A review: ultrasonography for nasal bone fractures

Nazal kemik kırıklarında ultrasonografi

Ultrasonography and nasal bone fractures

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Özet

Nazal kemik kırıkları acil servis başvurularının önemli bir kısmını oluşturmaktadır. Radyografi ve bilgisayarlı tomografi (BT) genellikle burun muayenesinden sonra istenir. Ultrasonografi (US), noninvaziv, ucuz bir teknik olup yüz, burun, ekstremite kırıklarını göstermede kullanılmıştır. Acil serviste avantajlarından (hızlı, ucuz, radyasyonsuz) US nun faydaları bilinmektedir. Fakat acil serviste nazal kemik kırıklarının tanısı ve yönetiminde kullanımı konusu net olarak tanımlanmamıştır.

Anahtar Kelimeler

Nazal Kemik Kırıkları; Ultrasonografi; Bilgisayarlı Tomografi

Abstract

Nasal bone fractures are one of the most common reasons for emergency service admissions. Radiography and computed tomography (CT) examinations are usually performed following rhinologic examination. Ultrasonography (US) is a non-invasive, inexpensive technique that has been shown to reveal fractures of different areas of the face, such as the nasal bone and other extremity bone fractures. The advantages of US (fast, unexpensive, radiation-free) are well known in the emergency department (ED), but it's use for the diagnosis and management of nasal bone fractures in the ED are not as well-established.

Keywords

Nasal Bone Fractures; Ultrasonography; Computed Tomography

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Introduction

The nose is the most prominent part of the facial structure, and the nasal bone is the most common facial fracture [1-4]. The nasal pyramid consists of two nasal bones and the two frontal processes of the maxillary bone. All parts of the nasal region may be involved in a trauma although the lateral nasal walls, the nasal dorsum and the nasal septum usually require the most attention [5].

A careful clinical examination is the first step in the diagnosis of nasal fractures, but haematoma and oedema of soft tissues can make it difficult to diagnose. Radiography and other imaging procedures in midface traumas are also required for forensic reasons [6]. It may be a problem to determine which side is fractured using conventional radiographs [7, 8]. Computed tomography (CT) has been known as the gold standard in the diagnosis of midfacial fractures including nasal bone fractures [9-11].

CT imaging is expensive, not always readily available and causes high exposure dose. Because of cancer risk it's use is limited. Also, patients who are pregnant, uncooperative or suffering cervical trauma and needing coronal sections are not appropriate for CT examination [12, 13].

These difficulties made it necessary to find easier and safe techniques for nasal fractures. Ultrasonography (US) is a non-invasive, inexpensive technique and many studies have reported that it can detect fascial bone fractures, such as the nasal bone, orbital floor, anterior wall of the frontal sinus, and zygomatic fractures [5, 6, 9, 10, 14-16].

In the literature, the first use of US for nasal fracture was reported in 1996 by Danter et al. They used 20 MHz B-scan US for patients with clinical and/or radiological evidence for fracture and demonstrated that in certain cases ultrasonography is correlated with nasal fracture detection [17]. The increasing prevalence of such injuries emphasizes the need for adequate imaging of nasal fractures depending on the etiology of the fracture [6]. US is a common and easy method that does not use radiation. Use of US for other bone fractures such as the scaphoid and ribs has been shown in various studies [18, 19].

In a small patient population study, Ardeshirpour et al. determined the appearance of nasal fractures on US. They used US to image 12 patients with a clinical or radiologic (CT or x-ray) diagnosis of nasal fracture. All patients presented within two weeks of their injuries. The researchers found that they could easily diagnose nasal bone fractures on lateral-view US. They suggested that lateral US could be used to detect nasal fractures in adults [20, 21].

If US is used in the first evaluation of nasal bone fracture by an experienced operator, radiation exposure can be prevented, but when complicated fractures are suspected, a plain radiography or a CT scan will be required [9].

Hong et al. described the sonographic findings of nasal fracture in children, and they compared US and CT with the patients' clinical findings to find the first step diagnostic value of US for nasal bone fractures. US was found to be beneficial for the first radiologic evaluation but the autors similarly found that it should be supported by CT in complicated cases of nasal bone fractures in children [6].

Nasal Us For Estimating the Time of Occurrence of Nasal Trauma

Clinicians should always be careful in medico-legal issues. A recent nasal bone fracture should be differentiated from an old one, especially in emergency clinics. In one study, US was reported as a reliable diagnostic tool for estimating the time of a nasal bone fracture. Forty-five patients with nasal bone fractures were followed for six months. They underwent US evaluation regularly: in the first 5 days and the 3rd, 6th, 12th and 24th weeks after the trauma. The thickness of the subperiosteal hematoma was measured with US on those dates. Subperiosteal hematoma with a mean thickness of 1.14 mm (0.79-1.31 mm) was highly sensitive (100 %) for the diagnosis of nasal bone fracture during the first few days after the trauma, and disappeared in all patients by the 24th week, with a mean thickness of 0.47 mm [22]. So, the results of this study were important for emergency clinicians to estimate the time of nasal bone fractures.

Intraoperative Nasal Us

US is not just important for the diagnosis of nasal bone fractures, but it has also been used for intraoperatively assessing surgical outcomes [23-25]. The use of US findings before and after a closed reduction was compared to the use of visual inspection and palpation. One study has suggested that visual inspection and palpation are as reliable as US for intraoperatively evaluating the outcomes of surgery for acute nasal fractures [23].

