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Original Research Article

Naso-orbito-ethmoidal and nasal bone fractures, associated with anosmia and olfactory disorders

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ABSTRACT

Background: Facial trauma is among the first three causes of alterations in the sense of smell, however, among the many sequelae that can be left by a facial trauma involving the fracture of bone structures, this is one of the least addressed issues and for which there is less information about the prevalence and incidence as well as its management. The aim of this study is to determine the impact of olfactory disorders, after presenting a facial fracture that covers the area of the nasal bones and the naso-orbito-ethmoidal region (NOE).
Methods: This retrospective study analyzed the prevalence of alterations in olfaction after the presence of facial traumatisms that covered the centrofacial region known as naso-orbito-ethmoidal, during the period of time from 2019 to 2024, collecting 36 patients, subdividing the patients to assess whether there was a proportional relationship of severity with a higher prevalence of hyposmia or anosmia.
Results: The study included 36 patients with a mean age of 28.29 years, the 20–30 age group being the most prevalent (53.5%). A total of 13 (17.8%) patients have diagnosed a NOE fracture and 23 (82.2%) with nose fracture. Of the patients with type NOE fracture, 6 (46%) presented an olfactory alteration, being 2 with type NOE I, 3 with type NOE II and 1 with type NOE III. Of the patients with nasal bone fractures, 10 (43%) had an olfactory alteration.
Conclusions: Patients who suffer with a facial trauma of the centrofacial region, undergo in a large proportion with alterations of the sense of smell, observing a proportional relationship between the severity of the trauma and hyposmia without presenting an improvement despite appropriate surgical management, so it is very important that when performing the initial physical examination, to verify the presence of olfactory alterations if the patient's conditions are so affected.

Keywords: NOE, Facial injury, Anosmia, Nasal bones

INTRODUCTION

The naso-orbito-ethmoidal (NOE) region is located at the center of the face, defined by the orbit, the glabella, and the nose. Due to the osseous characteristics of this region and the surrounding soft tissues, it poses significant challenges during reconstruction. Often, a satisfactory reconstruction for the patient is not achieved because of the anatomical complexity.

NOE fractures refer to injuries involving the convergence area of the nose, orbit, ethmoids, base of the frontal sinus, and the anterior cranial base floor. This zone contains crucial structures such as the medial canthal tendons, lacrimal pathway, and the olfactory nerve. It has been described that nasal bone injury is closely related to olfactory nerve dysfunction in up to 46% of cases.[1]

Facial traumas are between 3 the main cause of alterations in the sense of smell and taste.[2] Some etiologies have been proposed to this among which are contusion or fracture of the sinonasal tract, possibly associated with damage to the olfactory apparatus, shearing or tearing of the olfactory nerve filament and intracranial hemorrhage or contusion in the olfactory regions of the brain.[3] In the case of NOE type fractures an alteration in airflow conduction preventing its contact with the olfactory neuroepithelium; second, a fracture of the cribriform plate on the ethmoid bone roof leading to olfactory nerve disruption, mainly explained by its pathway.[4] This latter mechanism frequently occurs in facial traumas including NOE fractures, which can sometimes be accompanied by deceleration injuries causing coup-contrecoup forces in the brain, even without associated skull base fractures.[5]

According to statistics from other countries, they account for 5% of all facial fractures.[6] At our hospital, a national referral center for facial trauma treatment, they represent 4.5% of all facial traumas. However, we believe that due to the area's complexity, these fractures are often underdiagnosed. In order to diagnose a NOE type fracture, a tomography is usually required that allows combining 2D and 3D view, with which it has been observed provides more details in the evaluation of NOE fractures as commented by Remmer et al.[7]

NOE fractures are classified based on the relationship of the medial canthal tendon with its insertion on the frontal process of the maxillary bone, as described by Markowitz and Manson in 1991.[8] In the classification the type I are those without bony comminution and type III featuring comminution and canthal detachment, each representing different treatment challenges. The surgical management of this type of fractures can vary in complexity according to whether the fracture is unilateral or bilateral and whether it is a single fragment or presents multifragmentation, among the types of techniques, there are multiple maneuvers to reestablish the structures that are found there either with plates or with wire this with the intention of approaching optimal reconstruction to restore anatomy as close as possible to pre-trauma condition, emphasis is often placed on proper osteosynthesis allowing reinsertion of the medial canthal tendon into the frontal process of the maxillary bone through canthopexy, consequently restoring parameters like intercanthal distance and better facial symmetry.[9-10]

However, we've observed that patients with fractures experience olfactory alterations ranging from hyposmia to anosmia, impacting their daily lives, and are often associated with more severe central nervous system injuries. These are frequently overlooked and not followed up or treated as sequelae. Thus, this study aims to determine the incidence of olfactory alterations secondary to NOE and nasal bone fractures.

