



ROLE OF CT FOR THE ASSESSMENT OF TEMPORAL BONE FRACTURE

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Abstract:

Temporal bone fractures are classified as longitudinal or transverse fractures, each with its own set of clinical characteristics. Transverse fractures mostly result in conductive hearing loss, but longitudinal fractures virtually always result in abrupt deafness, typically accompanied by vertigo. Longitudinal fractures are the most common cause of facial nerve paralysis. Imaging is considered essential in temporal bone fractures. To diagnose fractures, both temporal bones must be compared, as well as knowledge of normal temporal bone architecture, sutures, and fissures. It should be noted that delayed imaging is frequently necessary in the case of transverse fractures, since the concomitant middle ear and mastoid blood deposition may hide ossicular separation in the beginning, both clinically and on imaging. Because of its lower radiation doses and superior resolution, cone beam CT is favoured over CT for the examination of temporal bone fractures.

Keywords: Fracture, CSF leak, vertigo, longitudinal fracture, conductive hearing loss.

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Introduction:

Computed tomography (CT) is the imaging modality of choice for the assessment of temporal bone fracture. It is a non-invasive procedure that uses X-rays to create detailed images of the bones and soft tissues of the head and neck. Computed Tomography can be used to identify fractures, as well as any associated injuries to the inner ear, middle ear, and facial nerve.

Computed Tomography is particularly useful for evaluating temporal bone fractures because it can provide detailed images of the complex anatomy of the temporal bone. This information can be used to determine the extent of the fracture and to plan appropriate treatment. Computed Tomography is also useful for identifying complications of temporal bone fracture, such as hearing loss, vertigo, and facial paralysis. These complications can occur if the fracture damages the inner ear, middle ear, or facial nerve.

If someone have been diagnosed with a temporal bone fracture, their doctor may recommend CT to assess the extent of your injury and to plan appropriate treatment. CT is a safe and effective procedure that can provide valuable information about your condition.

Here are some of the findings that CT can identify in temporal bone fractures:

- Fracture lines.
- Air or fluid in the middle ear or inner ear.
- Ossicles (small bones in the middle ear) damage.
- Damage to the facial nerve.
- Cerebrospinal fluid leak.

CT can also be used to assess the severity of a temporal bone fracture and to determine whether there are any associated injuries. This information can be used to plan appropriate treatment and to monitor the patient's progress.

Etiology:

A large lateral strain to the cranium causes Temporal bone fractures. There are a number of different causes of temporal bone fractures such as motor vehicle accidents, assaults, and falls account for almost one-third of all temporal bone fractures in the general population and additionally:

- Blunt force trauma, such as a blow to the head from a fall or a car accident
- Gunshot wounds
- Sports injuries
- Surgical procedures

Epidemiology:

It is estimated that temporal bone fractures occur in approximately 20% of all cases of head trauma. CT is the most common imaging modality used to

diagnose temporal bone fractures, and it is estimated that CT is used in approximately 80% of cases.

Males are at least three times more likely to suffer temporal bone fractures than females. Unilateral temporal bone fractures are common.^{[1][2]}

Pathophysiology:

The temporal bones are the thickest cranium base components. The fracture path will be determined by the path of least resistance relative to the direction of the starting force, which will commonly include the pneumatized parts of the bone rather than the denser petrous component. According to dynamic loading tests, a lateral impact force of 6000 to 8000 Newton (N) is required to create a fracture.^[3] The pathophysiology of a temporal bone fracture is complex and varies depending on the location and severity of the fracture. However, some common findings associated with temporal bone fracture include: Hearing loss, Vertigo, Dizziness, Tinnitus, Facial paralysis, Cerebrospinal fluid leak, Infection.

History and Physical:

Any history of significant trauma to the head, especially with hearing loss, vertigo, dizziness, tinnitus, facial paralysis, cerebrospinal fluid leak, or infection should elicit suspicion for cranial bone fractures. On physical examination patients with head and neck injuries such as bruises, cuts or swelling, palpation and Vertigo, nystagmus, facial paralysis, conductive or sensorineural hearing loss, and ear canal laceration are all symptoms of vertigo. Patients with neurological examination to assess the patient's mental status, cranial nerves, motor function, and sensory function.

