

The Treatment of Nasal Fractures

A Changing Paradigm

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Objectives: To compare the efficacy of closed vs open treatment of nasal fractures, and to suggest an algorithm for nasal fracture management that includes closed and open techniques.

Methods: Retrospective study of 86 patients with nasal fractures who received either closed treatment (41 patients) or open treatment (45 patients) between January 1, 1997, and December 30, 2007. Fractures were classified as 1 of 5 types. Revision rates were calculated for each group. Preoperative and postoperative photographs were rated, if available, and patients were interviewed about aesthetic, functional, and quality of life issues related to surgical treatment.

Results: The revision rate for all fractures was 6%. The revision rate for closed vs open treatment was 2% vs 9%,

respectively. Many closed treatment cases were classified as type II fractures, whereas most open treatment cases were classified as type IV fractures. There was no statistical difference in revision rate, patient satisfaction, or surgeon photographic evaluation scores between the closed and open treatment groups when fractures were treated in the recommended fashion.

Conclusions: Patients who undergo open or closed treatment have similar outcomes if the surgical approach is well matched to the individual fracture. Our treatment algorithm provided consistent aesthetic and functional results while minimizing the need for revision procedures.

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NASAL FRACTURES ARE EXTREMELY common. However, the treatment of traumatic nasal fractures remains a controversial subject among surgeons. Recommended management varies widely from no intervention at all to extensive open procedures involving rhinoplasty techniques. Traditionally, the treatment of nasal fractures is divided into closed reduction (CR) and open reduction (OR). Closed reduction is a relatively simple procedure, at times producing acceptable outcomes. However, advocates of OR purport better cosmetic results and a high likelihood that CRs will eventually need a second operation using an OR technique.¹

Deciding which technique to use for a given nasal fracture can be challenging. Not all fractures can be treated using closed techniques and, conversely, not all fractures require the time and expense of an OR. Similar to other facial trauma, the efficacious management of nasal fractures should take into account the specific characteristics of the fracture. As such, there are several nasal fracture classification systems. A classification method should pro-

vide the surgeon with guidance about which repair technique to choose for the initial repair.

This study sought to measure and compare multiple outcomes of open and closed nasal reductions, including rates of revision, patient satisfaction (aesthetic and functional), and surgeon assessment of outcomes. We introduce a nasal fracture treatment approach based on a logical classification of nasal fractures.

METHODS

This retrospective study examined all patients with traumatic nasal injuries seen between January 1, 1997, and December 30, 2007, at Penn State Hershey Medical Center. A total of 164 adult and pediatric patients with a history of nasal trauma repair were identified on the basis of Current Procedure Terminology codes. Patients with prior nasal fractures (n=6), naso-orbital ethmoid fractures (n=7), gunshot wounds (n=1), or insufficient medical records (n=54) were excluded. Ten patients declined to be included in the study. Of the remaining 86 patients, 41 were treated with CR, and 45 underwent OR (**Table 1**). Closed reduction was defined as traditional closed management without incisions. Open reduction in-

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Table 1. Patient Demographic Characteristics

Characteristic	Closed Reduction (n = 41)	Open Reduction (n = 45)
Sex, No. of patients		
Male	31	26
Female	10	19
Age at repair, y		
Mean	27	24
Median	21	18
Range	6-70	11-58

involved the use of at least 1 of the following procedures: open septal repair, osteotomies, intranasal or external nasal incisions, or cartilage grafting. Both CRs and ORs were performed by faculty and residents in the Division of Otolaryngology–Head and Neck Surgery.

FRACTURE CLASSIFICATION

Preoperative and postoperative patient photographs, radiological and operative reports, and clinic notes were used to classify all patients as having 1 of 5 fracture types based on the authors' criteria, which took into account symmetry, status of the septum, and overall severity of the injury (**Table 2** and **Figure 1**).

REVISION RATE

Operative procedures performed after a patient's initial fracture repair were considered revision procedures. Revision procedures included the use of any closed or open surgical technique. The revision rate was calculated as the number of revision procedures divided by the total number of initial fracture repairs. Rates were calculated for the closed and open treatment groups and by fracture type.

