Ann Med Res 2020;27(7):1913-7

Annals of Medical Research

DOI: 10.5455/annalsmedres.2020.03.203

Original Article

Investigation of the effectiveness of physical examination and radiologıcal imaging methods in the diagnosis of nasal bone fractures

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Abstract

Aim: Our objective is comparing the physical examination and radiological imaging (lateral nasal x-ray and computed tomography (CT)) methods for diagnosis in patients admitted to the emergency department due to nasal trauma and referring them to the department of otolaryngology.

Material and Methods: We retrospectively analyzed the physical examination and radiological imaging (lateral nasal radiography, paranasal CT) of 64 patients who were admitted to our hospital emergency department between October 2016 and October 2018 due to isolated nasal trauma and consulted to the department of otolaryngology and head and neck surgery.

Results: Of the 64 patients who participated in the study, 51 were male and 13 were female. While nasal fracture was detected in 56 patients, nasal fracture was not observed in 8 patients. As a result of our study, the rate of detecting nasal fracture only by physical examination was 41%, 73.2% by lateral nasal radiography, and 85.7% by physical examination and lateral nasal radiography. With paranasal CT, nasal fracture was diagnosed in all patients. Paranasal CT was found to be statistically significantly more successful in detecting nasal fracture compared to physical examination and direct nasal radiograph findings ($p = 0.002$).

Conclusion: As a result; physical examination and lateral nasal radiography provide useful information for diagnosis, but paranasal CT was the best diagnostic method in the diagnosis of nasal fracture.

Keywords: Lateral radiography; nasal fracture; paranasal computed tomography

INTRODUCTION

The nose, which is the most protruding structure of the face; It is an important organ both functionally and aesthetically (1). Nasal bones can be fractured with less force than a force that can cause other facial bones to fructure (2). For this reason, nasal bones are the structure most affected by trauma to the face (3). Nasal bone fractures account for approximately 50% of the fractures of traumatic facial bones (3). In America, the incidence of nasal bone fractures is 53.2 / 100000 (4).

In the evaluation of patients admitted to the hospital due to nasal trauma, the mechanism of the occurrence of trauma should be examined first, whether there is any damage to vital organs, and if necessary, radiological evaluations should be investigated. The severity, direction and mechanism of trauma in the nose is very important in terms of the type of fractures / fractures that occur (2). It is possible to break in two nasal bones, especially in traumas coming from the lateral (2).

Physical examination is very important in the diagnosis of nasal bone fracture, but it is not sufficient. Therefore, it is important to radiologically evaluate whether there is a bone fracture in all patients with nasal trauma. When performing radiological evaluation, lateral nasal radiography is generally preferred. There are various opinions in the literature about whether lateral nasal x-ray is sufficient for diagnosis and the place of other radiological imaging methods (computed tomography (CT), ultrasonography) in diagnosis (5).

Received: 05.03.2020 **Accepted:** 27.04.2020 **Available online:** 06.07.2020
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Our aim in this study is to retrospectively compare the physical examination, direct radiography and paranasal CT findings of patients who are referred to the department of otorhinolaryngology and diseases from the emergency department with the suspicion of nasal fracture.

MATERIAL and METHODS

The study protocol was approved by the Kutahya University of Health Sciences University Research Ethics Committee (date "22/01/2020", number "2020/02-01")

In our study, a total of 64 patients, 13 women and 51 men, who were admitted to the emergency department between 01/10/2016 and 01/10/2018 due to nasal trauma and referred to our clinic with suspicion of nasal fracture, were evaluated retrospectively.

The patient's age and gender, the period between trauma and consultation with the otorhinolaryngologist and the mechanism of the formation of trauma were examined from the hospital database. During the physical examination, it was evaluated whether there was crepitation by palpation, nasal axis deviation, presence of skin defect, and any trauma-related damage to the organs and bones. The anamnesis and physical examination of all patients were done by the same physician.

Lateral nasal radiography and paranasal CT were used for radiological examination of the patients. Lateral plan shots were evaluated using direct radiographs using a single device (RADspeed; Shimadsu; Osaka, Japan). Paranasal CTs were taken with 16 detector BT devices (Alexion, Toshiba Medical Systems, Japan). The shots were made at the cranial level from the vertex to the mandible. Section thickness is 2 mm and axial, coronal, sagittal and reformat images were evaluated by a single radiologist from our hospital's picture archiving and communication system (PACS).

On the lateral nasal radiograph and paranasal CT, it was recorded whether there was a nasal fracture, if any, which bones were present, the presence of a skin defect, and any accompanying facial bone fracture.

