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КАФЕДРА ЧЕЛЮСТНО-ЛИЦЕВОЙ ХИРУРГИИ И ПЛАСТИЧЕСКОЙ ХИРУРГИИ ЛИЦА
С КУРСОМ ПОВЫШЕНИЯ КВАЛИФИКАЦИИ И ПЕРЕПОДГОТОВКИ

В. В. Кончак, Н. Н. Черченко

ТРАВМЫ КОСТЕЙ ЛИЦЕВОГО ОТДЕЛА ЧЕРЕПА

INJURIES OF BONES OF THE FACIAL PART OF SKULL

Учебно-методическое пособие

Минск БГМУ 2025

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MOTIVATIONAL CHARACTERISTICS OF THE TOPIC

Total hours: 135 minutes.

The incidence of injuries of the maxillofacial region ranges from 6 to 16.4 % of the total number of patients with bone injuries. In the last decade, there has been a tendency for a significant increase in the number of patients with injuries to the maxillofacial area with a tendency to become more severe. A general practitioner must know the clinical manifestations of traumatic injuries to the bones of the facial skeleton, determine treatment and diagnostic tactics for multiple and combined injuries, and be able to provide first medical and specialized care for injuries to the face and neck.

Purpose: to be able to recognize clinical signs, justify and draw up a plan for diagnostic examination and treatment of patients with traumatic injuries of the maxillofacial area.

Objectives of the lesson:

1. To study specific features of damage to the bones of the facial part of the skull.
2. To acquire knowledge about the clinical picture of traumatic injuries to the bones of the facial skeleton, diagnosis and principles of treatment, provision of first medical and specialized care.
3. To know the clinical features of combined trauma of the maxillofacial area.
4. To master the principles of providing emergency care to patients with shock, asphyxia, bleeding due to injuries of the maxillofacial area and neck.

Requirements for the initial level of knowledge. In order to master the topic to a full extent, it is necessary to revise the material from the following sections:

– human anatomy: blood supply and innervation of the head and neck;

– pathological anatomy, pathological physiology: morphological processes occurring in bones under pathological conditions; phases of the wound process;

– X-ray diagnostics: X-ray examination of the bones of the facial skeleton;

– general surgery: emergency care for critical conditions; first aid and treatment of fractures.

Test questions from related disciplines:

1. Name the main branches of the external carotid artery.
2. Name the main parts of the lower jaw
3. Name the main parts of the upper jaw
4. Name the main sections of the zygomatic bone.
5. Name the walls of the maxillary sinus.
6. What bones form the orbit?
7. Name the parts of the base of the skull.
8. List the instrumental methods that are used when examining patients with pathology of the maxillofacial region.

Test questions on the topic of the lesson:

1. Specific features of the clinical picture of dental fractures depending on the location of the fracture line, principles of treatment.
2. List the features of the maxillofacial region that influence the nature of traumatic injuries to the maxillofacial region.
3. Traumatic injuries to the lower jaw. Classification. Mechanisms of displacement of bone fragments.
4. Clinical manifestations of mandibular fractures.
5. Diagnosis of mandibular fractures.
6. Classification of fractures of the upper jaw. Clinical features, diagnostics.
7. Interdisciplinary approach to the examination of patients with a fracture of the upper jaw.
8. Principles of treatment of fractures of the facial skeleton.
9. Methods of treating fractures of the facial skeleton.
10. Providing first aid for traumatic injuries, types of temporary immobilization.
11. Fractures of the zygomatic bone and arch, classification, clinical manifestations, diagnosis.
12. Fractures of the zygomatic-orbital and zygomatic-maxillary complexes, principles of differential diagnosis.
13. Fractures of the nasal bones, clinical features.
14. Combined craniofacial trauma, clinical manifestations, diagnostic and treatment tactics.
15. Diagnosis of liquorrhea.

DEFINITION AND CLASSIFICATION

Trauma (from ancient Greek τραῦμα "wound") is damage, which is understood as a disruption of the anatomical integrity or impairment of physiological functions of organs and tissues of the human body, resulting from external influences. Depending on the type of damaging factor, there are mechanical (fractures, etc.), thermal (burns, frostbite), chemical injuries, barotrauma (under the influence of sudden changes in atmospheric pressure), electrical injuries, and so on, as well as combined injuries.

A **fracture** is a complete or partial disruption of the anatomical integrity of a bone, accompanied by damage to the soft tissue surrounding the bone and impairment of the function of the damaged segment.

