

The key to surgery of rare maxillofacial fracture: A case report

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Abstract: The naso-orbital-ethmoid complex (NOE) fracture is a rare maxillofacial fracture, with an incidence of about 5% among all maxillofacial fractures. NOE complex damage may result in severe facial dysfunction and malformation. We report the case of an 18-year-old Indonesian woman presenting with pain on the right side of her face after falling from a motorcycle in a traffic accident 3 days prior to her admission to the hospital. There was no history of unconsciousness. Physical examination revealed periorbital hematoma, periorbital bleeding, crepitation in the superior and inferior orbits, and a positive bowstring test. A head CT 3D reconstruction was evaluated and showed a right type III NOE fracture. An elective open reduction and internal fixation were performed. The management of NOE complex fractures is challenging and requires comprehensive clinical examination and radiographic analysis to assess the type and severity of the fracture. Immediate and proper reconstruction can yield better results.

Keywords: *Naso-orbital-ethmoid (NOE) fracture, Maxillofacial fracture, Trauma.*

1. Introduction

The naso-orbital-ethmoid (NOE) fracture is a rare maxillofacial fracture. The incidence is 5% among all maxillofacial fractures [1]. The anatomy of NOE complex consists of bone structure, medial canthal tendon, and nasolacrimal duct. Structure of bones are composed by frontal bone, frontal process of maxilla, lacrimal bone, lamina papyracea of ethmoid bone, dan sphenoid bone [2]. It was bordered with frontal cranial fossa, frontal sinus, and medial orbital wall [3]. This structure is connected with brain and eyes that separate nasal and orbital cavum from the brain. The strength of this structure is within vertical and horizontal buttress⁴. The area of NOE complex was vascularized from internal carotid artery branch and innervated by ophthalmic nerve and maxilla branch of trigeminal nerve². Since the NOE fracture has complex anatomical structure, any minor damaged will disrupt function and aesthetic appearance of the face. Besides, trauma of the NOE area also could disrupt the frontal sinus drainage^{4,5}. The management of NOE fracture should be considered carefully. However, the surgery of NOE fracture is one of the most challenging maxillofacial reconstructions.

2. Case Presentation

An 18-year-old woman came to the emergency room of Dr Soetomo General Academic Hospital with chief complain pain on right side of her face. The patient felt the pain three days after she fell from the motorcycle. The patient fell from the motorcycle to the right side so her face hit the road hardly. She wore half-face helmet at the accident. There were no nausea, vomiting, dizziness, and history of unconsciousness. Since the area around her eyes keep bleeding, and the pain became worse, the patient came to emergency room of National Hospital first, then she was referred to emergency room of Dr Soetomo General Academic Hospital.

A primary survey was conducted, revealing a *compos mentis* patient with a patent airway and a stable cervical spine. Evaluation of the breathing showed no external lesions or intercostal retractions. Chest movement and tactile fremitus were symmetrical, and no crepitations were noted. Percussion of the lung fields demonstrated sonorous sound bilaterally. Auscultation of lung fields were clear bilaterally with vesicular breath sound and no additional breath sounds. From the circulation, warm acral, capillary refill time less than 2 seconds. Blood pressure was 118/83 mmHg, 101 times/minute heart rate. From abdominal inspection we found no lesion, normal bowel sound, tympanic on abdomen percussion, non-tender abdominal palpation, and there was no muscle guarding. From disability evaluation, we found 15 Glasgow Comma Scale, right pupil was difficult to evaluate, left pupil diameter was 3 mm, swinging light test of right eye was difficult to evaluate, and the results of left eye was positive.

In maxillofacial examination, we found deformity, periorbital hematoma and bleeding, periorbital crepitation, and a positive bow string test. From the imaging, we evaluate head CT and 3D reconstruction. The result was right naso-orbital-ethmoidal comminuted fracture, right orbital floor fracture, superior and inferior orbital wall fracture. The imaging shown in Figure 1.

