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Sub.: Acceptance of Manuscript for Publication in the KMJ

Re: Manuscript No. KMJ-103-014

Dear Dr. Ahmed,

I am glad to inform you that your manuscript titled "**Closed Reduction of Pediatric Nasal Bone Fractures**", has been accepted for publication in the Kuwait Medical Journal.

It will be published under the section '**Original Articles**' in one of the forthcoming issues of the KMJ.

We will send you a copy of the galley proof at the time of its publication, which has to be returned to us within two days with your final consent.

We thank you once again for your support to the KMJ and look forward to receive more contributions in future.

Sincerely yours,


Prof. Adel Khader Ayed
Editor



Closed Reduction of Pediatric Nasal Bone Fractures

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ABSTRACT (181 Words)

Objective: To review the closed reduction of pediatric nasal bone fractures, who presented at different times after trauma.

Design: Retrospective study and telephone questionnaire to assess the result of childhood nasal fracture outcome.

Setting: Department of Otorhinolaryngology, King AbdulAziz University Hospital (KAUH), King Saud University.

Subjects: Children came to KAUH Emergency Unit, with nasal bone fracture between 1 January 2009 – 1 December 2014.

Intervention(s): Closed reduction of nasal bone.

Main Outcome Measure(s): The overall satisfaction rate in terms of nasal function & cosmesis post surgery.

Results: Of the 57 pediatric patients/parents contacted and interviewed, 21 patients (37%) expressed complete satisfaction with the functional and aesthetic outcome; 19 patients (33%) were partially satisfied but would not consider revision surgery; and patients 17 (30%) were not satisfied and would consider revision surgery.

Conclusion: 30% of our patient are not satisfied with closed reduction procedure and are considering rhinoplasty. Such further surgical intervention has socio-economic impact on the family. Thus the general practitioner should be aware of this trauma and refer such patient professional such as facial plastic or maxillofacial consultants.

Key words: pediatric, nasal trauma, closed reduction, satisfaction

INTRODUCTION

Although maxillofacial injuries as a whole are relatively uncommon in children when compared with adults, an estimated one-third of all nasal fractures occur in the pediatric population^[1]. Among children, the nasal bones are the 2nd most common site of injury, representing between 41% and 60% of all pediatric facial fractures^[2]. The incidence of pediatric facial fractures increase by age. Pediatric facial fractures are much more common in males than females. It has been estimated that boys account for 63 to 76% of facial fractures^[2-4]. Common causes of nasal fractures in particular include motor vehicle accidents, sports, violence, falls, and other accidents. Intrauterine and birth trauma are infrequent causes of injury to the

external nose and/or septum requiring acute management, yet may be the occult origin of internal or external deviations presenting years later in a patient with no identifiable inciting traumatic event.

It is essential for a physician to have anatomy and embryology intelligence of the nose and midface in order to manage nasoseptal trauma. Many injuries to the nasoseptal framework, which may initially be missed or ignored by the patient, can result in a progressive deformity of the nose and midface, with both functional and aesthetic consequences. In children, the nasal framework is more cartilaginous than bony and has less frontal projection. In younger children, the nasal bones are separated in the midline by an open suture line, and laterally the nasal bones overlap the frontal processes of the maxilla^[5]. As the nose and midface grow, these structures take on the more familiar adult anatomy. The majority of nasal growth occurs in two distinct postnatal growth spurts, ages 2 to 5 years and again during puberty. Growth is usually completed by age 16 to 18 in girls and 18 to 20 in boys, although additional growth of the nasal septum may occur up to the age of 25 years^[6,7]. Between these two rapid growth phases, there is a period of moderate nasal growth^[7]. An understanding of growth periods has led many surgeons to delay rhinoplasty surgery until after the adolescent nasal growth phase.

The most common locations of injury to the nose are the nasal tip, dorsum, and nasal root region, and 32% of injuries involve the nasal skeleton^[8]. The long-term surgical outcome of a nasal bone fracture in a pediatric population is important because of the growing characteristics, whereby even a minor trauma could cause a major deformity as the patient becomes older^[9-10]. Pediatric nasal bone fractures should be reduced earlier than adult fractures, within 3–7 days^[1-11].

The purpose of this study is to review the age, gender, causes and the treatment outcome of pediatric nasal trauma cases treated in King Abdulaziz University hospital in over 6 years period.

