SSR Institute of International Journal of Life Sciences
ISSN (O): 2581-8740 | ISSN (P): 2581-8732
Bhavthankar *et al*., 2024
DOI: 10.21276/SSR-IIJLS.2024.10.4.42

Original Article

open access

A Cross-Sectional Descriptive Study to Assess the Findings of High-Resolution Computed Tomography in the Evaluation of Clinically Suspected Cases of Trauma to Temporal Bone

Shrutika Bhavthankar[1]*, Meenal Mohgaonkar[2], Amol Jagdale[3], Devendra Kulkarni[4], Sujit Kandagatla[5], Aishwarya Gosavi[5]

[1]Junior Resident, Department of Radiology, SMBT Institute of Medical Sciences & Research Centre, MUHS Nashik, India
[2]Professor & Dean, Dept of Radiology, SMBT Institute of Medical Sciences & Research Centre, MUHS Nashik, India
[3]Professor & HOD, Dept of Radiology, SMBT Institute of Medical Sciences & Research Centre, MUHS Nashik, India
[4]Associate Professor, Dept of Radiology, SMBT Institute of Medical Sciences & Research Centre, MUHS Nashik, India
[5]Junior Resident, Department of Radiology, SMBT Institute of Medical Sciences & Research Centre, MUHS Nashik, India

***Address for Correspondence:** Dr Shrutika Bhavthankar, Junior Resident, Department of Radiology, SMBT Institute of Medical Sciences & Research Centre, MUHS Nashik, India
E-mail: pbshrutika@gmail.com

Received: 28 Mar 2024/ Revised: 04 May 2024/ Accepted: 18 Jun 2024

ABSTRACT

Background: High-Resolution Computed Tomography (HRCT) is essential in the radiographic evaluation of temporal bone injuries, providing detailed images that aid in diagnosing and treating temporal bone diseases. This study examines the prevalence, types, and outcomes of temporal bone fractures, emphasizing the role of HRCT in clinical assessment. To identify the findings obtained by HRCT temporal bone in the evaluation of temporal bone fractures, to evaluate the extent of fractures, and to study the sites of involvement and types of temporal bone fractures.

Methods: A retrospective analysis was conducted on 70 patients with suspected temporal bone trauma. HRCT scans assessed the fractures' location, type, and associated abnormalities. Data on patient demographics, mechanisms of injury, and clinical outcomes were also collected and analyzed.

Results: Most participants were 41-60 years old, with a male-to-female ratio of 1.5:1. Road traffic accidents (RTAs) were the leading cause of injury (42.86%). Longitudinal fractures were the most common (50%), predominantly affecting the petrous part (57.1%). Middle ear involvement was noted in 64.3% of cases, and ossicular chain disruption occurred in 42.9%. Full recovery was observed in 50% of patients.

Conclusion: HRCT is invaluable for diagnosing temporal bone fractures, offering detailed visualization of bony and soft tissue structures. It effectively identifies fracture types and associated complications, guiding precise surgical planning and management. The study underscores the significant role of HRCT in improving clinical outcomes for temporal bone injuries.

Key-words: High-Resolution Computed Tomography, HRCT, Temporal Bone Fractures, Road Traffic Accidents, Longitudinal Fractures, Middle Ear Involvement, Clinical Outcomes

INTRODUCTION

Skull base and temporal bone fractures often result from high-velocity head trauma. The temporal bone is particularly intricate and prone to complex injuries.

How to cite this article
Gurung S, Shrestha S, Karki J. Value chain of Pangasius (*Pangasius hypopthalmus*) in Rupandehi and Nawalparasi districts of Nepal. SSR Inst Int J Life Sci., 2024; 10(4): 6067-6072.

