Kerala Journal of ENT and Head & Neck Surgery | ORIGINAL RESEARCH | Volume 4 | Issue 1 Jan-Jun 2025

Clinical outcome of Closed Reduction of Displaced Nasal Bone Fracture- A Prospective Study

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Published on 27th June 2025

Doi: https://doi.org/10.52314/kjent.2025.v4i1.69

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ABSTRACT

Background: Closed reduction is a simple and efficient method in the treatment of displaced nasal bone fracture. There is a paucity of studies that assess the variations in outcome of closed reduction depending on the types of nasal bone fracture. Furthermore no study has been reported in medical literature till date that assesses the outcome of closed reduction using nasal parameters, that are routinely used in rhinoplasty. Hence the aim of our study is to evaluate the clinical outcome of closed reduction using nasal parameters and patient satisfaction scores.

Methodology: This prospective observational study was conducted among 75 patients with displaced nasal bone fracture from March 2021 to August 2022. Visual analogue scale score, Nasal obstruction symptom evaluation score and nasal parameters were used to assess the subjective and objective outcome of closed reduction.

Results: Nasal bone fractures were most common among men in 20-29 age group. Road traffic accident was the most common mode of injury and two-third of patients did not use any protective equipment. Simple fractures outnumbered other types and had the best outcomes. Aesthetic satisfaction was assessed subjectively using Visual analogue scale, with 94.67% patients having a satisfactory outcome. When the aesthetic outcome was assessed objectively using nasal parameters 90.6% patients had either an optimal or satisfactory outcome. Nasal obstruction was also relieved in majority of the patients after closed reduction.

Conclusions: Nasal bone fractures treated within the first 2 weeks had the best outcome. Higher the severity of the nasal bone fracture and more the delay in performing closed reduction, greater was the residual nasal deformity.

Keywords: Closed reduction, Nasal bone fracture, nasal bone, nasal trauma, NOSE Survey score.

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Cite this article as: Krishnakumar L, Yamuna R, Rajan D, Venugopal M. Clinical outcome of Closed Reduction of Displaced Nasal Bone Fracture- A Prospective Study. Kerala Journal of ENT and Head & Neck Surgery. 2025 Jul 17;4(1):25–32.

INTRODUCTION

Nose is the central and most prominent structure of the face that is vulnerable to facial trauma.[1,2,3] Nasal bone fracture is the most common skeletal injury in facial trauma accounting for almost half of the facial bone fractures.[4-7] Closed reduction of nasal bone fractures is an efficient first-line choice of treatment.[8,3,9-,11] Although nasal bone fractures are often discussed as minor injuries, the incidence of post-traumatic nasal deformity remains high, often due to neglected nasal trauma. While these injuries are not life-threatening, inadequate primary treatment can lead to persistent airway obstruction and nasal deformities that are subsequently more difficult to correct.[11,13] Increasing evidence shows that patients have persistent concerns about the aesthetic outcome and obstructive symptoms after closed reduction.[12] Some of the factors that contribute to suboptimal aesthetic and functional outcomes include timing of reduction, nasal oedema at presentation and undetected pre-existing nasal deformity. Septal fractures are usually unrecognized and untreated at the time of injury.[1,11] Accurate diagnosis and appropriate surgical intervention are imperative in the management of nasal bone fractures.

Although many studies have focused on the surgeon's assessment of the outcome of closed reduction for

nasal bone fractures, there are fewer studies on Patient Reported Outcome Measures (PROM) of the same using Nasal Obstruction Symptom Evaluation (NOSE) scale and the Visual Analogue Scale (VAS) and no studies based on nasal parameters. Hence the aim of this study is to evaluate the clinical outcome of closed reduction of displaced nasal bone fractures using patient satisfaction scores and nasal parameters.