Evaluation:

Computed tomography (CT) is the imaging modality of choice for the assessment of temporal bone fracture. Computed tomography (CT) has a significantly higher sensitivity for temporal bone fractures than a physical examination.^[4] This is a non-invasive procedure that utilizes X-rays to generate comprehensive images of the bones and soft tissues in the head and neck area. CT can be used to identify fractures, as well as any associated injuries to the inner ear, middle ear, and facial nerve.

CT is particularly useful for evaluating temporal bone fractures because it can provide detailed images of the complex anatomy of the temporal bone. This information can be used to determine the extent of the fracture and to plan appropriate

treatment. There is a strong link to intracranial injury, and the temporal bone fracture may be discovered on a conventional head CT. To better define a temporal bone fracture, a non-contrast, high-resolution CT with less than 1.5-mm slice thickness and coronal/sagittal reconstructions is indicated.

There are three main types of fractures that can affect the temporal bone:

- Longitudinal fractures run parallel to the long axis of the petrous portion of the temporal bone. They are the most common type of temporal bone fracture, accounting for about 70% of all cases. Longitudinal fractures typically do not cause significant damage to the inner ear or facial nerve.
- Transverse fractures run perpendicular to the long axis of the petrous portion of the temporal bone. They are less common than longitudinal fractures, accounting for about 20% of all cases. Transverse fractures are more likely to cause damage to the inner ear and facial nerve.
- Comminuted fractures are characterized by multiple fracture lines that break the bone into small pieces. They are the least common type of temporal bone fracture, accounting for about 10% of all cases. Comminuted fractures are more likely to cause significant damage to the inner ear and facial nerve than other types of temporal bone fractures.
- Longitudinal fractures are typically caused by a blow to the side of the head that travels in a forward or backward direction. They are more common in children than adults.
- Transverse fractures are typically caused by a blow to the top of the head that travels in a horizontal direction. They affect adults more than youngsters.
- Comminuted fractures are typically caused by a high-impact injury, such as a fall from a great height or a motor vehicle accident. They can arise at any age.

The symptoms of a temporal bone fracture can vary depending on the type and severity of the fracture. Some common symptoms include: Hearing loss, Vertigo, Dizziness, Facial paralysis, Tinnitus, Pain, Swelling, Bruising. Audiometric testing to assess for any potential hearing loss, vestibular testing to detect vertigo or nystagmus, and nerve conduction studies for facial nerve paresis or paralysis are all part of an extensive additional workup. Historically, the minimal nerve excitability test or maximal stimulation test was used to evaluate the facial nerve; however, these tests have been superseded by more precise testing and are only listed for completeness. If a temporal

bone fracture causes instant, total facial nerve paralysis, urgent surgical exploration is required. Further nerve function testing is recommended if there is new facial paresis following a temporal bone fracture.

Treatment / Management:

- Acoustic neuroma: An acoustic neuroma is a benign tumor that grows on the facial nerve. It can cause hearing loss, tinnitus, and facial paralysis.
- Cholesteatoma: A cholesteatoma is a benign tumor that grows in the middle ear. Hearing loss, ear pain, and discharge are all possible side effects.
- Infection: Infection can cause inflammation and swelling in the temporal bone. It can result in hearing loss, ear discomfort, and discharge.
- Meningitis: Meningitis is an inflammation of the membranes around the brain and spinal cord. It can cause fever, headache, stiff neck, and nausea.
- Temporal bone tumor: A temporal bone tumor is a rare type of tumor that grows in the temporal bone. Excessive exposure to noise has the potential to result in auditory impairment, discomfort in the ears and the discharge of fluid.
- CSF leak
- Conductive hearing loss
- Sensorineural hearing loss
- Vertigo

Prognosis:

The overall prognosis of the patient is determined by intracranial involvement. The following are the prognoses for common temporal bone fracture complications:

- Hearing loss: Hearing loss can occur if the fracture damages the bones in the middle ear or the inner ear.
- Facial nerve paralysis: Facial nerve paralysis can occur if the fracture damages the facial nerve. This might result in muscle weakness or paralysis on one side of the face.
- Infection: Infection can occur if the fracture breaks through the skin and allows bacteria to enter the bone.
- Meningitis: The inflammation of the membranes that compass the brain and spinal cord is known as meningitis. The circumstance may take place when bacteria from a fracture in the temporal bone spread to the meninges.