Access this article online
https://iijls.com/

The most common sensory organ injured is the ear.[1] The temporal bone is a crucial and intricate anatomical structure situated on the sides of the skull. In addition to protecting the brain by forming the borders of the middle and posterior cranial fossae, the temporal bone houses several critical structures, including the middle and inner ear, the 7th and 8th cranial nerves, the internal carotid artery, and the jugular vein.[2]

Several imaging modalities are available for evaluating the temporal bone, including plain radiographs, angiography, cerebrospinal fluid (CSF) analysis, air and non-ionic contrast cisternography, computed tomography (CT), and magnetic resonance imaging (MRI).[3] However, CT and MRI are currently the most commonly used techniques and have largely supplanted the other methods. Typically, patients with temporal bone pathology undergo an initial clinical examination, often including audiology tests.[4] Combining clinical information and imaging findings enables accurate and reliable diagnosis, minimizes misinterpretation, and ensures appropriate treatment. [5]

Currently, conventional radiography is primarily limited to assessing mastoid pneumatization. HRCT offers superior image contrast and spatial resolution.[6] HRCT is more effective in detecting various soft tissue abnormalities and is less susceptible to artefacts, making it a preferred choice over polytomography. Additionally, HRCT exposes the eye's lens to less radiation than polytomography.[7,8] Its capacity for rapid image processing through multiplanar reformation (MPR) enables detailed evaluation of skull base and temporal bone anatomy. Multidetector HRCT with MPR is essential for assessing the extent of injuries involving specific structures, significantly influencing patient care. Thus, this study aims to identify the findings obtained by HRCT temporal bone in evaluating temporal bone fractures.

MATERIALS AND METHODS

Study Design- Cross-sectional descriptive study.

Study Population- The patient was referred for high-resolution computed tomography temporal bone to the department of radio diagnosis of the tertiary care centre.

Sample size- 70

Inclusion criteria

- ✓ All the patients with head injuries with signs and symptoms, and suspicion of temporal bone fractures.
- ✓ Ear bleeding
- ✓ Hearing loss
- ✓ CSF otorrhoea
- ✓ Facial nerve weakness

Exclusion criteria

- ✓ Patient with non-traumatic temporal bone pathologies.
- ✓ Pregnant patients.

Methodology- The ethics committee of our institute approved this cross-sectional descriptive study, and informed consent was obtained from all participants. Patients with head injuries presenting with signs and symptoms suggestive of temporal bone fractures, such as ear bleeding, hearing loss, CSF otorrhea, and facial nerve weakness, were included. Exclusion criteria were head injuries requiring emergency surgical intervention, unwillingness to undergo HRCT, a history of infection, and pregnancy. Data collection involved obtaining all participants' written, informed, and verbal consent. Patients presenting to the Department of Radiodiagnosis with relevant signs and symptoms were included, and a detailed medical history was taken for each patient.

Statistical Analysis- Imaging findings were correlated with surgical findings wherever applicable. Data was analyzed using appropriate statistical methods.

RESULTS

70 participants were included in this study. In this study, it is observed that in the 0-20 years age group, there were 5 males (7.14%) and 3 females (4.29%), making up 8 participants (11.43%) in total. The 21-40 years age group consisted of 15 males (21.43%) and 12 females (17.14%), totalling 27 participants (38.57%). The 41-60 years age group included 18 males (25.71%) and 10 females (14.29%), with a total of 28 participants (40%). In the age group over 60 years, there were 4 males (5.71%) and 3 females (4.29%), making up 7 participants (10%) in total (Table 1).

In the study of age and gender distribution, the maximum number of participants was observed in the age group of 41 -60 years with a maximum of male participants than female. With a male-to-female ratio of 1.5: 1.

Table 1: Mechanism of the injury

Mechanism of Injury	Number of Patients (n)	Percentage (%)
Road Traffic Accidents (RTA)	30	42.86
Fall	20	28.57
Assault	10	14.29
Sports-related injuries	5	7.14
Other (specify)	5	7.14

ISSN (O): 2581-8740 | ISSN (P): 2581-8732
Bhavthankar *et al.*, 2024
DOI: 10.21276/SSR-IIJLS.2024.10.4.42

Road traffic accidents emerge as the leading cause, affecting 30 patients, constituting approximately 42.86% of cases. Falls follow closely behind, contributing to 20 cases (28.57%). Assault-related injuries account for 10 patients (14.29%), indicating a significant portion of temporal bone trauma results from violent encounters. Sports-related injuries are less frequent but still notable, with 5 cases (7.14%). An additional 5 cases fall under the other category, representing miscellaneous causes. In this study, 32 participants were present, representing 45.71%. Ear bleeding was the next most common symptom, observed in 16 participants, accounting for 22.86%. CSF otorrhea was present in 8 participants, making up 11.43% of the cases. Facial nerve weakness was noted in 5 participants, constituting 7.14% of the total. Other symptoms were reported by 9 participants, comprising 12.86% (Fig. 1).

