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Original Research

Ultrasonography vs. Conventional Radiography for the Diagnosis of Nasal Bone Fractures

[1]Gyanendra Prasad Varshney, [2]Mratunjai Sharma

[1]Associate Professor, Department of General Surgery, United Institute of Medical Sciences, Prayagraj, Uttar Pradesh, India;
[2]Associate Professor, Department of Radio Diagnosis, United Institute of Medical Sciences, Prayagraj, Uttar Pradesh, India

ABSTRACT:
Aim: We compared the diagnostic accuracy of ultrasonography and conventional radiography to clinical examination as the gold-standard methodology to see whether ultrasonography may be used as the main diagnostic tool for nasal bone fracture. **Methods**: In the Department of Radiology, a cross-sectional research was carried out. The standard Waters and lateral nasal bone view radiography, as well as high resolution ultrasonography, were performed on 100 individuals having a clinical or forensic reason for the examination of nasal bone fracture. The diagnostic accuracy was determined using the negative likelihood ratio (LR-), positive likelihood ratio (LR+), specificity (Sp), and sensitivity (Se). The positive predictive value (PPV) and negative predictive value (NPV) were also calculated. **Results**: According to physical examination, 81 of the 100 patients had nasal bone fractures, whereas 19 were judged to be normal but were scrutinised owing to legal difficulties. In this study, conventional radiography revealed a fracture line in 71 of the 91 clinically verified nasal bone fracture patients. Ultrasonography was used to assess all 100 individuals. The fracture line was visible in 77 of 81 clinically confirmed nasal bone fractures. Ultrasonography has a lower LR than radiography. The LR+ of sonography for the diagnosis of nasal bone fracture was 65.81 [95% CI: [9.28-390.10], indicating a significant and convincing rise in the chance of fracture in the presence of positive results. Furthermore, the LR of sonography was 0.21 [95% CI: 0.10-0.21], suggesting a significant to moderate reduction in the chance of fracture in the case of negative results. The LR+ of radiography was 5.81 [95% CI: 2.87-6.27], indicating a minor increase in the chance of fracture in positive results, while the LR of x-ray was 0.41 [95% CI: 0.21-0.42], indicating a small reduction in the likelihood of fracture in negative results. **Conclusion:** In the case of a nasal bone fracture, high-resolution ultrasonography may be an effective diagnostic tool. Ultrasound imaging with a high resolution may be used instead of traditional radiography in many cases.
Keywords: Nasal Bone, Fracture, Ultrasonography, Radiography

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Corresponding author: Mratunjai Sharma, Associate Professor, Department of Radio Diagnosis, United Institute of Medical Sciences, Prayagraj, Uttar Pradesh, India

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INTRODUCTION

Worldwide, injuries account for a significant percentage of both fatalities and permanent disabilities. One of the most prevalent types of injury among them is a broken bone. Fractures occur when there is a break in the continuity of the bone, necessitating surgical intervention. They develop when a significant force breaks the bone. Traumatic bone fractures may be caused by anything from falls to moving accidents to hard impacts. Pathological bone fractures may be caused by diseases that weaken bones or by overuse.[1,2] The nasal pyramid is the most usually broken face bone, despite the nose being the most noticeable feature.[3] The nasal pyramid comprises the maxillary frontal processes and the two nasal bones. In examining a nasal pyramid fracture, it is important to pay special attention to the lateral nasal walls, the nasal dorsum, and the nasal septum, but a fracture may occur in any portion of the nasal pyramid.[4] Although clinical investigations are the gold standard for diagnosing nasal fractures, haematoma and oedema of nearby tissues may obscure the diagnosis. Forensic purposes also need imaging studies for midface fractures.[5] Although traditional radiographs are the principal diagnostic tool for nasal injuries, they are not particularly reliable

