

Auditory Consequences of Zygomaticomaxillary Complex (ZMC) Fractures: A Case Study

Sthitaprajna Lenka¹, Karan Baruah^{2*}, Santosh K. Subudhi³, Anandamay Goswami⁴, Susmita Nayak⁵,
Someswar Chakraborty⁶, Jyotiranjana Mohanty⁷, Anubhav Dey⁸

^{1,3}Professor, Department of Oral & Maxillofacial Surgery, Institute of Dental Sciences, Siksha 'O' Anusandhan (Deemed to be University),
Bhubaneswar, Odisha, India

^{2,4,5,6,7,8}Post Graduate Trainee, Department of Oral & Maxillofacial Surgery, Institute of Dental Sciences, Siksha 'O' Anusandhan (Deemed
to be University), Bhubaneswar, Odisha, India

Abstract: Zygomaticomaxillary Complex (ZMC) Fracture is basically a very complicated fracture which affects the facial bones, orbit and maxilla. A close anatomical proximity of the Zygomaticomaxillary Complex to important structures such as Temporomandibular joint (TMJ), Eustachian tube and Facial nerve put concerns on general health of an ear. It is evident that, within two years of the injury, Zygomaticomaxillary Complex Fractures are linked to a higher chance of acquiring ear-related conditions such as Peripheral Vertigo, Tinnitus, and Sudden Hearing Loss. There is also a higher chance of developing trigeminal neuralgia in people with zygomaticomaxillary complex (ZMC) fractures. There should be comprehensive ear examinations and appropriate managements in patients having ZMC Fractures to reduce the impact on ear health. The goal of this article is to investigate the possibility of risk of ear-related illnesses following fractures to the zygomaticomaxillary complex (ZMC).

Keywords: Zygomaticomaxillary Complex Fracture, Tinnitus, Trigeminal Neuralgia, Peripheral Vertigo, Hearing Loss.

1. Introduction

The main structure of the middle third of the facial skeleton, known as the Zygomaticomaxillary Complex (ZMC), is made up of the Zygoma and Maxilla. The primary structure is made up of progressively thick and thin segments of bone that are capable of withstanding tremendous pressure. This contributes to midface projection, occlusion support, and safeguarding of the brain and globes. The Zygomaticomaxillary Complex (ZMC) is an essential component of the facial skeleton, providing structural and functional roles. ZMC is especially vulnerable to damage because of its most pronounced convex shape [1]. Single buttress of ZMC (Zygomaticomaxillary complex Fracture) may be fractured as a result of facial trauma, but Tetrapod fractures involving all four buttresses are more common. A detailed head and neck examination is essential for a precise clinical diagnosis, that is made with an ophthalmologic consultation when needed. Computed Tomography (CT) is the gold standard for both surgical planning and clinical diagnosis confirmation.

After nasal fractures, which are the most frequent kind of facial fracture, ZMC fractures are the second most common [2].

In developed nations, assault is thought to be the primary contributing factor rather than accidents involving motor vehicles, while in developing nations, car crashes are among the most prevalent causes [3], [4].

ZMC Fractures is basically an osseous disturbance of the malar eminence at the 4 buttresses; that is the Zygomaticomaxillary, Frontozygomatic, Zygomaticosphenoid, and Zygomaticotemporal buttresses. Because of its distinct anatomical structure, even moderately displaced fractures can cause deformities which are both functionally and visually attractive. Depending on the underlying injuries, individuals who suffer from zygomaticomaxillary complex (ZMC) Fractures might suffer from a variety of signs and symptoms that involve soft tissue swelling, fluid retention, ecchymosis, the cheek numbness, trismus, diplopia, and epistaxis. Apart from these, we may also observe issues related to the ears, such as immediate loss of hearing, tinnitus, a condition called trigeminal neuralgia, and dizziness.

2. Consequences of ZMC Fracture

The potential damage or harm caused to the middle ear structures is the main risk factor for the development of ear-associated conditions that follows after ZMC fracture. The content of middle ear is ear ossicles which has 3 small bones that is Malleus, Incus and Stapes. These ear ossicles are responsible for transmitting sound wave or sound vibration from tympanic membrane or eardrum to the inner ear. Whenever ZMC fracture occurs the force of impact damage these fine structures which leads to conductive hearing loss, tinnitus, or even it may damage the inner ear.

ZMC Fracture can also result in damage to the temporomandibular joint (TMJ). Temporomandibular joint or TMJ acts like hinge joint or sliding joint and connects jaw bone to the skull. Abnormality in TMJ functions results in ear pain, tinnitus and even dizziness.