Complications:

- Facial paralysis: CN VII damage.
- Conductive hearing loss: Ossicle/tympanic membrane rupture, hemotympanum can also cause conductive hearing loss.

- CSF leak
- Meningitis
- Meningocele
- External Auditory Canal Stenosis

Consultations:

Interprofessional collaboration is required for the successful treatment and care of patients with temporal bone fractures. Consult trauma surgery, neurosurgery, otolaryngology, and neurotology. Following the ABCD approach and consulting with the appropriate specialists is required in all trauma situations, regardless of the pathology discovered on imaging examinations. Most patients with no intracranial injuries have good outcomes, but those with brain pathology have a guarded outlook. certain patients may have long-term persistent neurological impairments, with certain sequela lowering patients' quality of life.

Pearls and other issues:

- Pearls:
 - CT is the gold standard imaging modality for evaluating temporal bone fractures.
 - CT can show the location, extent, and severity of the fracture.
 - CT can also show any damage to the surrounding structures, such as the brain, the ear, and the facial nerve.
 - Other issues:
 - CT exposes the patient to ionizing radiation.
 - CT can be expensive.
 - CT scans can be time-consuming.
- Here are some of the specific findings that can be seen on CT scan of temporal bone fracture:
- Fracture line: A fracture line is a break in the bone that can be seen on CT scan. The fracture line may be linear, curved, or irregular.
 - Air: Air may be seen in the temporal bone if the fracture has caused a break in the bone that communicates with the air outside the body.
 - Blood: Blood may be seen in the temporal bone if the fracture has caused a break in the bone that communicates with the blood vessels.
 - Edema: Edema is swelling that can be seen on CT scan. Edema is often seen around the site of a fracture.
 - Hematoma: A hematoma is a collection of blood that can be seen on CT scan. A hematoma may be seen around the site of a fracture.
 - Dislocation: A dislocation is a condition in which the bones in a joint are not properly aligned. A dislocation may be seen in the temporal bone if the fracture has caused the bones in the joint to become misaligned.
 - Injury to surrounding structures: A temporal bone fracture may also cause injury to the surrounding

structures, such as the ear, the brain, and the facial nerve. These injuries may be seen on CT scan.

Results:

The results of a computed tomography (CT) scan for the assessment of temporal bone fracture can vary depending on the type and severity of the fracture. However, some common findings on CT scan of temporal bone fracture include:

- Fracture lines.
- Air or fluid in the middle ear or inner ear.
- Ossicles (small bones in the middle ear) damage.
- Damage to the facial nerve.
- Cerebrospinal fluid leak.
- CT scan can also be used to assess the severity of a temporal bone fracture and to determine whether there are any associated injuries. This information can be used to plan appropriate treatment and to monitor the patient's progress. Here are some of the possible findings on a CT scan of a temporal bone fracture.
- Air or fluid in the middle ear or inner ear: This finding can be seen in temporal bone fractures that involve the middle ear or inner ear. Air or fluid in the middle ear or inner ear can cause hearing loss, vertigo, and other symptoms.
- Damage to the ossicles: The ossicles are small bones in the middle ear that help to transmit sound waves to the inner ear. Hearing loss can occur when the ossicles are damaged.
- Damage to the facial nerve: The facial nerve is a nerve that controls the muscles of facial expression. Facial paralysis may occur as a result of damage to the facial nerve.
- Cerebrospinal fluid leak: Cerebrospinal fluid (CSF) is a fluid that surrounds the brain and spinal cord. A CSF leak can occur if a temporal bone fracture damages the bones that surround the brain and spinal cord. A CSF leak can cause a number of symptoms, including headache, nausea, and vomiting.

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