PATIENT SATISFACTION

Researchers attempted to contact all 164 patients. Many patients had wrong or disconnected telephone numbers. Of those who could be contacted, 20 patients (12%) agreed to complete the satisfaction survey, and 10 (6%) declined to participate in the study. The mean, median, and range of time between repair and survey of all respondents were 5.8, 5.5, and 1 to 10 years (SD, 3.0 years), respectively. The satisfaction survey consisted of 3 parts with a total of 23 questions that asked about nasal aesthetics, severity of obstructive symptoms, and severity of changes in health status since the repair (**Table 3**). Survey questions were adapted from multiple sources, including Crowther and O'Donoghue's study of nasal fractures,² the Nasal Obstruction Symptom Evaluation³ (NOSE) scale, and selected questions from the Glasgow Benefit Inventory.⁴ Most questions were based on a 5-point Likert scale.

SURGEON PHOTOGRAPHIC EVALUATION

Preoperative and postoperative photographs were reviewed in a blinded fashion via an electronic visual survey. Three faculty members in the Division of Otolaryngology–Head and Neck Surgery (F.G.F. and 2 others) were asked to rate each patient's repair in terms of deviation, symmetry, irregularity, and overall improvement on a 5-point Likert scale (**Table 4**). The mean, median, and range of time between repair and when the postoperative photographs were taken were 125, 62, and 6 to 453 days (SD, 131.8 days), respectively.

Table 2. Classification of Nasal and Septal Fractures

Type	Description	Characteristics
I	Simple straight	Unilateral or bilateral displaced fracture without resulting midline deviation.
II	Simple deviated	Unilateral or bilateral displaced fracture with resulting midline deviation.
III	Comminution of nasal bones	Bilateral nasal bone comminution and crooked septum with preservation of midline septal support; septum does not interfere with bony reduction.
IV	Severely deviated nasal and septal fractures	Unilateral or bilateral nasal fractures with severe deviation or disruption of nasal midline, secondary to either severe septal fracture or septal dislocation. May be associated with comminution of the nasal bones and septum, which interfere with reduction of fractures.
V	Complex nasal and septal fractures	Severe injuries including lacerations and soft tissue trauma, acute saddling of nose, open compound injuries, and avulsion of tissue.

RESULTS

CR GROUP

Revision Rate

The CR group included 41 patients. Most fractures were type II (simple unilateral or bilateral deviation). One patient (type III) underwent revision after a closed procedure. The revision rate for the CR group was 2% (**Table 5**).

Patient Satisfaction

The components of the patient satisfaction survey are seen in Table 3. Overall, 100% of patients were satisfied and perceived the postoperative appearance of their nose to be similar to its appearance before the fracture. The overall severity in obstructive symptoms was reported at 0.4. On the Likert scale used for the NOSE survey, these values roughly equate to a severity level between "not a problem" and a "very mild problem." Changes in health status were assessed using selected questions from the Glasgow Benefit Inventory. The median score for all individual questions, as well as the overall assessment of change in health status, was 3.0 ("no change").

Surgeon Photographic Evaluation

A median score of 5.0, defined as "no asymmetry," was obtained for patients who underwent a CR. The median score for asymmetry was 5.0, or "none." The median score for the degree of irregularity for patients who underwent a CR procedure was 4 (between "moderate irregularity" and "no irregularity"). The median degree of overall improvement for the CR group was 75% (Table 4).