MATERIALS AND METHODS

This is a prospective observational study conducted at a tertiary hospital among 75 patients with displaced nasal bone fracture. Patients with history of nasal trauma within 3 weeks of presentation were evaluated and closed reduction was performed at the earliest by different experienced ENT surgeons of the same institution under local or general anaesthesia. Patients who had previous history of nasal deformities, nasal obstruction or nasal surgeries and those who had concurrent fracture of other facial bones were excluded from the study. Data collection tool used was a semi-structured proforma and was collected after obtaining clearance from the Institutional Research Committee and Human Ethics Committee.

Clinical outcome of closed reduction was measured by subjective assessment using patient satisfaction scores- Visual Analogue Scale (VAS) and NOSE survey scores for aesthetic and functional outcomes respectively. Objective assessment of nasal deformity was done using nasal parameters from standardized digital photographs. Prior to reduction, patients were asked to subjectively assess their nasal appearance with respect to the same before the injury, using a Visual Analogue Scale. They were again asked to assess the nasal appearance at 2 weeks, 1-month and 3-month post-operatively. The scores ranged from 0 to 10,

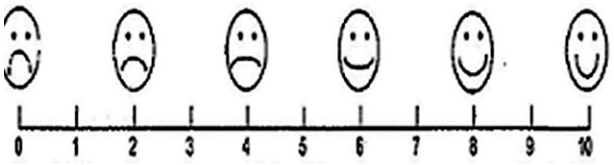

Figure 1. Visual Analogue Scale scores

where of 9-10 means happy, 5-8 means satisfied with the aesthetic outcome and a score of less than 5 means unsatisfied with the aesthetic outcome **(Figure 1).**

Standardized digital photograph of the patients' face were taken pre-operatively and post-operatively at 1-month and 3-months in frontal, lateral and basal views. Nasal parameters both linear and angular were measured using Digimizer software. Preoperative and postoperative nasal parameters thus obtained were used for objective assessment of correction of nasal deformity. The ten nasal parameters used were- nasal length, radix height, dorsal height, nasal tip projection, columellar show, nasal base, nasofrontal angle, nasolabial angle, nasofacial angle and nasomental angle **(Figure 2).** When only 4 or fewer of the nasal parameter measurements were in the normal range post-operatively, it was taken as an unsatisfactory outcome. When 5-9 nasal parameter measurements were in the normal range, it was taken as satisfactory outcome. When all 10 post-operative nasal parameters measured at 3-months were in the normal range, it was taken as an optimal outcome.

Patient's subjective nasal airway obstruction was assessed using NOSE survey (Nasal Obstruction Symptom Evaluation), measured at 2 weeks, 1-month and 3-month post-op. It is a validated survey that uses 5 questions graded on Likert scale from 0-4 which is multiplied by 5 to get a total score ranging from 0-100. Nasal obstruction severity was classified as mild (5-25), moderate (30-50), severe (55-75) and extreme (80-100)

Figure.2. Measurement of Nasal Parameters

a. Pre-operative and 3-month post-operative standardized photograph. b. Measurement of nasal parameters.

	Not a problem	Very mild problem	Moderate problem	Fairly bad problem	Severe problem
Nasal congestion or stuffiness	0	1	2	3	4
Nasal blockage or obstruction	0	1	2	3	4
Trouble breathing through my nose	0	1	2	3	4
Trouble sleeping	0	1	2	3	4
Unable to get enough air through my nose during exercise or exertion	0	1	2	3	4
NOSE SCORE (Total score X 5)					

Figure 3. NOSE Survey

(Figure 3). Clinical outcome was also assessed by comparing the patients based on timing of the procedure after nasal trauma. Patients were grouped according to the type of nasal bone fracture according to Rohrich and Adams classification- Type 1 Simple unilateral, Type 2 Simple Bilateral, Type 3 Comminuted, Type 4 Nasal bone fracture with associated septal fracture. Analysis of data was done 3 months after closed reduction. Paired t test was used as a test of statistical significance.

