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Original Research

To evaluate the diagnostic efficacy of ultrasonography and conventional radiography in identifying nasal bone fractures

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ABSTRACT:

Aim: To evaluate the diagnostic efficacy of ultrasonography and conventional radiography in identifying nasal bone fractures. **Methods**: A cross-sectional investigation was carried out in the Department of Radiology. An investigation was conducted on 100 individuals who required assessment for nasal bone fracture, either for clinical or forensic reasons. The investigation included the use of conventional Waters and lateral nasal bone view radiography, as well as high resolution ultrasonography. The diagnostic accuracy was determined using the negative likelihood ratio (LR-), positive likelihood ratio (LR+), specificity (Sp), and sensitivity (Se). The NPV and PPV were calculated as well. **Results**: The average age of the patients was 30.43±3.75 years. The research comprised a male youngster who was 10 years old as the youngest patient, and a guy who was 55 years old as the oldest patient. Out of the 100 patients, 78 were diagnosed with nasal bone fractures based on physical examination, whereas the other 22 patients were considered normal but were further studied owing to legal reasons. Out of the 78 confirmed occurrences of nasal bone fractures, conventional radiography detected a fracture line in 70 cases. **Conclusion:**High-resolution ultrasonography is a precise method for assessing nasal bone fractures. High-resolution ultrasonography may serve as a substitute for conventional radiography.

Keywords: Nasal Bone, Fracture, Ultrasonography, Radiography

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INTRODUCTION

Incidents resulting in physical harm are a significant contributor to mortality and impairment on a global scale. Fractures of the bone are often occurring injuries in this population. A bone fracture is a medical ailment that occurs when there is a disruption in the integrity of a bone, resulting in a break. Fractures happen when a substantial force results in the breaking of a bone. Bone fractures may occur as a result of falls, high-velocity collisions, or severe impacts. Pathological bone fractures may be caused by diseases that result in bone weakening and excessive usage.[1,2]The nose is the most prominent facial structure and the nasal pyramid is reportedly the most commonly fractured facial bone.[3] The nasal pyramid is a complex structure consisting of the two nasal bones and the two frontal processes of the maxillary bone. A nasal fracture can involve any part of the nasal pyramid but the lateral nasal walls, the nasal dorsum and the nasal septum generally require the most attention when assessing a nasal pyramid fracture.[4]Although clinical examinations are considered standard procedure in the diagnosis of nasal fractures, haematoma and oedema of adjacent tissues make it difficult to diagnose them. Imaging procedures in midface traumas are also needed for forensic reasons.[5] Although a routine radiographic examination is the main diagnostic tool for traumas to the nose, it is not very accurate and it is difficult to determine which side is fractured on conventional radiographs.[6,7] CT has been considered as a gold standard and it is the procedure of choice for diagnosing complex facial fractures, especially mid-facial fractures.[8-10] However, CT techniques are

expensive, are not readily available and provide a high patient exposure dose. Owing to the proximity of the eyes and the thyroid gland, there is an increased risk for cataract and thyroid carcinoma from X-ray exposure. Furthermore, CT techniques cannot be freely used for pregnant women and coronal CT sections cannot be provided for patients with traumas to cervical vertebrae and for non-co-operative patients.[11,12] These considerations make it necessary to find an alternative and appropriate technique to CT imaging. Ultrasonography is a non-invasive, inexpensive technique that has been shown to reveal fractures of different areas of the face, such as the nasal bone, orbital floor,[13] anterior wall of the frontal sinus6 and zygomatic fractures.[10,14] Previous studies have evaluated the use of ultrasonography in detecting nasal bone fractures in cases where a fracture had already been diagnosed.[4,5] However, the sensitivity and specificity of ultrasonography has not been tested in the diagnosis of nasal bone fractures. The aim of this study was to evaluate the diagnostic value of ultrasonography in detecting nasal bone fractures compared with CT as the reference method in a single-blind study.

MATERIAL AND METHODS

Cross-sectional research was done at the Department of radiology, after the permission of the protocol review committee and institutional ethics committee. Following obtaining informed permission, a comprehensive medical history was obtained from the patient or, if the patient was not in a stable state, from their family. All patients were informed about the approach, risks, advantages, outcomes, and potential problems of the surgery. The research cohort included 100 individuals diagnosed with nasal bone fracture, who had a thorough physical examination by an otolaryngologist for either medical or legal reasons. Subsequently, these individuals underwent evaluation using standard radiography and sonography. The physical examination was regarded as the most reliable method for diagnosing a nasal bone fracture. At the outset, all patients underwent radiographic investigation using a lateral and a Waters view x-ray. An expert radiologist assessed the findings. The reports were then categorized as either "positive" or "negative" based on the presence of a nasal bone fracture. Subsequently, the patients underwent sonographic examination. The sonographies were conducted using an ESAOTE MYLAB 50 ultrasound equipment and a 10 MHz linear probe. The sonographic exams were conducted by a radiologist who specialized in soft tissue and musculoskeletal imaging. The radiologists were apprised of the main diagnosis, but they were unaware of the physical examination findings and each other's diagnostic reports. The patients underwent examination while lying on their backs, with assessments conducted from several angles (right, left, and longitudinal) to evaluate the right and left sides, as well as the lateral wall and dorsum of the nose. The sonographic finding was considered positive when there was cortical disruption of the nasal pyramid. The presence of soft tissue edema and subperiosteal hemorrhage was also assessed as a potential indicator to distinguish between an acute and a chronic fracture. The LR- and LR+ values, Sp, Se, NPV, and PPV together with their 95% confidence intervals were computed to assess the diagnostic accuracy.