Patients with a history of nasal fracture and a history of nasal surgery were excluded from the study. In addition, patients whose history, physical examination or radiological imaging (lateral radiography and paranasal CT) data were not available were excluded from the study.

The data obtained were statistically evaluated. Descriptive statistical methods (n, %) were used to evaluate all numerical data. In addition, physical examination findings and radiological imaging method findings were compared with each other with a cross table and chi - square test was applied. $p<0.05$ was considered significant.

RESULTS

Of the 64 patients who participated in the study, 51 (80%) were male and 13 (20%) were female. The average age of the patients is 30.21 ± 16.54 (range: 7- 92) years. 13 patients are under the age of 18.

In the physical examination and radiological examinations of the patients included in the study, 56 (87.5%) nasal fractures were detected, while eight (12.5%) patients were not. Traffic accidents were found as the most common reason for patient admission (43.8%). The most common cause of nasal fracture in women is slip or fall down (7 patients); in men, it was found as a traffic accident (24 patients). The mean duration of the patients' admission to our clinic after trauma was 1.68 (range: 1-7 days). Demographic data are summarized in Table 1.

Table 1. The demographic distribution of patients

Gender	
Male	51 (80%)
Female	13 (20%)
Total	64 (100%)
Age Average	30.21 (7-92)
Cause of Nasal Trauma	
Traffic Accident	28 (43.8%)
Slip / Fall down	21 (32.7%)
Physical violence	11 (17.2%)
Industrial Accident	4 (6.3%)
Application Period	1.68 day (1-7. day)

On the physical examination of the patients included in our study, 23 (36%) patients had crepitation. While nasal axis deviation was observed in 12 patients, edema was not observed in 35 patients. Only 2 patients had skin defects.

First lateral nasal radiography was taken as the imaging method. In 41 (64.1%) patients, fracture was seen on the nasal x-ray. While 23 (56%) of the patients had a nasal fracture with displacement; nasal fracture without displacement was observed in 18 (44%).

Physical examination findings (crepitation, nasal deviation) were observed in only 17 (41.5%) patients with fractures on the nasal x-ray. Although 6 patients (26.1%) had crepitation, there was no fracture on the nasal x-ray. Soft tissue edema was detected on the lateral x-ray of 15 patients (36.5%).

When the paranasal CT of patients were examined, nasal fracture was detected in 56 patients (30 of them nasal fracture with displacement and 26 patients with nasal fracture without displacement). Only 73.2% of the fractures detected on paranasal CT could be seen on the nasal x-ray (Table 2). Paranasal CT was found to be statistically significantly more successful than direct lateral nasal x-ray in showing nasal bone fractures ($p <0.05$). In 3 patients, other than nasal fractures, fractures were detected in other facial bones.

Table 2. Comparison of Paranasal CT and Lateral Nasal X-ray Findings

		Paranasal CT		
		Fracture (+)	Fracture (-)	Total
Nasal graphy	Fracture (+)	41 (64.1 %)	0	41 (64.1 %)
	Fracture (-)	15 (23.4 %)	8 (12.5 %)	23 (35.9 %)
Total		56 (87.5 %)	8 (12.5 %)	64

The number of patients who could be diagnosed with nasal fracture as a result of evaluating the lateral nasal radiograph and physical examination findings together was 48. Compared with paranasal CT, 8 (14.2%) patients were diagnosed with fracture only by CT (Table 3). Paranasal CT was found to be statistically significantly more successful in fracture detection compared to physical examination and direct nasal radiograph findings (p = 0.002).

Table 3. Comparison of Paranasal CT with Lateral Nasal X-ray and Physical Examination Findings

		Paranasal CT		
		Fracture (+)	Fracture (-)	Total
Nasal graphy and Physical examination	Fracture (+)	48 (75 %)	0	48 (75 %)
	Fracture (-)	8 (12.5 %)	8 (12.5 %)	16 (25 %)
Total		56 (87.5 %)	8 (12.5 %)	64

Of the 13 pediatric patients included in the study, 10 were boys and 3 were girls. 8 children were admitted to the clinic for slip/fall down, 4 for traffic accidents and 1 for physical violence. While fracture was observed in 6 (46%) children with nasal graphy, no fracture was observed in 7 (54%) children. However, nasal fracture was observed in 10 (77%) children with paranasal CT and no nasal bone fracture was observed in 3 (23%) children. Nasal radiography was able to detect 6 (60%) of nasal bone fractures detected in paranasal CT, and not 4 of them.

Nasal bone reduction was performed in 37 patients included in the study. 1 patient refused the operation and surgical intervention was not required in 18 patients.