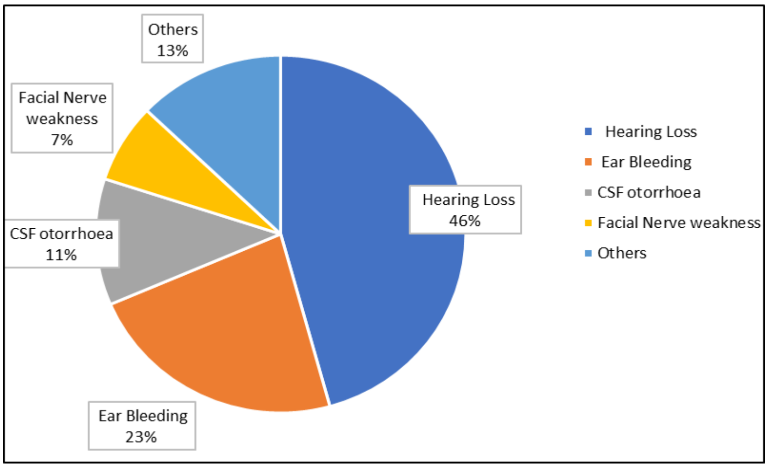

Fig. 1: Study of symptoms in the study population

In the fractures of the temporal bone by the specific parts affected and the patterns observed 22 had fractures in the squamous part of the temporal bone, with 15 being longitudinal, 5 transverse, and 2 mixed fractures, making up 31.43% of the total fractures. The mastoid part was affected in 18 cases, with 10 longitudinal, 3 transverse, and 5 mixed fractures, accounting for 25.71% of the total. The tympanic part saw 11 fractures, including 8 longitudinal, 2 transverse, and 1 mixed, representing 15.71% of the fractures. The petrous part had 16 fractures, with 7 longitudinal, 6 transverse, and 3 mixed, constituting 22.86%. There were 3 fractures in other unspecified parts of the temporal bone, with 2 longitudinal and 1 mixed, making up 4.29% of the fractures (Table 2).

Table 2: Parts of Temporal Bone Fracture with Pattern of Fracture in the study population

Temporal Bone	Longitudinal Fracture (n)	Transverse Fracture (n)	Mixed Fracture (n)	Total (n)	Percentage (%)
Squamous Part	15	5	2	22	31.43
Mastoid Part	10	3	5	18	25.71
Tympanic Part	8	2	1	11	15.71
Petrous Part	7	6	3	16	22.86
Other (specify)	2	0	1	3	4.29

The present study on different types of fractures and other abnormalities within the temporal bone and adjacent structures was conducted using HRCT scans. Longitudinal fractures were the most common in 50% of cases, followed by transverse fractures in 28.6% and mixed fractures in 21.4%. The fractures predominantly involved the petrous part of the temporal bone in 57.1% of cases; 28.6% were in the squamous part, and 14.3% involved both petrous and squamous parts. Middle ear involvement was observed in 64.3% of the cases, making

DOI: 10.21276/SSR-IIJLS.2024.10.4.42

it most frequent finding. Ossicular chain disruption was noted in 42.9% of the cases, indicating a significant impact on the auditory structures. Mastoid air cell opacification was present in 35.7% of cases, suggesting inflammation or infection. Temporal lobe contusions and petrous/squamous involvement were each found in 14.3% of cases. Facial canal dehiscence was noted in 21.4%, and the least common finding was sigmoid sinus thrombosis, occurring in 7.1% of the cases.

Table 3: Outcome in the study population

Outcome Parameters	Number of Patients (N)	Percentage (%)
Full Recovery	35	50
Partial Recovery	20	28.57
Persistent Symptoms	8	11.43
Hearing Improvement	5	7.1
Persistent Hearing Loss	2	1.43

Among these patients, full recovery was observed in 35 cases, representing exactly half of the study population. Partial recovery was noted in 20 patients, accounting for around 28.57% of the total. A notable proportion, comprising 8 patients or 11.43%, continued to experience persistent symptoms post-treatment. Additionally, hearing improvement was observed in 5 patients, constituting 7.1% of the cohort. However, a smaller fraction, consisting of only 2 patients (1.43%), unfortunately experienced persistent hearing loss despite interventions.