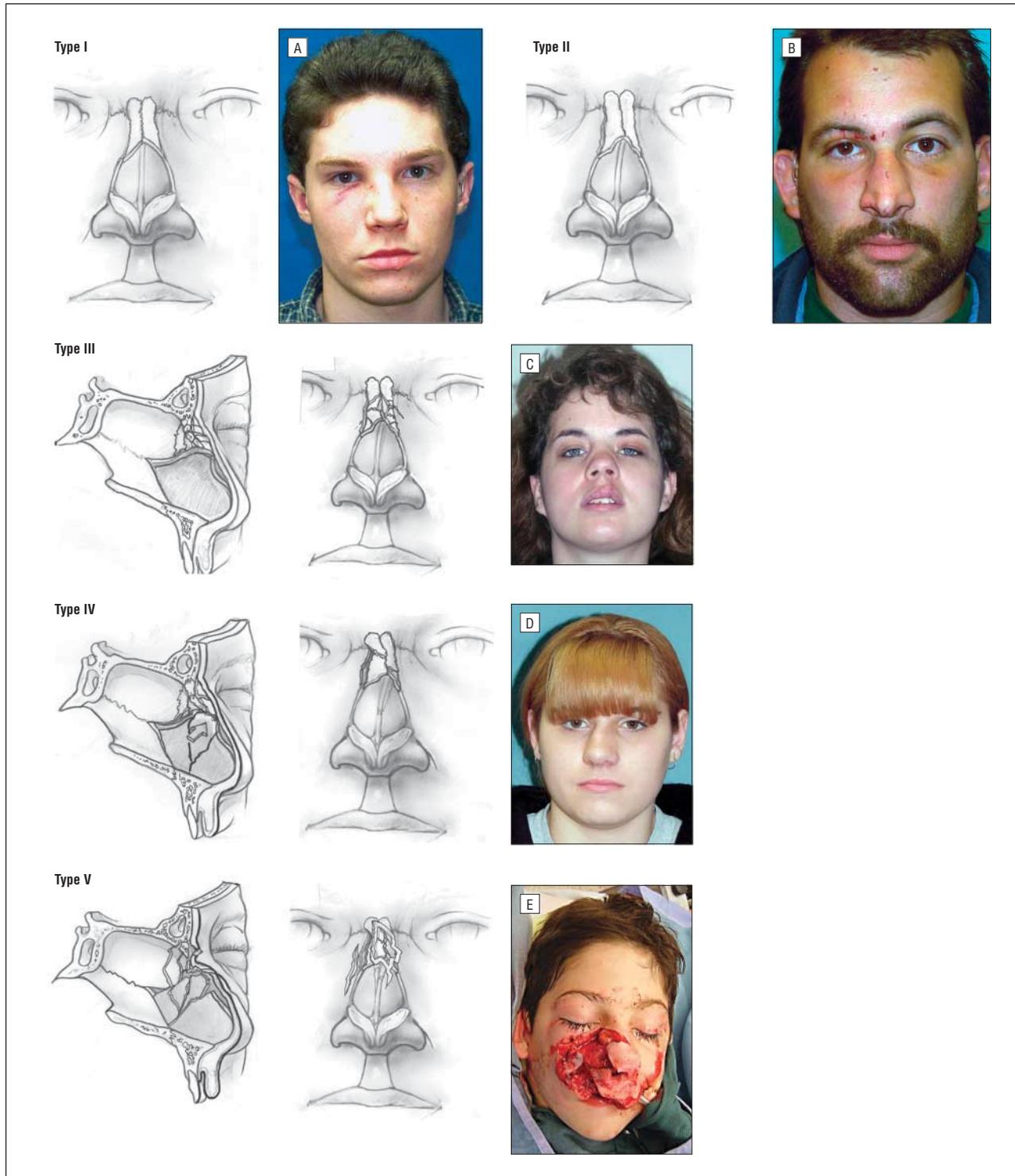


Figure 1. Schematics and patient photographs demonstrating nasal fracture types I (A), II (B), III (C), IV (D), and V (E).

OR GROUP

Revision Rate

A total of 45 patients met the inclusion criteria for the OR group. Most fractures were classified as type IV (severely deviated nasal and septal fractures). Altogether, 4 patients underwent revision procedures. Of these, 1 pa-

tient had a type II fracture and 3 had type IV fractures. One patient (type IV) required 2 revisions. The revision rate for all ORs was 9% (Table 5).

Patient Satisfaction

Eleven patients (84.6%) stated that they were satisfied with the appearance of their nose at the time the survey