DISCUSSION

In this study, we wanted to investigate the physical examination and radiological imaging methods (direct nasal radiography and paranasal CT) used to diagnose nasal bone fracture in patients with nasal trauma, which ENT physicians frequently encounter. As a result of our study, we determine that the rate of detecting fractures only by physical examination 41%, 73.2% by lateral nasal radiography and 85.7% by physical examination and lateral nasal radiography. With paranasal CT, we found that all patients were diagnosed with fracture.

Due to its anatomical structure and protruding location, nasal bone fractures are the most common among maxillofacial traumas (6-8). However, there is no algorithm for the evaluation of patients with nasal fractures (9).

Detailed anamnesis and physical examination are very important in the evaluation of nasal bone fractures. The main findings to be encountered in physical examination are; nosebleeds, sharp edges, nasal axis deviation, collapse in the nasal bone, tenderness in the nose, edema and crepitation found in bimanual nasal palpation (1). Öğreden et al. (7) were able to diagnose nasal fractures in 12 of 24 cases with nasal bone fractures only by physical examination in their study. In our study, 41% of patients were diagnosed with a physical examination. There are opinions in the literature that only physical examination can be diagnosed in nasal bone fractures without the need for supportive imaging methods, and that physical examination is the gold standard in diagnosis (2). However, most of the studies show that only physical examination is insufficient in diagnosis and imaging methods must be performed (7-10). The data obtained in our study is that the physical examination alone is insufficient to make a diagnosis.

In the evaluation of patients, the most preferred radiological imaging method after physical examination is lateral nasal radiography. Since the nose is not a flat but a three-dimensional pyramid-shaped organ, the evaluations made with the lateral nasal radiography are insufficient. Although there are various publications in the literature that nasal radiographs are very successful in detecting fractures, there are studies that advocate its inadequacy and suggest additional radiological evaluation. Hwang et al. (1) reported that nasal radiography detect on only 82% of patients with nasal fracture so paranasal CT must be performed to all patients. Becker et al. (11) reported that they were able to diagnose 53% of patients by lateral nasal radiography. Tezer et al. (9) found this rate as 45% and indicated that paranasal CT detected all fractured patients in patients with nasal trauma. Cao et al. reported that lateral nasal x-ray was given 19.6% false negative results and insufficient to diagnose nasal bone fracture (12). In our study, 73.2% of the patients were diagnosed with nasal fracture by lateral nasal radiography. When it is evaluated together with the physical examination findings, this rate rises to 85.7%. With paranasal CT, all patients were diagnosed.

It has been reported that paranasal CT is required for the diagnosis of septal fracture, although it is difficult to detect fractures in the cartilage septum, fractures in the bone septum can easily be detected by CT (8-13). Again, paranasal CT is superior to lateral nasal radiography in order to detect fractures that may occur in other facial bones due to the impact on the face.

The most common causes of nasal bone fractures are; traffic accidents, slip/fall down, exposure to physical violence, occupational accidents and sports injuries (2-6).

Of the 64 nasal trauma patients evaluated in our study, 43 (67%) were forensic cases and the most common cause of trauma was traffic accidents with 28 (43.8%) patients. According to the third paragraph of Article 87 of the Turkish Criminal Code; if the injury causes bone fracture in the body, it is sentenced to 1 to 6 years' imprisonment according to the effect of the fracture on life functions. In the scoring made by considering the related item, linear fracture in the nasal bones or fracture at the tip, vital functions are mild; fragmented fracture in the nasal bone and collapse affect the fracture moderately (6-14). The physician evaluating the patient in forensic cases should be objective and should not make mistakes because the physician's report is an important document in the decisions to be made by the judicial authorities. For this reason, it is valuable that the patient is present in the forensic file in the radiological imaging reports in addition to the examination findings. Again, in radiological examination, the presence of fracture should be seen precisely. In this case, the lateral nasal radiography is insufficient and further radiological evaluations should be made.

Paranasal CT is a more effective method in evaluating the presence of nasal bone fracture than physical examination and lateral nasal x-ray, however, take a long time of imaging method, patient density in emergency departments, radiation exposure and high cost are important disadvantages (15-16). Nevertheless, intervention of nasal bone fracture without being diagnosed or failure to intervene leads to inadequate treatment, leading to more costly interventions such as rhinoplasty and septorhinoplasty in the future. In a study, direct nasal radiographs were reported to give negative results in 25% of patients requiring surgical intervention (17). Post-reduction nasal deformity rates range from 29 to 50% (18).

Another radiological method that can be used in nasal fracture evaluations is ultrasonography. In studies comparing lateral nasal radiography and ultrasonography, ultrasonography has been found to be more successful in diagnosis of fracture than lateral nasal radiography (10-19). Lee et al, in the study comparing ultrasound and CT, it was found that ultrasound was more successful than CT in detecting fractures (20).