RESULTS

This study was conducted among 75 patients with displaced nasal bone fracture. Displaced nasal bone fractures were common among men (81.3%) in 20-29 age group (48%) with mean age of presentation at 27.23 ± 11.28 and male: female ratio of 4.36:1. The most common mode of injury was by road traffic accidents (45.3%) with drivers of two-wheelers being most commonly affected. Two-third of the patients with road traffic accidents did not use any protective equipment **(Figure 4 a,b).** One-third of the patients or their assailants were inebriated at the time of injury. The other causes of injury were by falls, assault, sports injury and other accidental injuries.

All patients presented with complaints of nasal deviation and bleeding. On examination, all patients had nasal deformity and reduced or absent fogging on cold spatula test. Majority had bony crepitus and bony tenderness while fewer patients had nasal septal deformity. Nasal bone fractures were categorized based on Rohrich and Adams classification using clinical

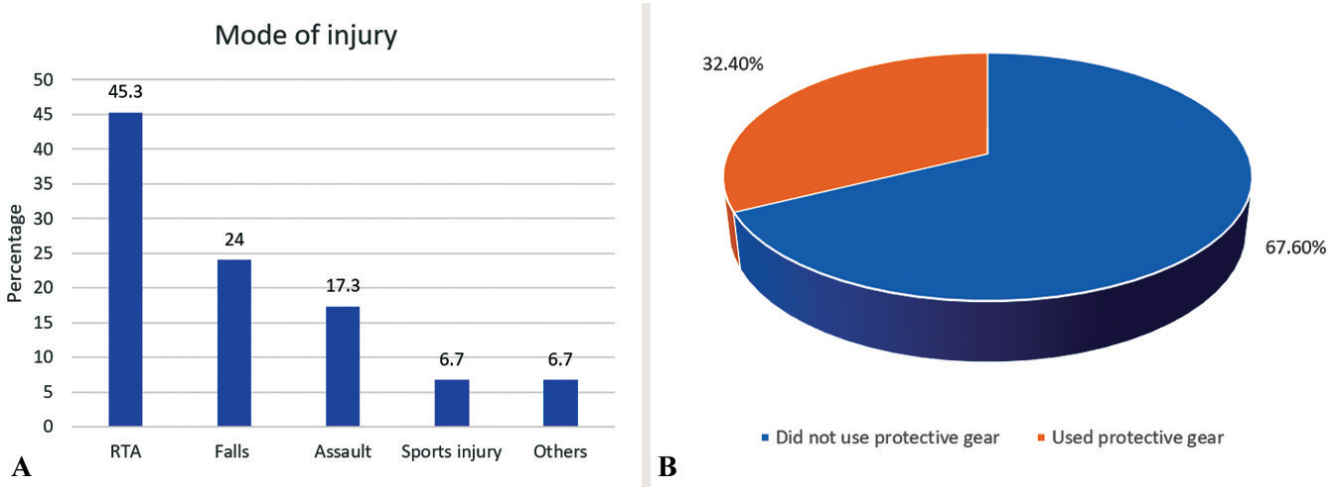

Figure 4. Mode of Injury

a. Percentage distribution of sample based on mode of injury; b. Percentage distribution of sample based on use of protective equipment.

