthetic reasons | Revision for Functional reasons | Revision for both reasons |
|---|---|---|---|---|---|
| *Group A:* Closed reduction | 50 | 14 | 8 | 4 | 2 |
| *Group B:* Open reduction | 50 | 6 | 2 | 2 | 2 |

## DISCUSSION

Nasal fractures are the commonest facial fractures accounting for more than 50% of all facial fractures in adults **[9]**. The most common mechanisms of injury are blunt traumas due direct assaults, motor car accidents, sports-related injuries. The natural projection and the fragility of the structures in the nose contribute to its susceptibility to injury. The bony and cartilaginous frameworks of the nose provide both cosmetic and functional support for the midface and airway; therefore, without comprehensive knowledge and proper judgment and management nasal deformity and nasal airway dysfunctions are certain.

Classical approaches have many drawbacks even with skilled surgeons firstly due to edema which can disguise most nasal fractures at the first few days. Secondly there is a high rate of revisional surgeries after closed treatment as adequate repositioning of the nasal structures is difficult to be achieved. Revisional surgeries in post-traumatic nasal deformities had been reported can reach about 50% of cases **[10]**. There is a common agreement that secondary collapse is due the failure of the severely comminuted nasal bones and the disrupted septum to provide adequate structural support against the contractile forces of scarring.

The decision of whether to manage nasal fracture immediately or delayed can be tricky and proper selection of patients and wise assessment are required. Patients with severe septal or bony shift presenting with nasal airway obstruction almost always require acute treatment with open reduction and proper management of the septum under vision. In patients where a primary reduction is inappropriate or unavailable, a delayed reduction after the edema subsides **[11]**.

Clinical evaluation by both detailed history taking and precise physical examination are the keys to diagnose nasal fracture. Physical examination should include both intra-nasal and extra-nasal evaluation. External exam should include nasal defects, malposition, and other apparent soft tissue injuries. Palpation of the nose is very important, the presence of crepitus, tenderness, depression, step-offs, nasal shortening, or widening of the nasal base can indicate that there is a nasal fracture. Intercanthal measurements are useful to detect any associated nasoorbital ethmoid fractures **[12]**.

Although diagnosing nasal fractures is mainly clinical, radiological studies can be of benefit as a computed tomography (CT) scan is indicated when to rule out intracranial injuries and other associated periorbital fractures and showing septal deviation, especially of the posterior ethmoid **[13]**.

Closed reduction is usually reserved for simple, non-comminuted nasal fractures, although exceptions can be made. The key principal is to apply a force opposite to the vector of trauma to achieve fracture reduction. After anesthesia, attention should be paid to the bony nasal pyramid. An elevator or forceps can be inserted to aid in manual repositioning of bones. The nasal septum should have a separate attention as nasal bone deformities will typically recur if a septal injury is missed. Closed reduction can be an effective tool in the appropriately selected patient **[14]**.

Comminuted fractures with severe loss of nasal support, severe septal injuries, and injuries with considerable soft tissue damage should be addressed with full exposure as the advantages of open reduction are many. The greater exposure allows for direct visualization and precise re-approximation of dislocated structures, especially in cases of nasal tip distortion. Also, the traditional incision in the membranous septum allows for drastically improved caudal, inferior, and posterior septal visualization. Surgery should occur early enough that secondary healing and remodeling has not drastically distorted the pre-injury form. However, it is critical that edema be allowed to subside prior to any procedure, usually after 5 to 7 days if proper post-injury care is used.

In our study, we compared the closed reduction for nasal fractures with the open reduction. The aim and target of reduction of a fractured nasal

bone is to realign the cartilaginous and the bony structures to their previous anatomical locations prior to trauma; aim to decrease pain, discomfort and functionally providing adequate airway. The cosmetic results after closed reduction are often less optimal than in case of open reduction. Even the patients should be counseled that a later revision surgery may be necessary after closed reduction **[15]**.

Similar to Stafell, 2002 **[16]** in our study, in case of open reduction; it identified the septum as a key factor in nasal fracture repair. We also concluded its equal important role of the degree of nasal trauma. Patients requiring septoplasty have experienced a more severe nasal fracture. The study also showed that the patients requiring septoplasty who did not undergo a concomitant open approach to the nasal pyramid have a higher revision rate.

This study supports the use of open reduction in the treatment of nasal fractures. In our series, there is superior results obtained with the open reduction especially the dorsal depressed un-stable fractures; both functional and cosmetic.

There were clear selection criteria in the study that included generally fit young adults and adult patients with isolated nasal fracture. Closed reduction mostly was performed for cases that are not considered severe and open reduction for more complex fractures. That may be seen as a bias especially in a study that assesses the outcomes from different surgical techniques. This may result that the patients who underwent a closed reduction are having an advantage for more successful repair; In-spite of that, this was true in our study.

But still, there is the possibility of bias from patients who may not have returned for follow-up. This may to be higher in one particular group than in another; therefore, that may affect the result.

*Conclusion:*

It has been mentioned in the literature that repair of nasal fractures have a lower postoperative expectations than among patients undergoing a cosmetic rhinoplasty. Therefore, traditional practices had induced approaches that allow a minimal intervention and produce acceptable functional and aesthetic results, unfortunately, that had led to the recorded high rates of revision needed. In our review of 100 patients with acute nasal fractures, using the open approach to the nasal fractures resulted to an accepted functional, aesthetic result with an overall lower revision rate. Open reduction showed a better stability, especially in dorsal depressed fractures and lateral unstable fractures after reduction (unfavorable reductions).

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