and it is sometimes difficult to tell which side is broken. [6,7] When it comes to identifying complicated facial fractures, particularly mid-facial fractures, CT has been widely regarded as the gold standard and is the preferred procedure.[8-10] However, CT methods are prohibitively costly, have limited accessibility, and subject patients to a substantial radiation dosage. Because of their close closeness, the eyes and the thyroid gland are particularly vulnerable to the harmful effects of X-ray radiation in the form of cataracts and thyroid cancer. Furthermore, CT methods cannot be freely employed for pregnant women and coronal CT sections cannot be offered for patients with injuries to cervical vertebrae and for non-co-operative patients.[11,12] This necessitates investigating potential replacement methods for CT imaging. Ultrasonography is a non-invasive, affordable technology that has been demonstrated to uncover fractures of several parts of the face, such as the nasal bone,[2,3,6] orbital floor,[9,13] anterior wall of the frontal sinus6 and zygomatic fractures.[10,14] Ultrasound has been studied for its ability to identify previously confirmed nasal bone fractures in prior research.[4, 5] Although ultrasonography has been used to detect nasal bone fractures, its sensitivity and specificity have not been evaluated. The purpose of this single-blind research was to assess the diagnostic usefulness of ultrasonography and CT for identifying nasal bone fractures.

MATERIAL AND METHODS

After receiving clearance from the protocol review committee and the institutional ethics committee, a cross-sectional research was undertaken at the Department of radiology. After obtaining informed permission, a complete history was obtained from the patient or family if the patient was in poor health. All patients were informed about the procedure's approach, risks, advantages, outcomes, and related complications. The research group included 100 individuals with nasal bone fractures who were examined physically by an otolaryngologist for a medical or legal cause. These patients were subsequently subjected to standard radiography and sonography. The gold standard for the diagnosis of nasal bone fracture was physical examination. At the outset, all patients were radiographically examined with a lateral and a Waters view x-ray. A radiologist reviewed the findings. The reports were then classified as "yes" or "negative" based on the presence of nasal bone fracture. The patients were then sonographically examined. Sonographies were performed on an ESAOTE MYLAB 50 ultrasound equipment equipped with a 10 MHz linear probe. A radiologist who specialised in soft tissue and musculoskeletal imaging conducted all sonographic exams. The radiologists were made aware of the main diagnosis, but they were unaware of the physical examination or each other's diagnostic results. Patients were evaluated supine and in right, left, and longitudinal views to assess the right and left sides, lateral wall, and dorsum of the nose. The cortical rupture of the nasal pyramide was a favourable condition for sonographic observation. Soft tissue edoema and subperiosteal haemorrhage were also investigated as potential predictors of acute versus chronic fracture. The negative and positive likelihood ratios (LR- and LR+), specificity (Sp), sensitivity (Se), NPV, and PPV were computed and utilised to determine diagnostic accuracy.

RESULTS

In this investigation, sonography and radiography were used to examine 100 patients who had nasal bone fractures during their physical examination. There were 26 women and 74 males among these patients. The patients' average age was 22.5 years. The bulk of the cases, 91 (91%), were between the ages of 10 - 59, with 37 (37%), between the ages of 20 -30, and 31 (31%), between the ages of 30 - 40. 6 (6%) patients were under the age of 20, while 9(9%) were beyond the age of 50. The youngest patient in the trial was a 10-year-old male youngster, and the oldest was a 59-year-old guy. According to physical examination, 81 of the 100 patients had nasal bone fractures, whereas 19 were judged to be normal but were scrutinised owing to legal difficulties. In this study, conventional radiography revealed a fracture line in 71 of the 91 clinically verified nasal bone fracture patients.