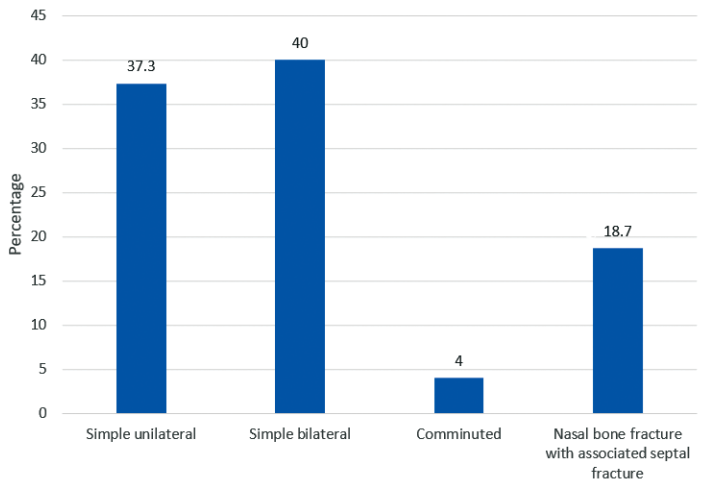

Figure 5. Percentage distribution of sample based on type of nasal bone fracture

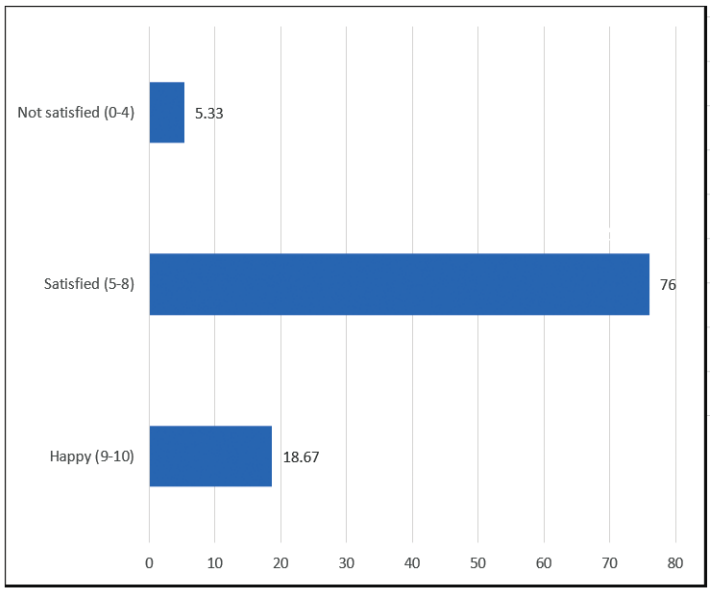

Figure 6. Percentage distribution of sample based on Visual analogue scale scores at 3-months post-op

Table 1. Distribution of sample based on mean Visual analogue scale scores

VAS	Mean ± SD	Multiple comparison	p
Pre-op	2.6 ± 1.1	Pre-op vs	<0.001
Post-op 1-month	7.4 ± 1.4	1-month post-op 1-month post-op vs 3-month post-op	0.002
Post-op 3-month	7.6 ± 1.4	Pre-op vs 3-month post-op	<0.001

examination, diagnostic nasal endoscopy, X-ray nasal bone, CT scan nose and paranasal sinus reports. **(Figure 5).** The average intervention time of the patients was 11.56 ± 3.41 days in our study. 40% patients had simple bilateral nasal bone fracture. 96% of patients underwent closed reduction of nasal bones under local anaesthesia, while only 4 patients underwent the same under general anaesthesia, out of which 2 were paediatric patients.

In this study, 18.67% patients were happy, 76% were satisfied with the cosmetic outcome at 3-months after closed reduction of nasal bone fracture. Only 5.33% were unsatisfied with the aesthetic outcome using VAS scores. It was observed that simple unilateral fractures had the best post-op VAS scores, whereas type 4 fractures had the worst results, even when reduction was performed within 2 weeks of injury **(Figure 6, Table 1,2)**. Higher the severity of the nasal bone fracture and more the delay in performing the closed reduction, greater was the residual nasal deformity.

