Case report

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OPEN COMMINUTED EXPRESSED-DEPRESSED SKULL FRACTURE

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Skull fractures occur as the result of the effect of kinetic forces and represent discontinuity of the bones of the skull. They can be opened and closed affecting tissues; linear, diastatic, comminuted affecting cranial level; or depressed ones often leading to injuries of meninx, brain tissue with different types of intracranial bleeding. The paper presents a 56-year old male patient who suffered severe craniocerebral injury of the frontal region including orbit while operating the wood processing machine. The injury manifested as scalp damage, expressed-depressed open fracture of frontal-orbital region with cerebrospinal fluid leak. Computerized tomography of the brain showed the presence of epidural, subdural, and intracerebral hematoma with mass effect. The injuries were surgically treated, hematomas evacuated, and skull defect was reconstructed by previous plasticizing the dura in order to stop cerebrospinal fluid leak In the reconstruction of the multifragmentary fracture, a star titanium implant was used, but significant implantation of artificial material was not performed due to already contaminated wound and the possibility of a subsequent infection.

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Key words: *expressed-depressed fracture, frontal-orbital region, intracranial bleeding, defect reconstruction, cerebrospinal fluid leak*

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Introduction

The size of the contact surface of the mechanical force impact on the skull larger or smaller than 5 cm^2 determines the type of fracture and often leads to different intracranial lesions (1, 2). The incidence peak is between 4^{th} and 6^{th} decade of life (3), with global incidence of mortality relating to head injury 91-546 out of 100,000 in the given population (4). Fractures are most frequent in parietal region (38.6%,), in frontal region (28.9%), and in the base (20%) (5). They are classified as fractures of the epicranium including linear, diastatic fractures (characteristic for children), cominuted and limultilinear, as well as depressed skull base fractures. Depending on the intactness of the epicranium integrity fractures can be open and closed.

Open fractures almost always require surgical treatment, as they often lead to different types of intracranial hemorrhage (epidural, subdural, intracerebral) and in order to prevent infections in leaking of liquor (6).

In clinical practice, even if there is no intracranial hemorrhage, surgical treatment is undertaken if the bone fragment is depressed below the tabula interna.

The goal of the surgical treatment as the primary treatment modality is not only to manage the injury but to prevent communication of liquor space with the external environment in order to prevent the possibility of infection. Satisfying the aesthetic principles of the head and bones of the skull is always the ultimate goal in the management of such injuries (7).

Case report

A 56-year old man was admitted to the Emergency Centre of the Clinical Centre in Niš due to serious head injury caused by the rotary blade. The frontal parietal part of the skull was affected as the result of the impact of tangential force of the sharp object on the epicranium.

The patient's state of consciousness was changed, GCS was 10, and vital parameters were stable. There was no pyramidal motor deficiency in the neurological state. During the primary and temporary treatment of the wound with sutures and ligation of injured superficial temporal artery, severe skull injuries manifested as bone fragments were

found. The largest bone fragment was on the right frontal part with the destruction of a larger part of the orbital roof, and was above the level of the rest of the cranium, while the smaller ones were depressed into the cranium covering lacerations of the meninx and parenchyma. Diagnostic procedures included computer tomography (CT) of the brain with bone windows and cross sections of 1-1.5 mm and sagittal reconstruction important in the assessment of the injury.