The literature describes olfactory alterations, ranging from hyposmia to anosmia after nasal bone fractures; however, such sequelae are less documented in patients with NOE fractures. There is a relatively low number of studies in the literature that investigated the impact of facial bone fractures, including NOE-type fractures and their different subtypes with respect to the alteration of olfactory function. According to the above-mentioned scale, it remains to be determined which type has a higher incidence of sequelae. This study aimed to identify olfactory alterations in patients with NOE and nasal bone fractures treated at the General Hospital of Mexico during a four-year period, from January 2021 to April 2025.

METHODS

This is a descriptive, observational, retrospective study conducted based on the data base of patients treated at the General Hospital of Mexico from 2021 through the first quarter of 2025, involving 201 patients diagnosed with facial trauma who attended the plastic and reconstructive surgery service and had a complete medical history. Patients who did not complete treatment at the hospital unit or had incomplete medical records were excluded.

Out of a total of 201 patients reported with facial trauma, we focused on those with documented NOE fractures (regardless of severity) and nasal bone fractures, both confirmed by tomography. Other inclusion criteria were patients aged 18-60 years old, with no history of COVID infection prior to the trauma. The age limit was set at 60 years old considering that aging affects all aspects of smell detection, with reports indicating odor discrimination and identification deteriorate after age 20 and olfactory threshold rapidly decreases starting at age 50.11 Data were analyzed using Google Spreadsheets 2024 for data organization, statistical calculations, and graphic representation.

This study adhered to ethical standards for data collection and publication. All hospitalized patients signed informed consent allowing the use of their clinical data for medical research at the time of admission. Due to the retrospective nature of the study and considering potential limitations in follow-up, a telephone questionnaire was administered to gather clinical information. Patients were first asked whether they recognized a decrease in their ability to perceive odors after the trauma. If the response was affirmative, further questions explored possible factors that could bias these findings, including: smoking status, frequent exposure (more than 4 days a week) to wood smoke, work involving chemical compounds or odors, and whether they had experienced SARS-CoV-2 infection after the trauma (confirmed by positive test. The patients were divided into 2 groups, the first in patients who had NOE type fractures regardless of the type of fracture and those who had only nasal bone fracture. The first group was subdivided according to the type of NOE fracture they presented and those who presented nasal bone fracture together with NOE fracture.

RESULTS

The study sample consisted in a total of 36 patients were included, 28 were men and 8 women, of which 13 (36%) presented with a NOE fracture (Types I, II, and III), and 23 patients had nasal bone fractures (64%) (Table 1). the age groups were from 21 to 60 years, the main age group being 20-30 years, representing 52% (Table 2). The mean age of all subjects was 28.29±10 years. Each tomography was reviewed to classify the degrees of NOE fractures according to the aforementioned classification. Of the 13 patients, 7 had a Type I fracture, 4 had Type II, and 2 had Type III NOE fractures (Table 3).

Table 1: Distribution of patients with NOE type fractures and nasal bones.

Type of fracture	N	%
NOE	13	36
Nasal bones	23	64

Table 2: Distribution of patients with NOE type fractures and nasal bones according to age.

Age group (years)	N	%
21-30	19	52.77
31-40	10	27.77
41-50	5	13.8
51-60	2	5.55

Table 3: Distribution of patients with NOE fracture acording to severity.

NOE type	N	%
I	7	53.84
II	4	30.76
III	2	15.38

Among the patients, they were divided between those who underwent surgery and those who did not, with 21 (58%) undergoing some type of surgical procedure and 15 (42%) managed conservatively. To gather information about the presence of olfaction alterations, a telephone questionnaire was conducted, asking if patients noticed a change in odor perception after the trauma.