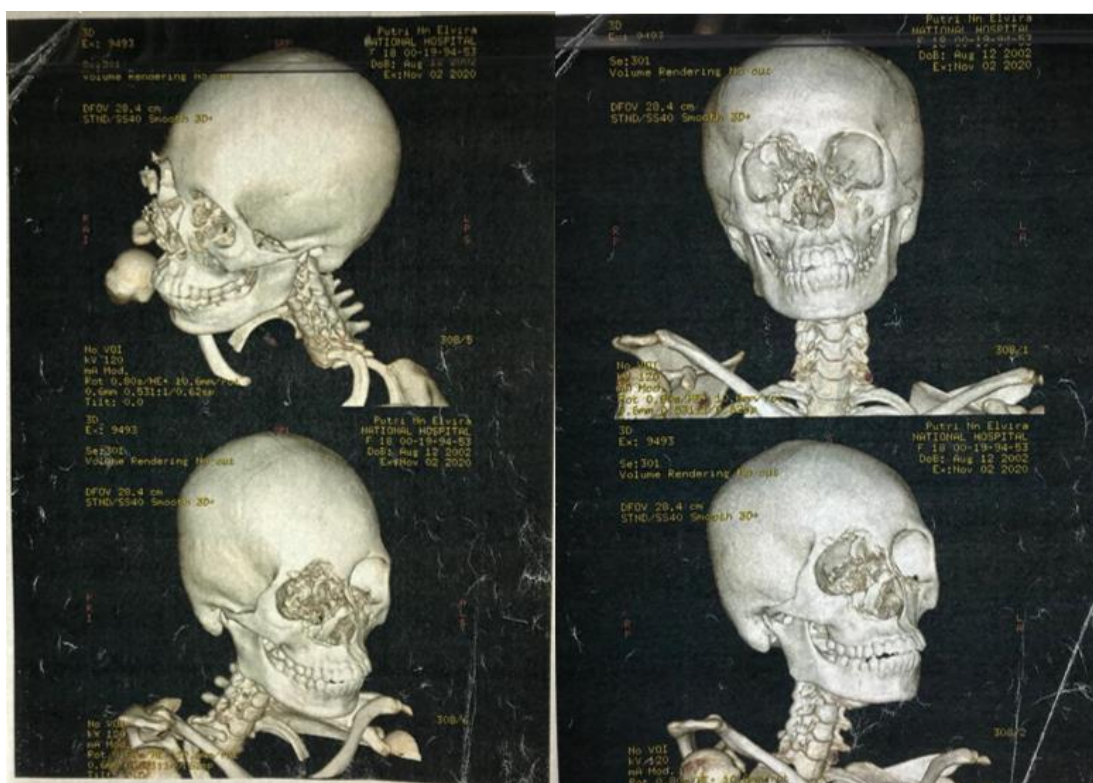


Figure 1.
Head CT and 3D reconstruction.

The patient was assessed with type 3 right NOE fracture with blow out fracture, superior and inferior right orbital fracture. She underwent elective surgery and conducted open reduction internal fixation (ORIF). The surgical approach was sub-ciliary incision. The plating was using 9 holes 4 screw miniplate for the frontonasal bone and 8 holes 4 screw miniplate for the maxilla bone. For the inferior orbital wall fracture, a titanium mesh was used and nasal tampon was maintained for three days.



Figure 2.
Miniplate for fronto-nasal bone and maxilla bone.

The patient was examined one day post operative, we found there were no epiphora, normal eye vision, no diplopia, normal eye movement, and palpebral edema still present. Overall, post operative patient condition was good.

3. Discussion

A naso-orbital-ethmoid complex (NOE) fracture is a fracture involving the nose, orbit, and ethmoid sinuses. NOE fracture is one of the fractures that is rarely found in maxillofacial fractures. The incidence rate is 5% of all cases of maxillofacial fractures [1]. The anatomy of the NOE complex consists of bone structures, medial canthal tendons, nasolacrimal ducts. The bone structure is composed of the frontal bone, the processes frontalis of maxilla, the lachrymal, the papyracea bone, ethmoid lamina, and the sphenoid bone [2]. This structure is bounded by the anterior cranial fossa and the frontal sinus on the superior side, the medial orbital wall on the lateral side [3]. The strength of this structure lies in the vertical buttress (angular processus of frontal and frontal processus of maxilla) and horizontal buttress (frontal bone, superior and inferior orbital wall) [4]. The NOE complex area gets vascularization of the internal and external carotid arteries and innervation of the ophthalmic nerve and maxillary branches of the trigeminal nerve [2].

NOE fractures have the complexity of anatomical structures where minimal damage to these structures can interfere with facial function and aesthetic appearance. This fracture can also include frontal sinus drainage pathways. In addition, this complex of structures is also related to the brain and eyes that separate the nasal and orbital cavum from the skull. Therefore, the handling of NOE fractures is quite complicated and is one of the most challenging maxillofacial reconstructions [4, 5].