Pre-operatively, 42.7% patients had moderate, 34.7% had severe, 20% had extreme and 2.6% had mild nasal obstruction according to NOSE survey score; whereas at 1-month post-op 52% had moderate nasal obstruction, 44% had mild obstruction and only 4% had severe nasal obstruction. At 3-month post-op there was a significant improvement with 56% patients only having mild nasal obstruction and 44% with moderate nasal obstruction according to NOSE survey score **(Figure 7).** The mean pre-operative NOSE survey score was 57.3 ± 16.5, at 1-month post-op was 30.5 ± 10.1 and at 3-month post-op was 27.3 ± 6.7. This shows a significant reduction in nasal obstruction in all patients post-operatively **(Table 3).**

73.3% of the patients had an optimal correction of nasal deformity objectively using digital photographs at 3-month post-operatively, while 17.3% patients had a satisfactory correction and 9.3% patients had an unsatisfactory result based on the nasal parameters measured. It is important to note that even though 9.3% patients had unsatisfactory outcome on objective assessment only 5.33% patients expressed their dissatisfaction based on VAS scores **(Figure 8).**

None of the patients with simple unilateral fractures or those who underwent reduction in the first week after injury had an unsatisfactory outcome. All patients who received reduction within 2 weeks of injury had an optimal or satisfactory outcome except those with type 4 nasal bone fracture.

Table 2. Distribution of sample based on mean VAS score, intervention time and type of nasal bone fracture (n= 75, VAS score range 0-10)

Type of nasal bone fracture	Intervention time								
	0-7 days			8-14 days			15-21 days		
	Mean VAS Score Values								
	Pre-op	1month post-op	3month post-op	Pre-op	1month post-op	3month post-op	Pre-op	1month post-op	3month post-op
I	3.7	8.3	8.3	2.8	8.2	8.2	0	0	0
II	3	7	7	2.8	7.5	7.5	0	4	4
III	0	0	0	0	8	8	0.5	5.5	5.5
IV	4	6	6	2.6	7.1	7.4	0.8	4.3	4.3

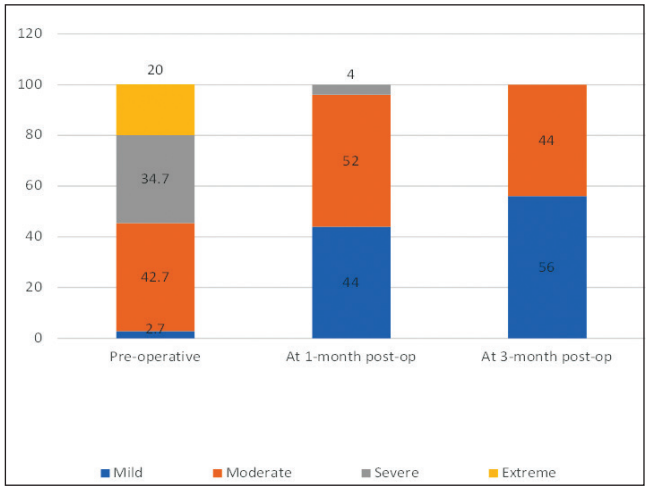

Figure 7. Percentage distribution of sample based on NOSE survey score.scores at 3-months post-op

Table 3. Distribution of sample based on mean NOSE survey score

NOSE Survey	Mean ± SD	Multiple comparison	p
Pre-op	57.3 ± 16.5	Pre-op vs 1-month post-op	<0.001
Post-op 1-month	30.5 ± 10.1	1-month post-op vs 3-month post-op	<0.001
Post-op3-month	27.3 ± 6.7	Pre-op vs 3-month post-op	<0.001

Out of the total 7 patients with unsatisfactory correction of nasal deformity, 5 patients had their reduction performed on or beyond 20 days after injury. The other 2 patients, even though their surgery was performed within 2 weeks of injury, had Type 4 fractures. 3 patients had comminuted fracture of whom, one had an optimal correction when performed in the second week, while beyond 2 weeks after injury optimal correction could not be achieved. Optimal correction of deformity could not be achieved irrespective of the fracture type, when the reduction was performed after 2 weeks **(Table 4, Figure 9,10).**

Hence both the timing of the surgery and the type of fracture have to be taken into account while planning closed reduction of nasal bone fracture. Higher the severity of the nasal bone fracture and more the delay in performing the closed reduction, greater will be the residual nasal deformity.