Table 3. Patient Satisfaction Survey

	Closed Reduction (n = 7)	Open Reduction (n = 13)	All Patients (N = 20)	P Value
Aesthetic assessment, No. (%) answering yes ^a				
Is the appearance of your postoperative nose similar to your preinjury nose?	7 (100)	10 (77)	17 (85)	.25
Are you satisfied with the shape of your nose?	7 (100)	11 (85)	18 (90)	.41
If unhappy, would you consider reoperation?	NA	2 (16)	NA	NA
Severity of obstructive symptoms, ^b median score				
Nasal congestion	1	1	1	.82
Nasal blockage	0	1	0.5	.82
Trouble breathing	0	0	0	.24
Trouble sleeping	0	0	0	.18
Inability to move air through nose	0	0	0	.64
Overall severity	0.4	0.6	0.4	.48
Change in health status, ^c median score				
Affected the things you do	3	3	3	>.99
Change in the level of embarrassment in a group	3	3	3	.49
Change in self-confidence	3	3	3	.64
Change in amount of time needed to go to doctor	3	3	3	.64
Change in level of self-confidence about job opportunities	3	3	3	.82
Change in level of self-consciousness	3	3	3	.82
Change in amount of meds needed since procedure	3	3	3	.82
Overall change	3	3	3	.70

Abbreviation: NA, not applicable.

^aAdapted from Crowther and O'Donoghue.²

^bAdapted from Stewart et al.³ A score of 0 indicates not a problem; 1, a very mild problem; 2, a moderate problem; 3, a fairly bad problem; 4, a severe problem.

^cAdapted from the Glasgow Benefit Inventory.⁴ A score of 1 indicates worse; 3, no change; 5, better.

Table 4. Objective Evaluation by Surgeons

	Median Score			P Value
	Closed Reduction (n = 5)	Open Reduction (n = 13)	All Patients (N = 18)	
Degree of deviation ^a	5	5	5	.37
Degree of asymmetry ^a	5	4	4	.40
Degree of irregularity ^a	4	4	4	.54
Degree of overall improvement ^b (1%-0%, 3%-50%, 5%-100%)	4	3	4	.20

^aA score of 1 indicates gross, except for "irregularity" (which indicates major); 3, moderate; 5, none.

^bA score of 1 indicates 0%; 2, 25%; 3, 50%; 4, 75%; 5, 100%.

Table 5. Revision Rates by Fracture Type

Type	Closed Reduction		Open Reduction		P Value
	No. of Patients	No. of Revisions	No. of Patients	Revisions	
I	8	0	0	0	<.99
II	19	0	13	1	.41
III	7	1	5	0	.58
IV	5	0	22	3 ^a	.53
V	2	0	5	0	<.99
Total	41	1	45	4	.18

^aOne patient underwent 2 revision procedures.

was completed. Only 2 patients were not satisfied with their current appearance. Both of these patients stated they would consider a revision procedure. The overall severity in obstructive symptoms was 0.6 among those who underwent OR. On the Likert scale used for the NOSE

survey, these values roughly equate to a severity level between "not a problem" and a "very mild problem." Changes in health status were assessed using selected questions from the Glasgow Benefit Inventory. The median score for all individual questions, as well as the over-

all assessment of change in health status, was 3.0 ("no change") (Table 3).

Surgeon Photographic Evaluation

A median score of 5.0, or "no deviation from the midline," was obtained for degree of deviation. A median score of 4.0, defined as between "moderate asymmetry" and "no asymmetry," was calculated for patients who underwent OR. The median score for patients who underwent a CR procedure was 4.0 (between "moderate irregularity" and "no irregularity"). The median degree of overall improvement for the OR group was 50%.

CR VS OR

There was no statistical difference in revision rates between the CR and OR groups as a whole or by fracture type, using a Fisher exact test.

Patient satisfaction survey data were also analyzed using the Fisher exact method. Between the 2 groups, CR vs OR, no statistical difference was found regarding the components of aesthetic satisfaction ($P = .25$ and $.41$). A Wilcoxon rank-sum (Mann-Whitney) test of medians did not reveal a statistically significant difference between patient groups ($P = .48$) in terms of obstructive symptoms. Examining the individual questions of the NOSE also did not reveal any significant differences between the groups. Changes in health status were assessed using selected questions from the Glasgow Benefit Inventory. The median score for all individual questions, as well as the overall assessment of change in health status, was 3.0 ("no change"). A Wilcoxon rank-sum test of medians did not reveal a statistically significant difference between the 2 treatment groups.