They were divided into two main groups: those who reported a decrease in odor perception were classified as having hyposmia, and those who reported not perceiving odors were classified as having anosmia. Among patients with NOE fractures, 6 (46%) reported some degree of hyposmia, divided as follows: 2 with NOE Type I, 3 with NOE Type II, and 1 with NOE Type III. It was similarly ensured that patients had no antecedents that could impact odor perception, such as smoking or confirmed COVID-19 infection by a positive test. Among patients with nasal bone fractures, 10 (43%) reported decreased odor perception, aligning with international literature that reports values of 46%. 1 No patient reported clinical signs of anosmia in either group.

Upon analyzing the statistics, it was identified that out of the 23 patients with nasal bone fractures, 10 were smokers (43.47%), 6 (46%) of the patients were not smokers, and none of the patients with NOE fractures were smokers. Of the 6 patients with NOE fractures reporting hyposmia, 4 had received surgical treatment: 1 with NOE Type I, 2 with NOE Type II, and 1 with NOE Type III.

DISCUSSION

The present findings showed that olfactory dysfunction after a NOE or nasal bones fracture, are common, and that the severity of the NOE type fracture, increases the risk of having an olfactory dysfunction.

In our study, we observed that a significant percentage of patients with NOE fractures exhibited olfactory alterations, which correlated directly with the severity of the fracture (specifically in NOE Type III), this can be seen in the same way in other studies such as the one carried out by Renzi et al, in which it was found with patients who also presented NOE type fracture, however, as it was not of great severity, they did not show any olfactory alterations.[12] Within our results we did not observe the association between advanced age or gender and a worst outcome after a facial trauma in of olfactory function, however there are other studies such as Fan, in which it showed that younger patients have a better prognosis in recovering the sense of smell after a trauma, however they do not mention what type of facial trauma each patient has.[13] In our study it agrees with what was published in other studies in which an association was shown between nasal trauma with nasal fracture and the subsequent development of olfactory alterations not so, when a single nasal trauma without fracture occurs.[14]

The facial skeleton can be divided into areas, with some zones having greater clinical relevance due to the structures they house or the reconstruction difficulty they present. This is the case for the central facial area, which includes the naso-orbito-ethmoidal region, composed of the lamina papyracea of the ethmoid bone, nasal bones, nasal process of the frontal bone, lacrimal bones, sphenoid bone, and the frontal process of the maxilla as described by Junjun Wei et al.[15]

However, an often overlooked structure in this zone is the olfactory nerve, which contains nerve fibers passing through the cribriform plate of the ethmoid bone en route to the olfactory bulb and tract—the most ancient part of the prosencephalon: the rhinencephalon as described by Van Damme et al, patients with more forceful injuries to the frontal region, especially those associated with other types of fractures such as Le Fort fractures, are more likely to develop olfactory disturbances.[16]

In our country, the incidence of hyposmia or anosmia following facial trauma is not precisely known. Therefore, we believe it's important to consider olfactory assessments during exploration, record findings, and determine the prevalence of sequelae in patients following facial trauma.

Most of the studies deal with the aspect of the sequelae after trauma to nasal bones or centrofacial lesions that may include different types of Le fort or with other classifications such as Knight and North, however there is very little publication on the presence of secondary olfactory alterations fractures that only include the NOE region, so we consider this lack of knowledge the objective to evaluate in patients who did not have a frank lesion of nasal bones compared to patients who do present them.

Our study shows that nasal and NOE bone fractures, which are sometimes underdiagnosed, tend to occur with olfactory dysfunction and it is relatively common for them to go unnoticed at the patient's first check-up because our attention is usually on other lesions in adjacent areas. similarly, in our study we show the relationship between the severity of the injury and the presence of olfactory impairment. This oversight can have significant consequences for the patient´s quality of life, affecting their ability to enjoy food, detect environmental hazards, and fully appreciate the breadth of emotions linked to olfaction.

We highlight as strengths of this study the sample size, which, although it might seem small due to the underdiagnosis of such fractures, represents a substantial sample and the biggest recorded in a study in our country. We believe the findings hold value to early diagnosis and increase awareness of possible trauma sequelae, often lacking definitive management. Our data reveal a significant association between the severity of NOE fractures and the degree of subsequent olfactory alteration. This observation suggests than more complex and displaced fractures confer an elevated risk of persistent olfactory sequelae.

The main limitations of our study have to do with the long-term follow-up of patients who, due to distance issues, cannot make a transfer to our hospital in a simple way, as well as the way in which we assess olfactory alterations using a of a telephone questionnaire, which might underestimate the olfactory threshold, as well as the impossibility of performing long-term imaging studies to evidence the presence of alterations in the anatomy that could suggest any of the previously described alterations.

