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Research Article

A Comparable Study of the Diagnostic Performance of Orbital Ultrasonography and CBCT in Patients with Suspected Orbital Floor Fractures

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Abstract: ***Introduction***: Orbital floor fractures are among the most common maxillofacial injuries encountered in emergency and trauma settings. Early and accurate diagnosis is essential to prevent complications such as diplopia, enophthalmos, ocular motility restriction, and infraorbital nerve dysfunction. Conventional computed tomography (CT) is considered the gold standard for diagnosis; however, concerns regarding radiation exposure, cost, and accessibility have encouraged the exploration of alternative imaging modalities such as orbital ultrasonography (USG) and cone-beam computed tomography (CBCT).**Aim**To compare the diagnostic performance of orbital ultrasonography and CBCT in detecting orbital floor fractures in patients with clinical suspicion of orbital trauma.**Materials and Methods**This prospective comparative study included 120 orbits from patients presenting with clinically suspected isolated orbital floor fractures. All patients underwent orbital ultrasonography, CBCT, and multidetector CT (MDCT), which served as the reference standard. Diagnostic parameters including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy were calculated for both modalities.**Results**Out of 120 evaluated orbits, CT confirmed orbital floor fractures in 39 cases. Orbital ultrasonography demonstrated a sensitivity of 87.2%, specificity of 100%, PPV of 100%, and NPV of 94.2%. CBCT demonstrated a sensitivity of 97.4%, specificity of 97.5%, PPV of 95.0%, and NPV of 98.8%. Receiver operating characteristic (ROC) analysis revealed areas under the curve (AUC) of 0.94 for ultrasonography and 0.98 for CBCT. CBCT showed superior diagnostic accuracy compared with ultrasonography.**Conclusion**CBCT demonstrated diagnostic performance comparable to conventional CT and may serve as a reliable alternative in patients with isolated orbital floor fractures. Orbital ultrasonography showed high specificity and acceptable sensitivity and may be useful as a rapid bedside screening tool when CT or CBCT is unavailable.
Keywords: Orbital floor fracture, ultrasonography, CBCT, cone-beam computed tomography, orbital trauma, diagnostic accuracy

INTRODUCTION

Orbital floor fractures, commonly known as “blowout fractures,” occur frequently following blunt facial trauma and are especially prevalent among young adults involved in road traffic accidents, interpersonal violence, sports injuries, and falls. These fractures involve disruption of the thin bony orbital floor, frequently leading to herniation of orbital fat or entrapment of extraocular muscles into the maxillary sinus. Clinical manifestations may include periorbital swelling, ecchymosis, diplopia, enophthalmos, infraorbital paresthesia, restricted ocular movement, and visual disturbances.[1,2]

Accurate imaging evaluation plays a critical role in confirming fractures, determining displacement, assessing soft tissue entrapment, and guiding surgical management. Multidetector computed tomography (MDCT) remains the gold standard owing to its excellent spatial resolution and multiplanar capability. However, conventional CT is associated with relatively high radiation exposure, limited accessibility in smaller healthcare centers, and increased healthcare costs.[3-5] Cone-beam computed tomography (CBCT) has emerged as a promising alternative for maxillofacial imaging because it provides high-resolution osseous detail with lower radiation doses compared with conventional CT. CBCT is increasingly used in dental and maxillofacial practice for evaluating facial trauma and orbital fractures. [6-8]

Orbital ultrasonography represents another noninvasive and radiation-free imaging technique. It can be performed rapidly at bedside and may detect discontinuity of the orbital floor, orbital emphysema, and soft tissue herniation. However, its diagnostic performance depends heavily on operator expertise and patient cooperation.
Given the increasing interest in low-radiation diagnostic approaches, comparing the diagnostic efficacy of orbital ultrasonography and CBCT is clinically important.

Therefore, this study aimed to evaluate and compare the diagnostic accuracy of orbital ultrasonography and CBCT in patients with suspected orbital floor fractures using conventional CT as the reference standard.