RESULTS

This research examined 100 individuals who suffered nasal bone fractures during their physical examination using sonography and radiography. Out of the total number of patients, 27 were female and 73 were male. The average age of the patients was 30.43±3.75 years. Out of the total cases, 95% were in the age range of 20-56 years. Among them, 38% were between 20-30 years old and 31% were between 30-40 years old. Out of the total number of patients, 5 (5%) were in the age group below 20 years, while 9 (9%) were in the age group beyond 50 years. The research comprised a male youngster who was 10 years old as the youngest patient, and a guy who was 55 years old as the oldest patient. Out of the 100 patients, 78 were diagnosed with nasal bone fractures based on physical examination, whereas the other 22 patients were considered normal but were further studied owing to legal reasons. Out of the 78 confirmed occurrences of nasal bone fractures, conventional radiography detected a fracture line in 70 cases.

Table 1: Demographic profile of patients

Gender	**N=100**	**%**
Male	73	73
Female	27	27
Age		
Below 20	5	5
20-30	38	38
30-40	31	31
40-50	17	17
Above 50	9	9

Table 2: Diagnostic Values of Conventional X-ray and Ultrasonography

Diagnostic Accuracy Values	Ultrasonography [95% CI]	Conventional X-ray [95% CI]
Sensitivity (Se)	0.95 [0.77–0.98]	0.78 [0.67–0.85]
Specificity (Sp)	0.97 [0.88–0.98]	0.84 [0.77–0.93]
Positive Likelihood Ratio (LR^+)	61.87 [14.68–367.89]	6.45 [3.37–8.56]
Negative Likelihood Ratio (LR^-)	0.31 [0.23–0.44]	0.37 [0.18–0.44]
Positive Predictive Value (PPV)	0.94[0.88–0.97]	0.87 [0.76–0.94]
Negative Predictive Value (NPV)	0.89 [0.78–0.93]	0.77 [0.58–0.84]

96% CI: 96% Confidence Interval

All 100 patients were examined by ultrasonography. The fracture line was shown in 77 out of 78 cases with a clinically diagnosed nasal bone fracture. Although physical examination results were positive for nasal bone fracture in 5 of the patients, the fracture line could not be found in ultrasonography. The Se, Sp, LR^+, PPV and NPV of ultrasonography were higher than radiography (Table 2). The LR^- of ultrasonography was lower than radiography. The LR^+ of sonography for the diagnosis of nasal bone fracture was 61.87 [14.68–367.89]which represents a large and conclusive increase in the likelihood of the fracture in the presence of positive findings. Furthermore, LR^- of sonography was 0.31 [0.23–0.44]which proposed a large to moderate decrease in the likelihood of the fracture, in the presence of negative findings. LR^+ of radiography was 6.45 [3.37–8.56]which showed a small in- crease of the likelihood of fracture in positive results and the LR^- of x-ray was 0.37 [0.18–0.44]which proposed a small decrease in the likelihood of the fractures when the findings were negative

DISCUSSION

Due to the limited sensitivity of radiography, the diagnosis of nasal bone fracture is often conducted by physical examination. Previous studies have shown a sensitivity of 75% for the lateral and Waters radiography views in diagnosing nasal bone fractures.[15,16] CT can precisely show anatomic details of the nasal bone and the soft tissue, but it is not always sufficient. The fine nasal fracture line might be missed from the partial volume artifact effect of CT.[15] The previous study showed that sonography can even show a disruption of 0.1 mm in nasal bones.[17]So far only six studies have been conducted to evaluate sonography for the diagnosis of nasal bone fracture.In a study on 63 patients, Oliver et al., found that the accuracy of sonography is more than radiography in diagnosing the fracture line.[15]

In another study carried out by Hyun et al., it was found that the Sensitivity of sonography in diagnosing nasal bone fracture is more than radiography.[15]In a study on 18 patients, Danter reported a Sensitivity of 83% and a Specificity of 50% using a 20-MHz sonography probe compared to physical examination. He also showed that the Se and Sp of sonography compared to radiography is 94% and 83%,respectively.[18]Kown showed a positive correlation between sono- graphy and CT by evaluating 45 patients suspected of having nasal bone fracture.[19]Beck et al., investigated 21 patients suspicious of having nasal bone fracture using a 5–7.5 MHz linear probe and showed that all the fracture lines shown by radiography were also diagnosed by sonography.[17]Zagolski and Strek showed that in individuals with nasal bone fracture the diagnosis can be made exclusively on the results of the sonographic examination.[20]In this study, we used a 10-MHz linear probe and the results of this study were similar to those from Beck et al.,[19]who used a 5–7.5 MHz probe, and also were similar to the studies of Danter who used a 20 MHz probe.[17]In our study, it was shown that while radiography is not able to differentiate chronic from acute fracture lines, sonography can help diagnosing the acuteness of the fracture by showing subperiosteal hematoma and soft tissue edema. Sonography can show trauma of the cartilaginous part of the nose more accurately than radiography.[15] Sonography is a fast, cheap and accurate method for diagnosing nasal bone fractures and can show anatomic details of the nose much better than conventional radiography.Finally, sonography can be a very fast imaging method in suspected cases of nasal bone fracture and by using this method there would be no need to use radiography.

CONCLUSION

High-resolution ultrasonography is a precise method for assessing nasal bone fractures. High-resolution ultrasonography may serve as a substitute for conventional radiography.

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