The most common causes of NOE fractures are accidents, violence or fights, falls, work accidents, or injuries during sports. The occurrence of NOE fractures usually occurs after blunt trauma with moderate to high energy. These fractures are communitive and complex so they are often overlooked and undertreated [5, 6].

Markowitz first described and classified NOE fractures into three types, namely types I, II, and III, based on the severity and damage to the medial canal ligament [3]. Type I when there is damage to the central fragment with the medial canal ligament still attached to the fractured bone. Type II when a

central communitive fracture occurs without avulsion of the medial canal ligament. And type III when there is a communitive fracture of the NOE complex and there is an avulsion of the medial canal ligament. In severe NOE fractures, damage to the lacrimal system often occurs. These types will determine the management of NOE fractures [3, 7].

Patients with NOE fractures usually experience complaints in the eyes and nose such as pain in the nose, eyes, forehead, epistaxis, anosmia due to damage to the cribriform plate, hematoma. Physical examination is carefully performed to assess for lacerations, periorbital edema, ecchymosis, diplopia, telecantus (the distance between the two medial canals is greater than normal, due to damage to the medial canal tendon), enophthalmos, epiphora, pupil reflex, eyeball movement, and shortening of the palpebra fissures due to damage to the orbital wall or medial canal ligament. In the palpation examination, the presence of septal deviation, step deformity is evaluated by examining the bow-string and nasal depression/regression. In addition, the presence of rhinorrhea and otorrhea should be suspected of cerebrospinal fluid leakage and fracture of the cranial base [4, 8]. The presence of NOE fractures does not rule out the existence of other maxillofacial fractures [6].

Often the physical examination is not optimal because of the pain, so it requires the help of radiological support examinations using CT scans of the head and 3D reconstruction⁴. This examination is carried out after the patient is stable.

Initial treatment is in the form of primary surveys and resuscitation. Often profus epistaxis occurs in NOE fractures. This needs to be treated immediately by using tampons carefully. If a wound is obtained, it should be cleaned immediately and closed temporarily because it can be used as an access to fracture treatment. Antibiotics are given to reduce the risk of sinusitis [5].

The definitive management of NOE fractures can be carried out operatively or non-operatively. The goal is to restore the original anatomical shape and function. Non-operative management can be applied to certain patients such as minimally displaced fracture or the patient's condition not operable to conduct surgery. Simple closed reduction of the nasal bones and nasal septum is used under general anesthesia. The indication of closed reduction is if the periosteum is intact to retain the bone and medial cantus in normal position [5]. Meanwhile, NOE fractures with mobile and clear displacement are indications to conduct open reduction and internal fixation (ORIF). In addition, the presence of cerebrospinal fluid leakage, *telecanthus*, dystopia, lacrimal duct obstruction, nasal deformity, obstruction due to septal deviation, and obstruction of the frontal sinus are indications for repair of NOE fractures. Better cosmetic results are achieved if treatment is carried out earlier due to the onset of edema if surgery is delayed [5].

The treatment of NOE fractures is classified based on the type of fractures. In type I NOE fracture, minimally invasive surgery can be performed with local incisions of the fracture area. Fixation using miniplates on type I NOE fracture sequentially starting from the fronto-maxilla, zygomatica-maxilla, and maxillary medial buttress. In type II NOE fracture, the aim is to restore normal position of the medial orbital wall by using a microplate or titanium mesh to achieve the appropriate position of the medial canthal tendon. The repair of type III NOE fracture is more complex and difficult. The repair requires reconstruction of the medial canthal tendon and reconstruction of the orbital wall. Reconstruction of the medial canthal tendon (*medial canthoplasty*) can use a trans nasal wiring techniques or bone-anchoring devices [3, 4]. If there is damage to the lacrimal duct, a *dacryo-cystorhinostomy* (DCR) can be performed [5].

If repair surgery is postponed, it rarely gives good results. The main reason for delaying surgery is the difficulty of identifying facial structures such as medial canthal ligaments, nerve fibers, lacrimal drainage system, and soft tissue mobilization. The advantage of postponing surgery is that edema is reduced. If the repair is performed while the edema is still present, the surgical incision line may be distorted. The postponement of the surgery until the 10th day after the incident has reportedly still yielded good results [9].

4. Conclusion

The management of NOE complex fracture is challenging. It needs comprehensive clinical examination and radiographic analysis to assess the type and severity of the fracture. Immediate and proper reconstruction can give better prognosis.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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