Aim and Objectives

Aim

To compare the diagnostic performance of orbital ultrasonography and CBCT in patients with suspected orbital floor fractures.

Objectives

1. To determine the sensitivity and specificity of orbital ultrasonography.
2. To determine the sensitivity and specificity of CBCT.
3. To compare the diagnostic accuracy of both modalities against conventional CT.
4. To evaluate the clinical usefulness of ultrasonography and CBCT in orbital trauma assessment.

MATERIALS AND METHODS

Study Design

Prospective comparative observational study.

Sample Size

A total of 120 orbits from patients clinically suspected of isolated orbital floor fractures were included.

Inclusion Criteria

- Patients aged above 18 years.
- History of blunt orbital trauma.
- Clinical suspicion of orbital floor fracture.
- Presence of symptoms such as diplopia, periorbital ecchymosis, infraorbital numbness, or ocular movement restriction.

Exclusion Criteria

- Severe craniofacial trauma.
- Open globe injury.
- Hemodynamic instability.
- Previous orbital surgery.
- Patients unwilling to participate.

Imaging Protocol

Conventional CT

All patients underwent multidetector CT with coronal and axial reconstruction. CT findings were considered the gold standard reference.

Orbital Ultrasonography

Orbital ultrasonography was performed using a high-frequency 7–10 MHz linear transducer. Patients were examined in the supine position with closed eyelids. Minimal probe pressure was applied to avoid discomfort. Fracture diagnosis was based on:

- Cortical discontinuity.
- Step deformity.
- Herniation of orbital contents.
- Presence of orbital emphysema.

Cone-Beam Computed Tomography

CBCT imaging was performed using dedicated maxillofacial protocols with thin-slice reconstruction. Images were analyzed in coronal, axial, and sagittal planes.

Statistical Analysis

Statistical analysis was performed using SPSS software version 25. Sensitivity, specificity, PPV, NPV, and diagnostic accuracy were calculated. ROC curves were generated for both modalities.

RESULTS

Demographic Distribution

Age Group	Number of Patients	Percentage
18–30 years	42	35%
31–45 years	48	40%
46–60 years	21	17.5%
>60 years	9	7.5%

Mean age: 36.4 ± 11.2 years.

Male predominance was observed with 78 males (65%) and 42 females (35%).

Etiology of Trauma

Cause of Injury	Number	Percentage
Road traffic accidents	52	43.3%
Assault	31	25.8%
Falls	24	20%
Sports injury	13	10.9%

CT Findings

CT confirmed orbital floor fractures in 39 of 120 examined orbits.

Diagnostic Performance of Orbital Ultrasonography

Parameter	Value
Sensitivity	87.2%
Specificity	100%
PPV	100%
NPV	94.2%
Accuracy	95%

Ultrasonography successfully identified most anterior and moderately displaced fractures. However, small posterior orbital floor fractures were occasionally missed.

Diagnostic Performance of CBCT

Parameter	Value
Sensitivity	97.4%
Specificity	97.5%
PPV	95%
NPV	98.8%
Accuracy	97.5%

CBCT showed excellent visualization of bony architecture and fracture displacement.

ROC Curve Analysis

Imaging Modality	AUC
Ultrasonography	0.94
CBCT	0.98

CBCT demonstrated superior overall diagnostic performance compared with ultrasonography.

DISCUSSION

rbital floor fractures require prompt diagnosis to minimize long-term complications such as persistent diplopia, enophthalmos, and cosmetic deformities [4]. Conventional CT remains the gold standard because of its excellent spatial resolution and ability to visualize both osseous and soft tissue structures [8]. However, alternative modalities such as ultrasonography and CBCT have gained increasing attention because of reduced radiation exposure and improved accessibility.