Survey results from a panel of 3 otolaryngologists at our institution were pooled and analyzed using the Wilcoxon rank-sum test of medians (Table 5). Statistical analysis revealed no significant difference in the surgeon's assessment of nasal deviation ($P = .37$), asymmetry ($P = .40$), or irregularity ($P = .54$). There was no statistical difference between the 2 groups for overall improvement ($P = .20$).

COMMENT

CR TECHNIQUE

The treatment of nasal fractures has classically been divided into OR and CR. Closed reduction involves manipulation of the nasal bones without incisions and has been the time-honored method of fracture reduction for thousands of years. It generally produces acceptable cosmetic and functional results, but its detractors point out that 14% to 50% of patients have deformities after CR.¹

Of 41 patients in the CR group, most had type I or II fractures. This should come as no surprise because mild deviations can usually be conservatively managed with CR in the absence of moderate or severe septal deviation. Conversely, there were fewer type IV and V fractures in the CR

group. Type III fractures frequently exhibit comminution of the nasal bones and are relatively easily digitally reduced into an appropriate position with the placement of external and internal nasal splints. The low revision rate (2%) in the CR group is most likely a reflection of the fairly low severity of injury in these patients.

In terms of patient satisfaction, 100% of patients who underwent a CR were happy with their reduction and believed that their nose had been restored to its preinjury state. According to previous studies, patients were satisfied with the results of CR 62% to 91% of the time, with a mean satisfaction of 79%.⁵ Another study published by Ridder et al⁶ that same year reported a 94.8% patient satisfaction rate for CR. However, some patients in the study (3.7%) underwent concurrent septoplasty.⁶ Our satisfaction rate was slightly higher than this range (100%), which is probably a consequence of the small sample size.

Patients rated their obstructive symptoms as being less than a "very mild problem." Robinson reported that 68% of patients were satisfied with the function of their nose,⁷ whereas Illum et al found that 15% of patients complained of nasal obstruction initially.⁸ In a long-term follow-up study, this number had only increased to 16%.⁹ Fernandes¹ found that only 38% of patients had no obstructive or aesthetic complaints.

The median surgeon evaluation scores for deviation, asymmetry, and irregularity were 5, 5, and 4, respectively, indicating that CR produced acceptable results in our patients. The median improvement score was 75%.

OR TECHNIQUE

Open reduction techniques for nasal fractures were first described by Becker as early as 1948 and may include a range of techniques including septoplasty, osteotomies, and full septorhinoplasty. Open techniques may be more appropriate,¹⁰ especially in cases where the chance that the patient will require a revision procedure is high. Reilly and Davidson concluded in a study of 49 patients that nasal fracture revision rates could be lowered in patients with an associated septal deformity if an open approach to the nasal pyramid was used at the initial repair.¹¹

A total of 45 patients met the inclusion criteria for the OR group. Most fractures were classified as type IV. Whereas the overall revision rate was higher for the OR group (9%) vs the CR group (2%), this difference did not reach statistical significance.

Among surveyed patients who underwent OR, 85% were satisfied with their nasal repair, and 77% judged their nose to be similar to its preinjury state. Unfortunately, there is a relative lack of comparative data in the literature describing the patient's assessment of OR procedures. Surgeons evaluating patient photographs rated the degree of deviation, asymmetry, and irregularity as none or close to none. Overall, the median repair improvement was 50%.

CR VS OR

There was no statistical difference between the results of an open repair and closed repair in terms of revision rate, patient satisfaction scores, or surgeon evaluation scores.

Furthermore, our expert raters failed to find a difference in outcome based on the type of repair. Based on this data, it would seem that our patients did not perceive any difference in outcome, ie, patients were just as likely to be happy with the results of a closed repair as they were with open repair. These results contrast with those of many studies in which the surgeon's assessment shows a clear bias toward one technique or another.

MANAGEMENT APPROACH

Two of us (F.G.F. and M.P.O.) have found it helpful to categorize fractures as depicted in Table 2, which is a modification of the classification system proposed by Rohrich and Adams.¹² Based on the type of fracture, the treatment generally follows the algorithm developed in **Figure 2**. Generally speaking, types I to III nasal fractures were appropriately relegated to closed repair (or "modified open techniques"), and types IV and V often required open repair techniques. The comminution of the nasal bones in type III fractures may allow appropriate reduction of the nasal bones without the need for completion osteotomies.