DISCUSSION

High Resolution Computed Tomography is crucial in the radiographic assessment of the temporal bone, aiding in diagnosing and treating temporal bone diseases. CT imaging allows for slices in various planes, facilitating a comprehensive understanding of complex anatomical relationships.[9] In the study, the age and gender distribution revealed that most participants were in the 41-60 age group. Additionally, there were more male participants than female participants, with a male-to-female ratio of 1.5:1. Similarly, an identical study conducted by Rajesh reported comparable findings, highlighting male dominance in the participant population.[10]

The study highlighted various mechanisms of injury among the 70 patients examined. RTAs were the leading cause, accounting for 30 patients, or 42.86% of the cases. This finding underscores the significant impact of vehicular accidents on temporal bone injuries, reflecting the high prevalence of RTAs in contributing to such traumas.

Hearing loss, observed in 32 patients (45.71% of the total), underscores the significant impact of temporal bone fractures on auditory function. Ear bleeding, noted in 16 patients (22.86%), indicates a common association with such injuries. CSF otorrhoea, reported in 8 patients (11.43%), highlights a serious complication of these fractures. The study by Thukral et al. stated that inner ear anomalies, though rare, contribute significantly to sensorineural hearing loss. In contrast, conductive hearing loss and cosmetic deformities are often linked to combined external and middle ear abnormalities. Temporal bone defects frequently involve alterations during the facial nerve canal, which is crucial in surgical planning. [11]

The fractures of the temporal bone by specific parts and patterns observed in the study revealed distinct distributions. The squamous part of the temporal bone was most frequently affected, with 22 fractures accounting for 31.43% of the total, comprising 15 longitudinal, 5 transverse, and 2 mixed fractures. The mastoid part was the second most common site, with 18 fractures (25.71%), including 10 longitudinal, 3 transverse, and 5 mixed fractures. The tympanic part experienced 11 fractures (15.71%), of which 8 were longitudinal, 2 were transverse, and 1 was mixed. The petrous part had 16 fractures (22.86%), with a more even distribution of 7 longitudinal, 6 transverse, and 3 mixed fractures.

Temporal bone fractures are classified based on their orientation relative to the long axis of the petrous bone. These fractures, though not uncommon, are frequently associated with significant morbidity.[12] Most experts agree that longitudinal fractures are the most prevalent type, followed by transverse, oblique, and mixed fractures. These fracture types are most effectively evaluated using axial imaging.[13] The study utilized HRCT scans to evaluate fractures and abnormalities within the temporal bone and adjacent structures. Longitudinal fractures (50%) were the most common, with the petrous part affected in 57.1% of cases. Middle ear

DOI: 10.21276/SSR-IIJLS.2024.10.4.42

involvement was frequent (64.3%), and ossicular chain disruption occurred in 42.9%. HRCT effectively identified these complexities, emphasizing its crucial role in diagnosing temporal bone injuries.

50% of patients fully recovered, while 28.57% experienced partial recovery. Persistent symptoms were observed in 11.43% of cases. Hearing improvement was noted in 7.1% of patients, but 1.43% continued to suffer from persistent hearing loss despite treatment. The study by Watts *et al.* mentioned that HRCT is less expensive and provides useful information about surgical trends.[14] HRCT offers the advantage of topographic visualization without artefacts from superimposed structures.[15] It includes detailed information on both bony structures and soft tissue changes, enabling accurate pathology assessment. This facilitates precise evaluation of the disease's location, extent, and complications before surgical exploration.[16]

CONCLUSIONS

Thus, this study underscores the critical role of High-Resolution Computed Tomography in assessing temporal bone injuries. HRCT's ability to provide detailed visualization of both bony structures and soft tissue changes allows for accurate diagnosis and effective surgical planning. The data revealed a higher prevalence of injuries among males, particularly from road traffic accidents, and highlighted the significant impact of these fractures on auditory function. Longitudinal fractures were most common, predominantly affecting the petrous part of the temporal bone. The study's findings emphasize the necessity of HRCT in identifying the complexities of temporal bone injuries and guiding appropriate treatment strategies.