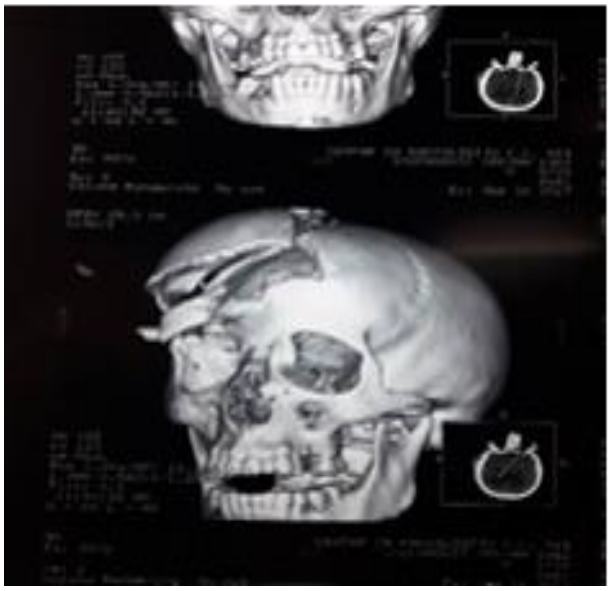

Figure 1. Expressed fracture - CT of the brain with bone window showed bone fragments out of which larger part of the right half of frontal squama descending to orbital roof was significantly above in relation to other depressed bone fragments

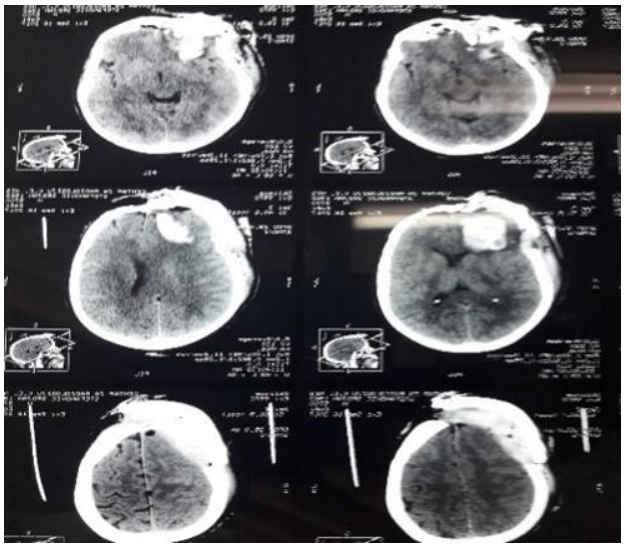

Figure 2. Intracranial hematomas - signs of brain edema as well as of epidural, subdural and intracerebral hematoma

The finding was subsequently confirmed by CT of the brain (Figures 1 and 2), and showed the presence of deeper contusion hemorrhagic zones. After short preparation that included analysis of biohumoral status (Glu 4.5 mmol/L, urea 4.2 mmol/L, Crea 90.1 mmol/L, WBC 7.5/L, RBC 5.48/L, PLT 300.0/L), coagulation factor screening (prothrombin time 70-140%, INR = 1, aPTT 25-35s) and the blood group, surgical treatment was performed.

During the operation, soft epicranial tissues, periosteum in particular, were treated; smaller, contaminated parts of the skull were eliminated, and larger ones were removed and preserved for further reconstruction of the skull. Laceration of the dura mater was expanded for intradural surgery, but only after removal of epidural hematoma. After the wide opening of the dura, we removed subdural hematoma, as well as significant intracerebral hematoma, with careful hemostasis. The defect of the meninx was plasticized, periosteum was strengthened by synthetic derivative of fibrin (Surgicel, absorbable hemostat, ETHICON, GELITA-CEL Standard Medical, hemostat, GELITA MEDICAL GmbH). After that bone fragments were restored and fixed with osteosynthetic material (Flap Fix Cranial Clamp size 5, a product of Johnson & Johnson).

The epicranium was treated with suture material (Polypropilene blue monofilament 3.0 HS 27, Vicryl Plus 3-0, ETHICON).

After postoperative stabilization of the patient, brain CT was performed on the third postoperative day, (Figures 3, 4 and 5), showing a favorable intracranial finding with stable reconstruction of bone elements of the skull.