Our most important limitation in our study is that the patients included in the study were referred to the ENT clinic only through the emergency department. For this reason, in our study, patients who received nasal trauma were evaluated emergency department with a physical examination and lateral nasal radiograph, but not referred to the ENT, could not be evaluated.

CONCLUSION

As a result; physical examination and lateral radiography are insufficient in the diagnosis of nasal fractures. Advanced imaging methods such as paranasal CT are important for both accurate treatment of the patient and medicolegal in forensic cases in order to determine the presence of fracture precisely.

Competing interests: The authors declare that they have no competing interest.

Financial Disclosure: There are no financial supports.

Ethical approval: The study protocol was approved by the Kutahya University of Health Sciences University Research Ethics Committee (date "22/01/2020", number "2020/02-01").

REFERENCES

1. Hwang K, You SH, Kim SG, et al. Analysis of nasal bone fractures; a six-year study of 503 patients. J Craniofac Surg 2006;17:261-4.
2. Mondin V, Rinaldo A, Ferlito A. Management of nasal bone fractures. Am J Otolaryngol 2005;26:181-5.
3. Rubinstein B, Strong B. Management of nasal fractures. Arc Fam Med 2000;9:738-42.
4. Ortega A, Gauna F, Munoz D, et al. Music Therapy for Pain and Anxiety Management in Nasal Bone Fracture Reduction: Randomized Controlled Clinical Trial. Otolaryngology–Head and Neck Surgery,2019;161:613-9.
5. De Lacey GJ, Wignall BK, Hussain S, et al. The radiology of nasal injuries problems of interpretataion and clinical relevance. Br J Radiol 1977;50:412-4.
6. Toygar M, Şenol E, Can İO, et al. Burun kemik kırıklarının adli tıp açısından değerlendirilmesi. Turkiye Klinikleri J Foren Med 2007;4:17-22
7. Öğreden Ş, Tansuker HD, Cengiz AB, et al. Nazal fraktür tanısında lateral nazal grafi duyarlılığının araştırılması; retrospektif klinik çalışma. KBB-Forum 2018;17:157-60.
8. Yabe T, Ozawa T, Sakamoto M, et al. Pre- and postoperative X-ray and computed tomography evaluation in acute nasal fracture. Ann Plast Surg 2004;53:547-53.
9. Tezer MS, Dede D. Yılmaz Y, et al. Nazal fraktür tespitinde direkt grafiler ve bilgisayarlı tomografinin yeri. Turk Arch Otolaryngol 2006;44:137-40.
10. 10. Hong HS, Cha JG, Paik SH, et al. High-resolution sonography for nasal fracture in children. AJR Am J Roentgenol. 2007;188:86-92.
11. Becker OJ. Nasal fractures. Arch Otolaryngol 1948;48:344-61.
12. Cao R, Wu H, Li Y, et al. Clinical diagnostic value for nasal bone fracture by three-dimensional reconstruction of spiral CT. Lin Chuang Er Bi Yan Hou Ke Za Zhi 2004;18:270-1.
13. Murray JA, Maran AG, Mackenzie IJ, et al. Open v closed reduction of the fractured nose. Arch Otolaryngol 1984;110:797-802.
14. Türk Ceza Kanunu'nda tanımlanan yaralama suçlarının adli tıp açısından değerlendirilmesi rehberi. Haziran 2019. Açık erişim: https://www.atk.gov.tr/tckyaralama24-06-19.pdf (erişim tarihi: 01.03.2020)
15. Liu C, Legocki AT, Mader NS, et al. Nasal fractures in children and adolescents: Mechanisms of injury and efficacy of closed reduction. Int J Pediatr Otorhinolaryngol 2015;79:2238-42

16. Celik M, Sonmez S, Cicek MM, et al. Accordance between clinical and radiologic findings of nasal bone fracture. J Ist Faculty Med 2017;80:33-7.
17. Damman F. Imaging of paranasal sinuses today. Radiologe 2007;7:578-83.
18. Nishioka H, Kondoh S, Yuzuriha S, Convex Bone Deformity after Closed Reduction of Nasal Bone Fracture, Br J Plast Surg 2018;71:85-9.
19. Dogan S, Kalafat UM, Yuksel B, et al. Use of radiography and ultrasonography for nasal fracture identification in children under 18 years of age presenting to the ED. Am J Emerg Med 2017;35:465-8.
20. Lee HL, Cha JG, Hong HS, et al. Comparison of high resolution ultrasonography and computed tomography in the diagnosis of nasal fractures. J Ultrasound Med 2009;28:717-23.