MATERIALS AND METHODS

A review of Hospital Information System (HIS) system was used to pull out all the files of patients who were diagnosed with fracture of nasal bone in King AbdulAziz University Hospital, King Saud University from 1 January 2009 to 1 December 2014.

We found 57 cases who had closed reduction or splint application. All patients had a follow-up of 3 years except 2 children (aged 11 & 13) who had a follow-up of 6 months after surgery. All patients who presented 2 weeks post-trauma were excluded from the study. All these patients files were retrieved and all patients and parents were interviewed through telephone. The author was able to review 57 patients. The caller would introduce himself, explain the study and take verbal consent for their participation in the study. The caller asked a fixed format of (12) questions about the outcome and enter it in the datasheet. These datasheet would then be completed from information gathered from the file. All the data was statistically analyzed by Chi-square (X2 test) or Fisher's exact test and the significant level was set at $p=0.05$ or less, using SPSS version 16 Software, (SPSS Inc., Chicago IL).

RESULTS

57 children were enrolled in the study, with a mean age of 10.2 years (3-15 years). For the interview, response was from 51 mothers and 6 fathers; mean=28.6). 41 (72%) of them were male and 16 (28%) were female. 13 (23%) presented to the ER within 3 days of trauma, 15 (25%) within 7 days of trauma and 29 (51%) presented after 7 days of trauma. However this was not significant for satisfaction (Fisher's, $p=0.09$).

The most common complaint was nasal deformity in 51 (89%); and the next was nasal obstruction in 6 (10%). No statistical significant for the type of deformity and satisfaction (Fisher's, $p=0.8$). The causes of nasal bone fracture in our patient are described in Table 1.

On radiology (Table 2), the most common finding was a depressed fracture in 29 patients (51%); a greenstick fracture in 8 (14%) and communicated fracture in 8 (14%). Remaining children had no radiological fracture. 21 patients (37%) were

completely satisfied with their outcome, 19 (33%) were partially satisfied and were not looking to go ahead for any corrective procedures and 17 (30%) were totally unsatisfied and were planning to undergo rhinoplasty. Of the 6 patients whose primary complaint was nasal obstruction; 3 were totally satisfied and 3 were totally dissatisfied. Among the 51 patients whose primary complaint was nasal deformity; 23 were fully satisfied; 17 were partially satisfied but did not consider revision surgery and 11 were totally unsatisfied and considered revision surgery (Figure 1).

With regards to their time of initial presentation post trauma, most satisfied were children who presented 7 days after trauma 29 (51%) as compared to 15 (26%) who presented between 4-7 days after trauma 12 (21%) who presented 1-3 days after trauma. The least satisfied were those who presented 1-3 days after nasal trauma (Table 3).

DISCUSSION

Among children, the nasal bones are the most common site of injury, representing between 41% and 63% of all pediatric facial fractures ^[2-4]. The incidence of pediatric facial fractures increases with advancing patient age. In our study, the male groups were more involved in nasal trauma than females; by ratio of 2.5:1.

In very young children, nasal fractures are not common because of the underdeveloped nasal bones and the relative projection of the soft part of the nose with compliant cartilage, which easily bends during trauma^[2]. Low quality radiography and difficulty in taking computer Tomography (CT) scan at this age is also a contribution factor. In adolescence, a nasal bone fracture pattern more closely follows that of adults.

In 2007, Verwoerd and Verwoerd-Verhoef described in detail the developmental anatomy of the nose^[7]. They described two growth centers of the nasal septum, one that extends from the sphenoid to the nasal dorsum and is termed the sphenodorsal zone, and a second that extends from the sphenoid to the anterior nasal spine and is termed the sphenospinal zone. Vertical growth in the sphenodorsal zone results in increased length and height of the nasal dorsum, and sagittal growth in the sphenospinal zone contributes to anterior projection of the nose and maxilla. Injury to

either of these growth centers may lead to a loss of vertical height and sagittal projection of the nose and subsequently the midface, as the developmental organization provided by the nasal septum suffers.

Another proposed model for nasomaxillary growth is based on the septo-premaxillary ligament^[12]. In this model, the growth of the nasal septum is an important “starter mechanism” during fetal development for the initiation of downward and forward growth of the maxilla. The septopremaxillary ligament is described as a bundle of fibers arising from the anterior-inferior border of the nasal septum and coursing posteroinferiorly to insert on the nasal spine of the pre-maxillary bone.