ZMC fracture can also lead to damage to facial nerve and lead to facial nerve paralysis and complications involving the ear, changes in taste, hyperacusis, and hearing loss. Facial nerve which runs through temporal bone and is in close association

with the ZMC.

Infections is another major issue or problem in ZMC Fracture that can have impact on ear. Fracture line close to sinuses and nasal passages increases the risk of infection spreading to the middle ear which leads to otitis media or other related complications.

3. Discussion

A. Tinnitus

The sensation of ringing or any additional sound in either one or both ears when there is no interference or noise is known as tinnitus. It is a prevalent disorder, with an average incidence of 10% to 15%. Tinnitus can be triggered on by head and neck trauma, ototoxic medications, or even psychological stress [5], [6]. Certain studies have suggested that tinnitus may arise from injury to the neck and emotional trauma besides being due to head injuries caused by mechanical, pressure, or noise exposure. It is necessary to make an appropriate diagnosis.

Pulsatile tinnitus is a rare kind of tinnitus where people hear noise which may be loud or soft and often tends to happen in time with their heartbeats. People often hear rhythmic thumping, whooshing or throbbing in one or both the ears. Arteriovenous malformations, carotid dissections, and carotid artery fistulas are among the more serious underlying diseases or conditions for which pulsatile tinnitus is thought to be the first indication. Once the underlying condition is identified and treated, the condition of pulsatile tinnitus is also successfully treated [5].

Tinnitus occurred in 8% of individuals with head injuries, as reported by Vernon and Press [6]. Folmer and Greist also stated that tinnitus is regarded as a critical symptom, but the condition is more severe when it arises from neck and head injury than from other causes [7]. According to various research it has found that tinnitus is considered as a remarkable or important symptoms commonly seen in head or neck injuries. Treatment for patients who have suffered from head and neck trauma requires a thorough examination because it has been observed that tinnitus from these traumas will be more serious than tinnitus from other causes.

An increase in uncontrolled firing rate or an increase in neuronal activity may be the result of damage to the auditory or nonauditory pathway.

The cranial nerve or the brain could also be injured in addition to the impact to the midface region, which causes damage to the external auditory canal, tympanic membrane, cochlea, and skull base. Tinnitus is more common in patients who have had a ZMC fracture for these reasons. Given the distinctive characteristics of each trauma mechanism, each and every ZMC fracture case needs to be meticulously and individually examined.

B. Trigeminal Neuralgia

An alternative term for trigeminal neuralgia is "TIC DOULOUREUX." It typically ranges from only a few seconds up to several minutes and causes sudden, intense, intermittent facial pain that feels like burning, stabbing, or electric shock. It

a chronic pain disorder involving the trigeminal nerve of face and cause sudden, severe facial pain. This disease usually first manifests in middle aged and old aged, but it can also affect children and adolescents [8]. It has been shown that Microvascular Decompression (MVD) is a secure and successful treatment for Trigeminal Neuralgia (TGN) in adults. Patients with childhood-onset symptoms do not respond to Microvascular Decompression (MVD) therapy in the same way as those whose Trigeminal Neuralgia (TGN) onset occurs in adulthood. Both a higher prevalence of venous compression and a longer time frame for symptom onset prior to Microvascular Decompression (MVD) were observed in this cohort. The lower effectiveness of Microvascular Decompression (MVD) in this patient population could be caused by these reasons.

Demyelination of the sensory fibers in the intracranial or extracranial parts of the trigeminal nerve is the mechanism behind trigeminal neuralgia. The ganglion, divisions, root, and brain stem are all included in the intracranial portion. The terminal branches comprise the extracranial portion. Demyelination may result from trauma force or compression from outside brought on by different kinds of tumors or vessels. Amyloidosis, Charcot-Marie-Tooth disease, and multiple sclerosis are examples of systemic illnesses that can also cause trigeminal neuralgia.

We have discovered through multiple studies that there was a higher occurrence of trigeminal neuralgia in cases of ZMC fracture. Direct trauma to the nerve, compression by a bony fragment, a hematoma and even posttraumatic swelling of the tissues and edema are the causes. A thorough physical examination, a thorough history, and an advanced imaging study assist medical professionals in providing accurate diagnoses and prompt treatment recommendations.