In a patient satisfaction study, the benefits of intraoperative ultrasonic guidance in the management of isolated nasal bone fractures were evaluated. In this study, sixty-eight patients who had isolated fracture nose were treated by either a simple closed reduction or by ultrasound-guided reduction (34 patients each) with a follow up for an average of 4.5 and 5.5 months, respectively. They evaluated the nasal profile and also asked patient groups whether they were satisfied with the appearance of profile of their noses. Patients who had undergone USguided nasal bone reduction had significantly better nasal profile scores than patients who underwent simple closed reduction, however the patient satisfaction scores had no significant difference between the groups. These results indicated treating nasal bone fractures with the assistance of intraoperative US resulted in a significantly better nasal profile appearance than by treating it by simple closed reduction, but the the patient satisfaction was the same in both groups [24].

In a similar study, the nasal profile was considered via CT and photograph one year after USguided surgery. Park et al. classified patients according to their CT score. In almost all patients, postoperative external photographs showed a symmetrical nasal dorsum without external deformity, and postoperative CT showed stabilization of bony fragments and good alignment of the nasal bone. Postoperatively, the CT score was 3 (excellent) in 25 patients, 2 (good) in 5 patients, and 1 (fair) in 2 patients. They suggested that ultrasonography is very useful for evaluating intraoperative repositioning of nasal bone fractures [25].

Kishibe et al. used US intraoperatively to confirm adequate bone restoration. US findings and the CT scan of the nasal bone were almost the same, indicating that ultrasonography may be suitable and sufficient for the diagnosis of nasal fractures and that objective intraoperative evaluations can be performed by only using ultrasonography. US is a useful tool for the diagnosis of nasal fractures and also for the evaluation of medical treatment [26].

Ct/Us/Radiography Sensitivity Specificity

US was compared with CT and plain radiography for nasal fracture diagnosis in various studies [5, 27-34]. Lee et al. compared the diagnostic efficacy of US with radiography and multi-detector CT for the detection of nasal bone fractures. They included 41 patients who had a nasal bone fracture who underwent prospective US examinations. Plain radiographs and CT images were obtained on the day of trauma. In their study the radiologist used a linear array transducer (L17-5 MHz) in 24 patients and hockey-stick probe (L15-7 MHz) in 17 patients. The bony component of the nose was divided into three parts (right and left lateral nasal walls, and midline of nasal bone). Fracture detection by three modalities was subjected to analysis. They compared results with intraoperative findings. Their findings suggested that CT had greater sensitivity and specificity than US or radiography, and better intraoperative findings for the right and left lateral nasal walls. On the other hand, US had higher specificity, positive predictive value (PPV), and negative predictive value (NPV) than CT for midline fractures of the nasal bone. Two different US probe evaluations showed good agreement at all three sites, US findings obtained by the hockey-stick probe showed closer agreement with intraoperative findings for both the lateral nasal wall and midline of nasal bone. These results showed that US may be helpful for evaluating the midline of nasal bone and a smaller probe and a higher frequency US may be required for the nasal bone evaluation [27].

In another study 128 patients with suspected nasal bone fracture were enrolled and the diagnostic values of US and radiography were compared with clinical examinations. Radiography and a 10-MHz US were performed on all patients. Their findings: US sensitivity was 84%, specificity 75%, accuracy 82%, PPV 91%, and NPV 61%. Lateral-view radiography, sensitivity was 50%, specificity 72%, accuracy 55%, PPV 84% and NPV 32%. Waters view radiography, sensitivity was 53%, specificity 65%, accuracy 56%, PPV 82%, and NPV 31%. Lateral-Waters view radiography, sensitivity was 64%, specificity 58%, accuracy 62%, PPV 82% and NPV 34%. They suggested that when compared with radiography, fracture diagnosis by ultrasound was significantly better [28].

According to a study published in 2013, US examination of nasal bones is a more accurate method for diagnosis of fractures than x-ray examination [29]. The diagnostic sensitivity and utility of high-resolution ultrasonography (HRUS) were compared with CT in 87 patients with nasal trauma. Ultrasonograms were obtained with a high frequency linear transducer (10 MHz). In that study, results of the sensitivity and specificity of HRUS, CT, and conventional radiography (CR) compared with clinical exam in the diagnosis of nasal bone fracture were: HRUS 97%, exam 100%; CT 86%, exam 87%; CR 72% and exam 73%. The sensitivity and specificity of HRUS and CR in detecting fracture line in comparison with CT were HRUS 100%, CT 91% and CR 79%, CT 95% [30]. In another study, the sensitivity and specificity of US in assessing nasal bone fracture in comparison with CT was 94.9% and 100%, respectively. The PPV and the NPV of US evaluation of the nasal bone fractures were 100% and 95.3%, respectively [31].

Lee et al. suggested that the accuracy rates for detecting nasal fractures by HRUS, CT, and conventional radiography were 100%, 92.1%, and 78.6%, respectively. Compared with HRUS, CT revealed only 196 of 233 lateral nasal bone fractures; its accuracy was 80%. In high-grade fractures, the accuracy of CT was 87%, but it decreased to 68% in low-grade fractures. Compared with HRUS, CT had lower accuracy, especially in low-grade nasal fractures [32]. To detect fractures of the nasal dorsum, both modalities had high sensitivity (US 98, x-ray 88%) and specificity (95% for both US and x-ray). In lateral nasal wall fractures, specificity was higher for x-ray (US 75%, x-ray 94%). Sensitivity was significantly higher for the US examination (US 98%, x-ray 28%) [33].

In conclusion, US is a reliable method for the diagnosis and management of nasal bone fractures. There are advantages of using US (fast, inexpensive, radiation free) and emergency clinicians easily can use US for diagnosis and in treatment of nasal fractures. Further studies of their use in emergency departments with enrolment of large patient groups are needed.

Competing interests

The authors declare that they have no competing interests.

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