CONTRIBUTION OF AUTHORS

Research concept- Dr Amol Jagdale
Research design- Dr Shrutika Bhvathankar
Supervision- Dr Meenal Mohgaonkar
Materials- Dr Shrutika Bhvathankar, Dr Aishwarya Gosavi
Data collection- Dr Shrutika Bhvathankar, Dr Sujit Kandagatla
Data analysis and Interpretation- Dr Shrutika Bhvathankar
Literature search- Dr Devendra Kulkarni
Writing article- Dr Shrutika Bhvathankar
Critical review- Dr Meenal Mohagaonlar
Article editing- Dr Shrutika Bhvathankar
Final approval- Dr Amol Jagdale

REFERENCES

[1] Shah C, Shah P, Shah S. Role of HRCT temporal bone in pre operative evaluation of choesteatoma. Int J Med Sci Public Health, 2014; 3(1): 69-72.
[2] Yildirim-Baylan M, Ozmen CA, Gun R, et al. An Evaluation of Preoperative Computed Tomography on Patients with Chronic Otitis Media. Indian J Otolaryngol Head Neck Surg 2012; 64(1): 67-70.
[3] Rogha M, Hashemi SM, Mokhtarinejad F, et al. Comparison of Preoperative Temporal Bone CT with Intraoperative Findings in Patients with Cholesteatoma. Iran J Otorhinolaryngol 2014; 26 (74): 7-12.
[4] Nitin G, Saurabh V, Rajat B. A Study of Temporal Bone Fractures Indian J Otolaryngol Head Neck Surg., 2008; 60: 223-26.
[5] Hiroual M, Zougarhi A, Essadki O, Ousehal A, Tijani AO, et al. High-resolution CT of temporal bone trauma: review of 38 cases. J Radiol., 2010; 91(1): 53-58.
[6] Maqsood S, Iqbal HD, Shabir AB. Role of high-resolution computed tomography in evaluation of temporal bone diseases. IAIM, 2018; 12(5): 15-22.
[7] Thukral CL, Singh A, Singh S, Sood AS, Singh K. Role of High-Resolution Computed Tomography in Evaluation of Pathologies of Temporal Bone. J Clin Diagn Res., 2015; 9(9): TC07-10.
[8] Collins JM, Krishnamoorthy AK, Kubal WS, Johnson MH, Poon CS. Multidetector CT of temporal bone fractures. Semin Ultrasound CT MR, 2012; 33(5): 418-31.
[9] Watts S, Flood LM, Cli-Vord K. A systematic approach to interpretation of computed tomography scans prior to surgery of middle ear cholesteatoma. J Laryngol Otol., 2000; 114: 248-53.
[10] Dr Rajesh S. Role of High-Resolution Computed Tomography (HCRT) in Evaluation of Pathologies of Temporal Bone. JK Sci., 2018; 20(3): 153-58.
[11] Thukral CL, Singh A, Singh S, Sood AS, Singh K. Role of High-Resolution Computed Tomography in Evaluation of Pathologies of Temporal Bone. J Clin Diagn Res., 2015; 9(9): TC07-10.
[12] Swartz JD. Temporal bone trauma. Semin Ultrasound CT MR, 2001; 22(3): 219-28.

DOI: 10.21276/SSR-IIJLS.2024.10.4.42

[13] Collins JM, Krishnamoorthy AK, Kubal WS, Johnson MH, Poon CS. Multidetector CT of temporal bone fractures. Semin Ultrasound CT MR, 2012; 33(5): 418-31.

[14] Watts S, Flood LM, Banerjee A, Clifford K. A systematic approach to interpretation of computed tomography scans prior to surgery of middle ear cholesteatoma. J Laryngol Otol., 2000; 114: 248-53.

[15] Hashemi J, Rajati M, Rezayani L, Bahadori A. Temporal Bone Measurements; A Comparison Between Rendered Spiral CT and Surgery. Iran J Radiol., 2014; 11(3): 9400-25.

[16] Hari RJ, Sheena D, Mark S, Neel P. High Resolution Computed Tomography in the Evaluation of Temporal Bone pathology. IJMBS, 2021; 5(9): 180-89.