Table 1: Demographic profile of Patients

Gender	**N=100**	**%**
Male	74	74
Female	26	26
Age		
Below 20	6	6
20-30	37	37
30-40	31	31
40-50	17	17
Above 50	9	9

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

Diagnostic Accuracy Values	**Ultrasonograghy**	**Conventional X-ray**
Sensitivity (Se)	0.95 [0.86–0.97]	0.82 [0.71–0.86]
Specificity (Sp)	0.98 [0.89–0.98]	0.87 [0.74–0.97]

Positive Likelihood Ratio (LR+)	65.81 [9.28–390.10]	5.81 [2.87–6.27]
Negative Likelihood Ratio (LR^{-})	0.21 [0.10–0.21]	0.41 [0.21–0.42]
Positive Predictive Value (PPV)	0.98[0.91–0.97]	0.91 [0.82–0.95]
Negative Predictive Value (NPV)	0.92 [0.81–0.94]	0.76 [0.61–0.82]

Ultrasonography was used to assess all 100 individuals. The fracture line was visible in 77 of 81 clinically confirmed nasal bone fractures. Although physical examination findings for nasal bone fracture were positive in six of the patients, the fracture line could not be identified on ultrasonography. Ultrasonography had greater Se, Sp, LR+, PPV, and NPV than radiography. Ultrasonography has a lower LR than radiography. The LR+ of sonography for the diagnosis of nasal bone fracture was 65.81 [95% CI: [9.28-390.10], indicating a significant and convincing rise in the chance of fracture in the presence of positive results. Furthermore, the LR of sonography was 0.21 [95% CI: 0.10-0.21], suggesting a significant to moderate reduction in the chance of fracture in the case of negative results. The LR+ of radiography was 5.81 [95% CI: 2.87-6.27], indicating a minor increase in the chance of fracture in positive results, while the LR of x-ray was 0.41 [95% CI: 0.21-0.42], indicating a small reduction in the likelihood of fracture in negative results.

DISCUSSION

Because radiography has a limited sensitivity, the diagnosis of nasal bone fracture is typically made by physical examination.[15] Previous studies suggested 75% sensitivity of lateral and Waters radiography views for the detection of nasal bone fracture.[16] Although CT may reveal anatomic features of the nasal bone and soft tissue, it is not always adequate. The tiny nasal fracture line may be overlooked due to CT partial volume artefact impact. Sonography can detect 0.1 mm disruptions in nasal bones, according to a prior study.[17] There have only been six studies to date that have evaluated sonography for the diagnosis of nasal bone fracture. In a study of 63 patients, Oliver et al. discovered that sonography is more accurate than radiography in detecting the fracture line.[15]

Another research, conducted by Hyun et al., showed that the sensitivity of sonography in identifying nasal bone fracture is greater than radiography.[15] Danter reported a Sensitivity of 83% and a Specificity of 50% utilising a 20-MHz sonography probe compared to physical examination in a study of individuals. He also shown that the Se and Sp of sonography are 94% and 83%, respectively, when compared to radiography.[18] By analysing 45 patients suspected of having nasal bone fractures, Kown discovered a good association between sonography and CT.[19] Beck et al. used a 5-7.5 MHz linear probe to study 21 individuals suspected of having nasal bone fractures and found that all fracture lines identified by radiography were also detected by sonography.[17] Zagolski and Strek shown that in patients with nasal bone fractures, the diagnosis may be determined solely only on the findings of the sonographic examination.[20] We employed a 10-MHz linear probe in this work, and the findings were comparable to those of Beck et al.,[17] who used a 5-7.5 MHz probe, as well as Danter's experiments, which used a MHz probe.[17] While radiography cannot distinguish between chronic and acute fracture lines, sonography may aid in determining the acuteness of the fracture by demonstrating subperiosteal haemorrhage and soft tissue edoema. Sonography is more accurate than radiography in detecting injuries to the cartilaginous section of the nose.[15] Sonography is a quick, low-cost, and reliable way to diagnose nasal bone fractures, and it can reveal anatomic aspects of the nose far better than traditional radiography. Finally, sonography may be a very quick imaging approach in suspected instances of nasal bone fracture, eliminating the requirement for radiography.

CONCLUSION

In the case of a nasal bone fracture, high-resolution ultrasonography may be an effective diagnostic tool. Ultrasound imaging with a high resolution may be used instead of traditional radiography in many cases.

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