CONCLUSION

The present findings establish a clear correlation between the severity of the injury and the presence of olfactory impairment. While a substantial body of literature addresses facial trauma in general, secondary olfactory alteration resulting from NOE fractures remain relatively understudied. However, the present study is preliminary in nature, future research should prioritize longitudinal studies designed to comprehensively assess the long-term recovery of olfactory function following NOE fractures and to evaluate the efficacy of various therapeutic interventions. Investigations incorporating advance neuroimaging modalities may yield valuable insights into the structural and functional neural correlates of olfactory dysfunction in this patient population. Such concerted research efforts will not only refine our understanding of the physiopathology of post-traumatic olfactory alteration but will also facilitate the development of targeted and effective strategies for the management and rehabilitation of this condition.

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REFERENCES

1. Kim SW, Park B, Lee TG, Kim JY. Olfactory Dysfunction in Nasal Bone Fracture. Arch Craniofac Surg. 2017 Jun;18(2):92-6.
2. Nordin S, Brämerson A. Complaints of olfactory disorders: epidemiology, assessment and clinical implications. Curr Opin Allergy Clin Immunol. 2008 Feb;8(1):10-5.
3. Reiter ER, DiNardo LJ, Costanzo RM. Effects of head injury on olfaction and taste. Otolaryngologic Clinics of North America. 2004;37(6):1167–84.
4. Coelho DH, Costanzo RM. Posttraumatic olfactory dysfunction. Auris Nasus Larynx. 2016;43(2):137-43.
5. Howell J, Costanzo RM, Reiter ER. Head trauma and olfactory function. World Journal of Otorhinolaryngology - Head and Neck Surgery. 2018;4(1)39–45.
6. Dubois L, Dalmeijer SWR, Steenen SA, Gooris PJ. Obstruction of the Nasal Airway in NOE Fractures. Craniomaxillofacial Trauma & Reconstruction Open. 2020;5.
7. Daniel R, Arlen D, Arun G, Steven S. Role of Three-dimensional Computed Tomography in the Assessment of Nasoorbitoethmoidal Fractures. Annals of Plastic Surgery. 2000;44(5):553-63.
8. Markowitz BL, Manson PN, Sargent L, Vander Kolk CA, Yaremchuk M, Glassman D, et al. Management of the Medial Canthal Tendon in Nasoethmoid Orbital Fractures: The Importance of the Central Fragment in Classification and Treatment. Plastic and Reconstructive Surgery, 1991;87(5):843–53.
9. Palmieri CF, Meram AT. Panfacial and Naso-Orbito-Ethmoid (NOE) Fractures. Atlas of Operative Oral and Maxillofacial Surgery. 2015;12(2):185–94.
10. Shibuya TY, Chen VY, Young S. Naso-orbito-ethmoid fracture management, Operative Techniques in Otolaryngology-Head and Neck Surgery. 2008;19(2):140-4.
11. Schlosser RJ, Desiato VM, Storck KA, Nguyen SA, Hill JB, Washington BJ, et al. A Community-Based

Study on the Prevalence of Olfactory Dysfunction. Am J Rhinol Allergy. 2020;34(5):661-70.
12. Renzi G, Carboni A, Gasparini G, Perugini M, Becelli R. Taste and olfactory disturbances after upper and middle third facial fractures: a preliminary study. Ann Plast Surg. 2002 Apr;48(4):355-8.
13. Fan L-Y, Kuo C-L, Lirng J-F, Shu C-H. Investigation of prognostic factors for post-traumatic olfactory dysfunction. Journal of the Chinese Medical Association. 2015;78(5):299–303.
14. Karakurt SE, Orhan Z, Karakus MF, Cetin MA, Ikinciogullari A, Dere H. Impact of Nasal Trauma on Olfactory Function. J Coll Physicians Surg Pak 2020;30(09):912-6.
15. Wei J, Tang Z, Liu L, Liao X, Yu Y, Jing W, The management of naso-orbitalethmoid (NOE) fractures, Chinese Journal of Traumatology. 2015;15(5):221-8.
16. Van Damme PA, Freihofer HPM. Disturbances of smell and taste after high central midface fractures. Journal of Cranio-Maxillofacial Surgery. 1992;20(6):248–50.

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