Further treatment course included administration of II generation group of Cephalosporin and analgetics (Novalgetol every 12 hours for three days

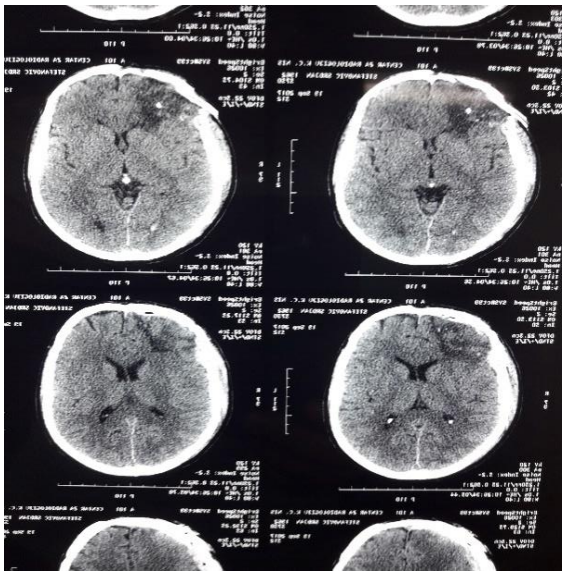

Figure 3. Control CT of the brain

and then as required), and rehydration therapy (Ringer's Solution 1000.0 for 12 hours, sol. Glucose 5% 500.0 every 12 hours, sol. Aminosol 250ml every 12 hours), as well as anti-edematous therapy (sol. Manitol 20%, 125 every 6 hours for three days) with accompanying antiepileptic protection (1 tablet of Phenobarbitone in the evening). The patient was discharged from clinic after ten days of treatment with the wound completely healed. His GCS was 15, and vegetative state stable without neurological deficit.

Figure 4. Reconstruction of bone fragments

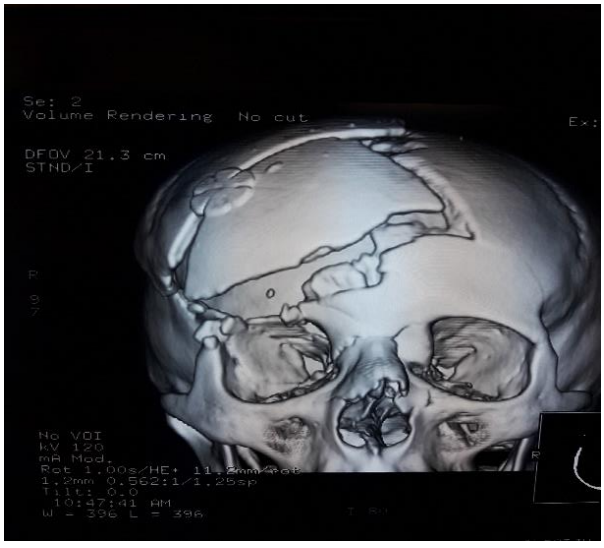

Figure 5. Fixed bone fragment

Discussion

Skull fractures belong to the group of craniocerebral injuries the incidence of which ranges from 1-2 ‰ (4). Epicranium fractures account for 80% of all skull fractures and 5 to 10% are depressed fractures. Half of the depressed fractures are open and may lead to damage of the dura or focal brain damage (6). According to a metaanalysis from literature out of 22,058 traumatized patients, 3.4% of them had fracture, and 0.6% of them had intracranial injury. Of this number, 91% of patients with fracture had no intracranial injury (5). The incidence of depressed fractures is 20 per 1 million, 85% are working men between 4th and 6th decade of life. The mortality rate is relatively low, about 11%, and intracranial hematomas are present between 5 and 7% (7).