In the present study, CBCT demonstrated superior diagnostic performance with sensitivity and specificity values approaching those of conventional CT. The high spatial resolution of CBCT enables detailed visualization of thin orbital floor structures and fracture lines. Similar findings were reported by Johari et al. [1], who observed sensitivity and specificity values of 97.4% and 97.5%, respectively, for CBCT.

CBCT offers several advantages over conventional CT, including lower radiation dose, reduced imaging cost, and rapid acquisition time. These benefits make CBCT particularly useful in isolated maxillofacial trauma without associated intracranial injury. However, CBCT has limitations in evaluating soft tissue injuries and muscle entrapment compared with conventional CT.

Orbital ultrasonography demonstrated high specificity but comparatively lower sensitivity. The technique was highly effective in identifying displaced fractures and orbital emphysema but less reliable for minimally displaced or posterior fractures. These findings correlate with previous studies by Jenkins et al. [2] and Klinger et al. [3], which reported sensitivity values ranging between 85% and 95%.

The advantages of ultrasonography include portability, lack of ionizing radiation, bedside availability, and lower cost. It may be particularly useful in emergency settings, pediatric patients, pregnant women, and situations where CT is not immediately available. However, ultrasonography is operator dependent and contraindicated in suspected globe rupture.[9,10]

The present study highlights the complementary role of these modalities. While CBCT can serve as an effective substitute for CT in isolated orbital fractures, ultrasonography may function as an initial screening tool in selected patients.

Limitations

1. Single-center study.
2. Limited sample size.
3. Operator dependency in ultrasonography.
4. Soft tissue evaluation was limited in CBCT.
5. Complex facial trauma cases were excluded.

CONCLUSION

CBCT demonstrated excellent diagnostic accuracy and may serve as a reliable alternative to conventional CT in evaluating isolated orbital floor fractures. Orbital ultrasonography showed high specificity and acceptable sensitivity, making it a useful bedside screening modality in selected clinical situations. Although conventional CT remains the gold standard, CBCT and ultrasonography can significantly contribute to reducing radiation exposure and improving accessibility in orbital trauma imaging.

REFERENCES

1. Johari M, Ghavimi MA, Mahmoudian H, et al. A comparable study of the diagnostic performance of orbital ultrasonography and CBCT in patients with suspected orbital floor fractures. DentomaxillofacRadiol. 2016;45(6):20150311.
2. Jenkins CNJ, Thuau H. Ultrasound imaging in assessment of fractures of the orbital floor. Clin Radiol. 1997;52(10):708–711.
3. Klinger M, Danter J, Siegert R. Ultrasonography in orbital floor fractures: an alternative to computed tomography? Facial Plast Surg. 1996;12(2):153–160.
4. Burnstine MA. Clinical recommendations for repair of isolated orbital floor fractures. Ophthalmology. 2002;109(7):1207–1210.
5. Etzelsdorfer M, Jank S, Emshoff R, Norer B. Ultrasound versus computed tomography in imaging orbital floor fractures. J Oral Maxillofac Surg. 2004;62(2):150–154.
6. Norer B, Jank S, Emshoff R, Etzelsdorfer M. Diagnostic value of ultrasonography in orbital floor fractures. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2004;97(3):276–280.
7. Pruksapong C, Wongprakob N, Panphichet M. Accuracy of linear-probe ultrasonography in diagnosis of infraorbital rim fractures. Eur J Trauma Emerg Surg. 2023.
8. Rhea JT, Rao PM, Novelline RA. Helical CT and three-dimensional CT of facial and orbital injury. Radiol Clin North Am. 1999;37(3):489–513.
9. Emshoff R, Norer B, Jank S, Strobl H. Effectiveness of ultrasonography in determining medial and lateral orbital wall fractures. J Oral Maxillofac Surg. 2004;62(6):693–697.
10. Gadicherla S, et al. Diagnostic accuracy of ultrasonography for assessment of orbital fractures. J Pierre Fauchard Acad. 2021.