In 1988, Precious et al described repercussions to nasofacial growth following traumatic injury to the nasal septum^[7,13]. Grymer et al in 1985 reported the long-term results of 57 adults who suffered nasal fractures as children and were treated by closed reduction at a single center and compared them to a control group^[14]. The group with nasal fractures had a significantly higher incidence of dorsal hump, saddling, bony pyramid and cartilaginous vault deviations, columellar dislocation, septal deviation, and septal spines. Despite 70% of the patients with nasal deformities were initially satisfied the deformities had developed gradually as the nose grew following injury.

According to Moran^[15], the most commonly seen pattern is the lateral fracture, in which an in-fracture is noted on the side of the traumatized nasal bone at the point where the ascending process of the maxilla and the nasal bone meet, and an out-fracture is seen in the opposite nasal bone, similar to our study where we had 29 (51%) as depressed in fracture (Table 2).

In an adult population, nasal bone fractures may be reduced 7–10 days after injury. Pediatric patients, however, have been known to need reduction sooner^[1-11], as osteogenesis is faster in children. Some authors^[13], have suggested reduction of the fracture within 3–5 days, whereas others^[14], have suggested that it should be within 10 days. We found that the most satisfied children were those whose reduction was done 7 or more days after trauma. Our finding is similar to that of D.H. Lee et al^[1]. Time to surgery is not a relevant factor in predicting long-term surgical outcome.

The general practitioner or ER physician, as the first person to see most of trauma nose cases, should not neglect nasal trauma and should refer them to professionals like facial plastic or maxillofacial surgeon for assessment. We recommend that once a nasoseptal fracture has been diagnosed and any emergent problems (e.g., epistaxis, hematoma) treated, the patient is instructed to follow up in 3 to 5 days to be reexamined. Once the edema has improved and the follow-up exam completed, the surgeon must consider: (a) whether a surgical intervention is indicated; & if indicated to plan it 7-14 days post trauma for best result. The ultimate goal of any intervention should be to restore the nasal airway, return the nose to its premorbid appearance, and preserve the integrity of the nasal growth centers for future development.

After fracture reduction, the nasal bones remain mobile for approximately two weeks and can be depressed by force for up to six weeks^[17]. Thus, it is recommended that children with nasal fractures refrain from all sports activities for two weeks and contact sports (e.g., football, wrestling..) for six weeks.

CONCLUSION

Facial trauma affects facial growth. 30% of our patients consider advanced surgical procedure in the future. A parents should be aware of the effect of facial trauma on the child, and it's socio-economic impact. Also General practitioners and trauma doctors should be aware of this and refer all nasal traumas professionals like facial plastic or maxillofacial consultants. Late intervention (7-14 days) has better outcome as compared to early intervention (1-7 days). Further studies designed to prospectively investigate long-term effects of surgical intervention are necessary to maximize successful outcome in the pediatric population.

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Table 1: Number of patients according to gender and type of trauma.

| Gender Type | Type | | | | Total |
|-------------|-----------|----------|-----|-------|-------|
| | Fall Down | Football | RTA | Fight | |
| Male | 19 | 14 | 2 | 6 | 41 |
| Female | 11 | 0 | 5 | 0 | 16 |
| Total | 30 | 14 | 7 | 6 | 57 |

Table 2: Radiological study showing type of fracture and number of patients.

| Type of Fracture | Frequency | Percent |
|-------------------------|-----------|---------|
| Depressed (In fracture) | 29 | 51% |
| Comminuted | 8 | 14% |
| Greenstick | 8 | 14% |
| No radiology done | 12 | 21% |
| Total | 57 | 100% |

Table 3: Long term satisfaction survey of pediatric patient with nasal bone fracture based on time of surgery.

| Variable | 1-3 days (n=12) 21% | 4-7 days (n=16) 28% | 7 days (n=29) 51% |
|--------------------|------------------------|------------------------|----------------------|
| Median age (range) | 9.3 (5-11) | 10.5 (4-14) | 9.5 (4-15) |
| NASAL DEFORMITY: | | | |
| Yes | 10 | 15 | 26 |
| No | 2 | 1 | 3 |
| Satisfaction | | | |
| Yes | 5 | 14 | 21 |
| No | 7 | 2 | 8 |
| NASAL OBSTRUCTION | | | |
| Yes | 2 | 1 | 3 |
| No | 10 | 15 | 26 |
| Satisfaction | | | |
| Yes | 1 | 0 | 2 |
| No | 2 | 1 | 1 |