C. Sudden Hearing Loss

Seen especially in patients who have experienced a temporal bone fracture [9]. Additionally, it has been observed that patients, even those with mild head traumas, are at an increased risk of developing hearing impairment in the immediate aftermath of their injuries and in the early stages of Hearing loss is the most frequent symptom following head trauma, their recovery. Hearing loss, both conductive and sensorineural, is a common side effect of closed head injuries, whether or not a bone fracture occurs [10]. Contralateral loss of hearing is typically associated with labyrinthine concussions, whereas ipsilateral, or same side, sensorineural loss of hearing is most frequently observed in the transverse form temporal bone fractures [11]. The relationship between sudden hearing loss and ZMC fracture has not been thoroughly studied. Trauma, sensorineural injury, or both may have a role in the development of sudden hearing loss following a ZMC fracture. In the event that hearing loss is discovered in the early post-traumatic phase, specific tests, such as audiologic testing, otologic and neuro-otologic examinations, and image studies, must be performed on patients with ZMC fractures. However, it has been discovered that ZMC fracture patients have a bigger chance of hearing loss than do patients without ZMC fractures. However, there is still more to learn about this relationship.

D. Vertigo

Vertigo is characterized by an unexpected spinning feeling that we experience even though we are not moving. Vertigo is categorized as Central or Peripheral depending on where the vestibular pathway malfunction is located [12]. One of the major symptoms seen in patients with head injury is post-traumatic vertigo with incidence range from 34-50% [13].

Damage to the neck, head, and cranio-cervical junction can affect the brain-stem, cerebellum, and vestibular system in different places, including the vestibule, the vestibular nerve, and the semicircular canals [14]. Vertigo is thereby brought on by all of these variables. Research indicates that the identification of the underlying disorders is necessary for a high success rate in treating post-traumatic vertigo. When conservative treatment management proves to be ineffective, surgery should be the only option available for management. Any minor trauma to the head, neck, or cranio-cervical junction is likely to have a significant impact on the vestibular system's function at various locations. Even in trauma patients whose vertigo takes several weeks or months to start, a thorough diagnosis is still necessary.

Another cause of vertigo is post-traumatic peri-lymphatic fistula in which the symptoms of vertigo can be corrected by surgery [15], [16].

Patients with ZMC Fracture will have typically have large impact on force and related injuries. Hence a strict and careful examination need to be performed and also physical examination. Imaging tools which are required for obtaining detailed information regarding associated injuries are high resolution CT imaging or else MRI. A few tests that assist doctors in making an accurate diagnosis are computerized dynamic post-urography, rotation testing, head-thrust testing, Dix-Hallpike maneuver, and electronystagmography.

4. Methodology

20 patients diagnosed with ZMC fractures that reported to the dept of Oral & Maxillofacial Surgery from 1st January'24 to 31st May'24 were included in the study.

12 male patients and 8 female patients were included.

All routine investigations and radiographs were done for all the patients.

They were checked for ear - associated diseases as described in the literature above namely Tinnitus, Vertigo, Trigeminal Neuralgia and hearing loss.

BERA (Brainstem Evoked Response Audiometry) test was done for all the patients.

5. Results

Out of 20 patients that were included in the study, 4 recorded sudden hearing loss after the fracture, 2 of them reported with vertigo and 3 with persistent tinnitus. There were no reports of associated trigeminal neuralgia.

A total of 11 patients reported with so complications.

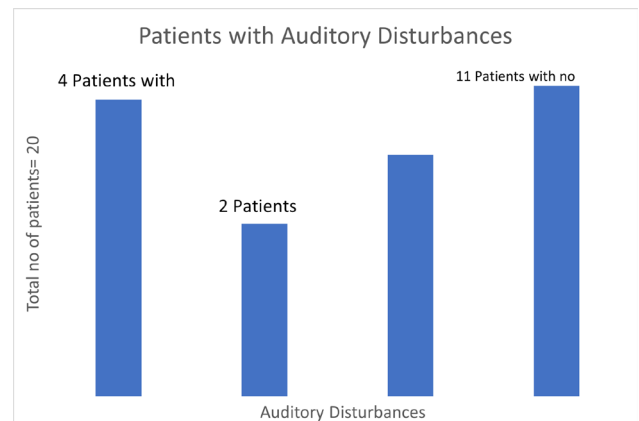


Fig. 1. Patients with auditory disturbances

6. Conclusion

In particular, during the first two years following injury, this study indicates that people with ZMC fractures may be more susceptible to ear-related conditions such as sudden loss of hearing, tinnitus, neuralgia of the trigeminal nerve, and peripheral vertigo. Since the Zygomaticomaxillary Complex fracture (ZMC) is unique in both location and structure, the same force that produces ZMC fractures may also cause related damage to the structures nearby. These may be the reason for illnesses linked to the ears. For an early diagnosis and appropriate treatment, we recommend doing thorough tests on all patients who have ZMC fractures.

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