DISCUSSION

The nose is the most prominent feature of the face and nasal bone fractures are one of the most common fractures of the human skeleton.[1, 2, 29] A fracture of the nasal pyramid is the most common facial fracture, requiring less force than that for any other facial bone. Although nasal bone fractures are often discussed as minor injuries, the incidence of post-traumatic nasal deformity remains high (14 to 50 percent), often due to neglected nasal trauma. Inadequate primary treatment can lead to persistent airway obstruction and nasal deformities that are subsequently more difficult to correct.[11,13]

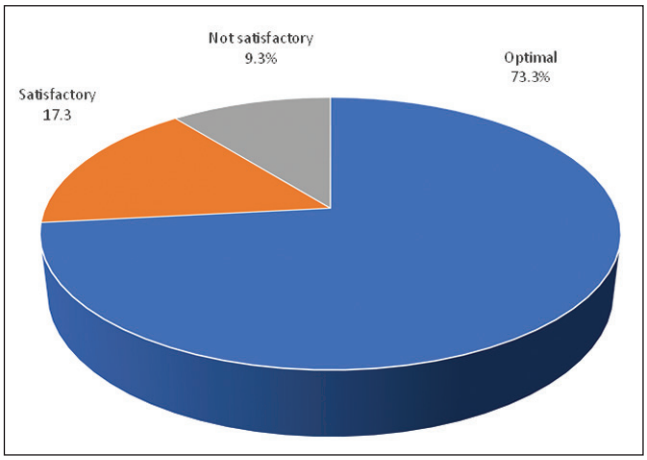

Figure 8. Distribution of sample based on post-op correction of nasal deformity

Table 4. Percentage Distribution of sample based on post-op correction of nasal deformity and intervention time.

	0-7 days	8-14 days	15-21 days
Optimal	4	69.3	0
Satisfactory	2.6	12	2.6
Unsatisfactory	0	2.6	6.6
Total		100 %	

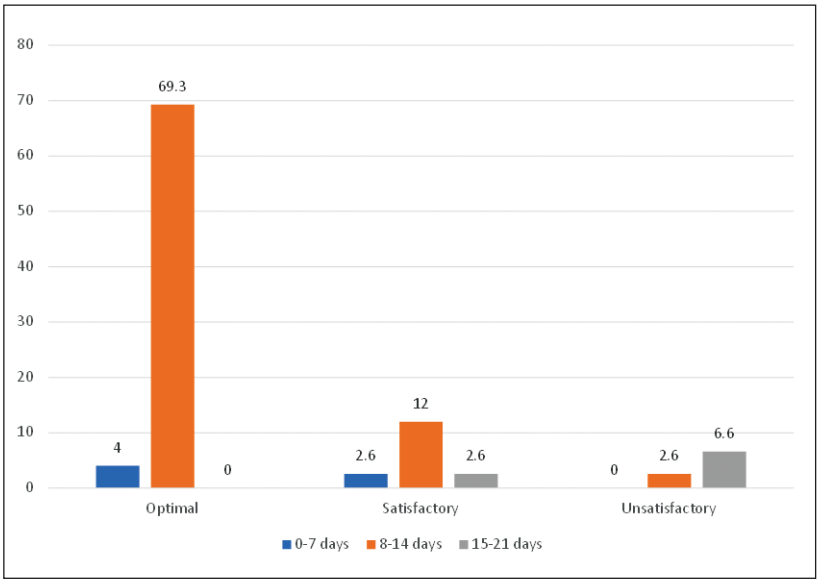

Figure 9. Distribution of sample based on correction of nasal deformity and timing of performing closed reduction.