Our case report presents a 56-year old working man with head injury. Such craniocerebral injury is a combination of all of the aforementioned types of fractures with the expression of a part of squama of the frontal bone with the destruction of a larger part of the orbital roof, thus increasing the degree of mutilation of the injury with intracranial bleeding. The injury was caused by mechanical force of high kinetic energy at a higher contact area in the frontal region (7). The consequence of the effect of such a force was extensive injury with the elevation of broken bone fragments in relation to the depressed fragments belonging to expressed-depressed fracture type. According to the literature data, within the first 30 minutes after the injury, the concentration of bacteria is 30.000 per gram of injured tissue on average (8), so primary closing of the wound is recommended within 6 hours from the moment of injury. In addition, care should be taken of the preservation of scalp vascularization during the surgical preparation. By closing the dura with plasticization by means of prepared periosteum, potential development of meningitis, cerebral abscess and pseudomeningocele formation is prevented, which is mentioned as the main goal of surgery in literature (9). Then, the planned reconstruction of the cranial defect was performed. In addition to closing the intracranial space, aesthetic correction of defects was taken into account as well. Free fragments were used for the partial reconstruction of the frontal squama and the superciliary arch. According to literature data (9), reconstruction by means of cranial bone grafts, the so-called 'titanium mesh', especially for frontal-orbital region, remains the method of choice. The advantage of using synthetic materials such as Polyhydroxyethyl methacrylate is the ade quate correction of frontal orbital defects (10), and main disadvantages include the possibility of infection, potential development of fistula, graft migration, as well as formation of granuloma and erosion. Considering these facts, and taking into account the fact that the tissue tolerates preserved bone fragments and represents reliable reconstructive material, we decided to postpone further reconstruction of a larger portion of the superciliary arch at this stage. As there were no functional defects including immobility of the eyeballs, enophtalmus, hypoglobus and upper lateral fissure syndrome, indexes of eye nerve compression, this decision turned out to be correct. However, early reconstruction is recommended in literature due to good condition of bone fragments, absence of contractures and fibrous changes in the soft tissues. Antibiotic parenteral therapy reduces

the risk of infection (11). In the later course after the recovery of the patient, the possibility of remediation of the defect would be considered, thus completing aesthetic correction using planned titanium mesh. The titanium mesh in the reconstitution may significantly shorten the time of intervention with a simple placement technique with a minimum incidence of complications of about 10% according to the literature data and excellent esthetic recovery in 90% of cases (11). Surgical closing of the scalp involved preservation of the hair line, follicular hair orientation, scar remediation and prevention of alopecia (12).

Conclusion

Prompt and adequate surgery of open skull fractures with evident intracranial complications is of vital importance to the patient. Appropriate and moderate use of synthetic material may represent a compromise between the infection risk, stability of damaged soft or bone tissue, and management of functional aesthetic problems. The extent of this injury was also reflected in elevated bone fragments that we defined as expressed-depressed fracture.

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Prikaz bolesnika

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OTVORENA KOMINUTIVNA EKSPRESIONO-DEPRESIVNA FRAKTURA KRANIJUMA

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Prelomi lobanje nastaju pod dejstvom kinetičkih sila i podrazumevaju prekid kontinuiteta kostiju lobanje. Mogu biti otvoreni i zatvoreni u odnosu na tkiva, u nivou kranijuma (linerani, dijastatski, kominutivni) ili depresivni, često dovodeći do povrede moždanih ovojnica, moždanog tkiva, sa različitim tipovima intrakranijalnog krvarenja. U radu je prikazan bolesnik star 56 godina, muškog pola, koji je u toku rada mašinom za obradu drveta zadobio tešku kraniocerebralnu povredu frontalne regije sa zahvatanjem orbite. Povreda se manifestovala oštećenjem skalpa, *ekspresiono*-depresivnim otvorenim prelomom fronto-orbitalne regije i likvorejom. Kompjuterizovana tomografija (CT) mozga pokazala je postojanje epiduralnog, subduralnog i intracerebralnog hematoma sa prisutnim mas efektom. Operativnim tretmanom povrede su bile zbrinute, hematomi evakuisani, rekonstruisan defekt lobanje uz prethodno plastifikovanje dure u cilju zaustavljanja likvoreje. U rekonstrukciji multifragmentarne frakture koristili smo zvezdasti titanijumski implant, ali nismo pristupili značajnoj ugradnji veštačkog materijala, zbog primarno kontaminirane rane i mogućnosti kasnije infekcije.

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Ključne reči: *ekspresiono-depresivna fraktura, fronto-orbitalna regija, intrakranijalno krvarenje, rekonstrukcija defekta, likvoreja*