A successful management algorithm should provide each patient with an aesthetically and functionally superior repair, leaving the most invasive repairs for only those patients who require it and allowing simple fractures to be managed relatively conservatively. Our results validate this approach and effectively "even out" the outcomes between the open and closed groups.

The idea of integrating multiple techniques into an approach is not new. Staffel provides a graduated protocol for the treatment of nasal fractures.⁵ He begins with CR and then progresses to completion osteotomies. If the patient's nose was deviated before the injury, he takes the additional step of releasing the upper lateral cartilages from the septum. If these maneuvers do not fully correct the deviation, the anterior extension of the perpendicular plate of the ethmoid is fractured. Recalcitrant deviation may then be approached with cartilage grafting.

A central concept of our management approach is the use of completion osteotomies in patients who exhibit greenstick or impacted, but displaced, fractures (Figure 2). In these instances, completion osteotomies are made through endonasal stab incisions (hence "modified open") to osteotomize the nasal bones and symmetrically complete the fractures, allowing full manipulation of the nasal bones. It is believed that, when this technique is used in patients with displaced type I, II, or III and some type IV fractures, the nose can be successfully reduced with a relatively minor procedure. This described procedure is only minimally more aggressive than a traditional closed technique, but significantly less aggressive than a formal open nasal-septal repair or septorhinoplasty.

Another important aspect of the algorithm involves an assessment of the status of the nasal septum. Several authors have commented on its pivotal role in dictating the proper operative technique. Reilly and Davison¹¹ analyzed 49 patients who underwent CR and OR to determine the revision rate. They observed that, in the cohort of patients who required septoplasty for deviation, the revision rate was lower for those who underwent a

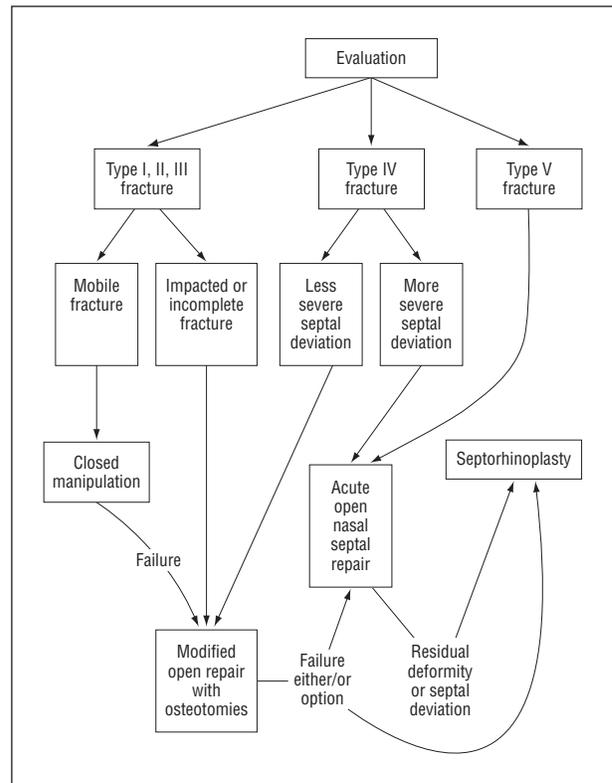


Figure 2. Algorithm for nasal fracture management based on type of fracture.

full OR. A 1984 study of 70 patients by Robinson⁷ bore out similar results, concluding that the presence of a septal fracture has a significant effect on the success of closed nasal reduction. Such septal assessment guides the surgeon in choosing the preferred approach to the operative management of patients with type IV and some type V fractures, as outlined previously.

STUDY LIMITATIONS

Our study is limited by a rather small sample size and is subject to several biases. Patient satisfaction is extremely subjective, and even "objective" evaluation relies heavily on the individual rater's ability to assess photographs and apply it to a predefined scale. Because of the retrospective nature of the study, the interviews and evaluations were not conducted at a fixed interval and are subject to recall bias.

CONCLUSIONS

The proper management of nasal fractures is a controversial subject. Ultimately, the treatment should provide the patient with consistent and acceptable results after the first procedure. We believe that our classification system and management algorithm represent a new paradigm in nasal fracture management.

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