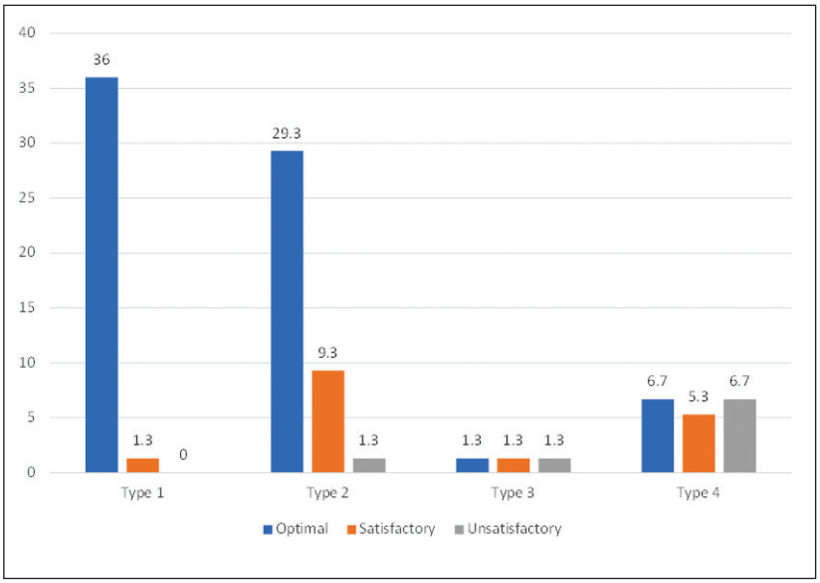

Figure 10. Distribution of sample representing the outcome of closed reduction based on correction of nasal deformity in each fracture type at 3-months post-op.

Some of the factors that contribute to suboptimal aesthetic and functional end results include timing, oedema and undetected pre-existing nasal deformity. Septal fractures are usually unrecognized and untreated at the time of injury.[1,11] Accurate diagnosis and appropriate surgical intervention are imperative in the management of nasal fractures. While these injuries are not life-threatening, mismanagement of nasal fractures can lead to both aesthetic and functional deformities. A thorough history and careful physical examination are adequate for the diagnosis of nasal fractures.[14]

Prior to deciding on a course of action, the surgeon must conduct a careful physical examination because the decision as to whether treatment is required, which technique to use (open vs closed reduction) and which type of anaesthesia is appropriate (local vs general) all depending on the clinical findings, such as the degree of deviation and airflow obstruction.[15]

A gold standard objective measure of nasal airway obstruction does not currently exist, so patient-reported measures are commonly used, particularly the Nasal Obstruction Symptom Evaluation (NOSE) scale and the visual analogue scale (VAS). In a systematic review Rhee JS et al have shown that normative and abnormal value ranges for NOSE and VAS can be established for clinical use. Given the consistency of both scales, they concluded that these measures can be used as a clinically meaningful measure of successful surgical outcomes.[1]

Out of the 43 patients included in the study by Yilmaz MS et al., 38 were male (88.3%), 5 (11.6%) were female, and the average age was 24.9, comparable to our study 81.3% male, 18.7% female, male: female ratio was 4.36: 1 and mean age of presentation at 27.23 (range 10-67). The average intervention time of the patients was 5.44 days, 3.4 ± 0.6 days in a study

by Vilela et al., compared to 11.56 ± 3.41 days in this study and 14.9 days in a study by Yi J S et al.[16, 17, 18]

In India, Yousuf et al. studied a total of 60 patients with nasal bone fracture including 48 men and 12 women.[13] Violence was the most frequent cause seen (48%), followed by traffic accidents (35%), 12% of cases were due to sports injury other causes about 5% (fall from their own height and work-related injury) whereas road traffic accident was the major cause of nasal bone fracture among patients followed by physical assault, fall injuries and sports injury in a study by Koirala K P and Sharma V, which was in coherence with our study in which road traffic accidents were the most common cause (45.3%) followed by falls (24%), assault (17.3%), sports injury (6.7%) and others (6.7%) including accidental injury to nose by self respectively.[13, 19]

In the study by Koirala et al., the most common symptoms at presentation were external nasal deformity, bleeding from nose, nasal obstruction, laceration and cut injury and pain in the nose which was in coherence with this study with almost all patients having external nasal deformity and epistaxis at presentation. 75% of patients had nasal obstruction during the time of presentation to hospital compared to 82.7% in our study. All of the patients had external nasal deformity (100%), 92% had bony crepitus, 84% had bony tenderness and 13.3% had nasal septal deformity. More than half of the patients (58.7%) had displaced bilateral nasal bone fracture on X-ray nasal bone lateral view (of which 40% of the sample had simple bilateral nasal bone fracture and 18.7% had nasal bone fracture with associated nasal septal fracture), while 37.3% had displaced unilateral nasal bone fracture and 4% had comminuted fracture.[19]

In our study, 94.67% patients were satisfied with cosmetic outcome (18.67% patients were happy, 76% were satisfied) and 5.33% patients were dissatisfied, compared to the study by Das et al. where 60% patients were happy, 35% were satisfied and 5% patients were unsatisfied.[20] In the study by Hung T et al. 29% participants expressed dissatisfaction with the aesthetic outcome of the reduction, compared to 33.3% in a study by Green K M et.al and 5.2% in a study by Ridder G J et al. compared to 5.33% in our study, all of whom had their reduction done beyond 2 weeks after injury and said they would consider further surgery to correct the residual nasal deformity.[15, 21,22] In the study by Koirala et al., patients who underwent closed reduction of nasal bones and septum within 2 weeks of initial injury (80%) were pleased with their results and had no post-operative nasal deformity, whereas 20% of patients developed a post-traumatic nasal deformity compared to 9.3% in this study and 6.2% in a study by Yi J S et al.[18, 19] Among the 7 patients with residual nasal deformity in our study, 5 patients had their closed reduction performed after 2 weeks. In a study by Hwang K et al., the overall deformity rate was 10.4% ± 4.8% comparable to this study.[23] Farber S J et al., had a low rate of post reduction deformity and a small percentage of need for revision surgery. The overall success rate of closed nasal reduction with postoperative manipulation was identified to be 94.5 percent, which was comparable to our study.[24] In a study by Yilmaz et al., 65% of 43 patients were satisfied with the result, whereas 35% patients were not happy with their operation.[16]

The mean aesthetic satisfaction score by visual analogue scale by Vilela et al., was 8.7 ± 0.2, compared to 7.6 ± 1.4 in this study.[17] The pre-operative mean Visual analogue scale in our study was 2.6 ± 1.1, at 1-month post op was 7.4 ± 1.4 and at 3- month post-op was 7.6 ± 1.4. In a comparison of patient satisfaction rates according to fracture type, the mild fracture group had a higher satisfaction rate compared to the severe fracture group which was in coherence with our study.[16] Optimal correction of deformity could not be achieved irrespective of the fracture type, when the reduction was performed after 2 weeks in coherence with the study by Fattahi et al.[25]

It is recommended for providers to explain to patients that approximately one-tenth of nasal bone fractures exhibit deformity, septal deviation, or nasal obstruction after surgery.[23] Patients with septal fractures should be counselled on the high risk of post-traumatic nasal deformity and obstruction despite closed reduction of nasal bone fracture.[26]

To summarize, closed reduction is an efficient treatment for nasal bone fractures.[3,8,9,27,28] The prudent selection of patients and specification of variable treatment options may be helpful in achieving a better treatment outcome. Early intervention increases the patient satisfaction rate.[16] Open reduction of nasal bone fractures should be offered to patients when a closed reduction is deemed insufficient to address all deformities and each patient

should receive an individually tailored procedure according to the extent of injury.[14,21]

END NOTE

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Acknowledgements: I acknowledge all faculty of Department of ENT for their guidance and support.

Conflict of Interest: No conflicts of interest for any author.

Funding: No funding received for the purpose of the study.

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