According to the nature of the damaging factor, injuries are divided into:

1. Mechanical
2. Firearms

3. Thermal
4. Chemical
5. Combined

Classification of injuries depending on the cause:

Occupational injury — damage associated with the performance of work duties (industrial and agricultural).

Sports injury — occurs during physical education and sports.

Domestic injury is damage that occurs while doing household work or during domestic conflicts.

Transport (road) injury — occurs as a result of a traffic accident.

TEETH LUXATION

According to ICD-10: S 03.2 — dislocation of tooth.

Tooth luxation is a traumatic injury to a tooth, as a result of which its connection with the socket is disrupted.

Tooth dislocation occurs most often as a result of a blow to the crown of the tooth. More often than others, the frontal teeth on the upper jaw are dislocated and less often on the lower jaw. Dislocations of premolars and molars most often occur when neighboring teeth are carelessly removed using an elevator.

There are incomplete dislocation (extrusion), complete dislocation (avulsion), impacted dislocation (intrusion) (fig. 1).

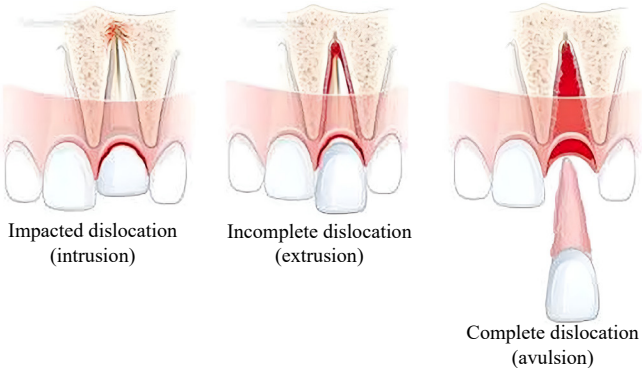

Fig. 1. Types of tooth luxation

In case of incomplete dislocation, the tooth partially loses its connection with the tooth socket, becomes mobile and moves due to rupture of periodontal fibers and disruption of the integrity of the cortical plate of the tooth alveolus. On a dental

(or orthopantomogram) radiograph, the tooth root is shortened due to the inclined position; the expansion of the periodontal gap is determined not only in the lateral, but also in the apical parts of the tooth root.

With complete dislocation, the tooth loses connection with the tooth socket due to the rupture of all periodontal tissues, falls out of the socket or is held only by the soft tissues of the gums; only the tooth socket is determined on a dental radiograph.

With an impacted dislocation, the tooth is embedded in the spongy substance of the bone tissue of the alveolar process of the jaw (the tooth is immersed in the socket). X-ray: the cutting edge of the crown is located below the adjacent teeth, the periodontal fissure is not defined, and the periodontal line is absent along the entire length on the dental radiograph.

Complex treatment of tooth dislocation is aimed at eliminating the cause or main factor in the development of tooth dislocation, relieving pain symptoms and acute inflammatory phenomena during tooth dislocation; ensuring tooth immobilization according to indications; prevention of the development of a pathological process in the bone and the development of inflammatory processes in the perimandibular tissues; preservation and restoration of the function of the patient's dental system.

If there are medical indications (the impossibility or ineffectiveness of conservative endodontic or restorative treatment of the causative tooth or the tooth is of no functional value), a tooth extraction operation is performed.

Ligature bonding of teeth (simple ligature bonding, continuous in the form of a figure eight) is indicated in the permanent dentition in the presence of 2–3 stable adjacent teeth on both sides. Splints-brackets, splints-mouth guards and dentogingival splints can also be used. Immobilization of dislocated teeth is usually carried out within one month (4 weeks).

If a tooth is completely dislocated, its replantation is possible (no later than three days after the injury), including extirpation of the pulp and filling the canal using calcium hydroxide; replantation itself; fixation for 4 weeks with a mouthguard or a smooth splint.

TEETH FRACTURES

According to ICD-10:
S02.5 — fracture of tooth;
S02.50 — fracture of tooth enamel only (enamel chipping);
S02.51 — fracture of the tooth crown without damage to the pulp;
S02.52 — fracture of the tooth crown without damage to the pulp;
S02.53 — tooth root fracture;

S02.54 — fracture of the crown and root of the tooth;
S02.57 — multiple tooth fractures;
S02.59 — unspecified tooth fracture.

A tooth fracture is a traumatic injury to a tooth that disrupts the integrity of its hard tissues. It occurs as a result of a strong blow to the crown of a tooth. The frontal group of teeth in the upper jaw (88.9 %) and less often in the lower jaw (11.1 %) suffer most often. A tooth fracture can be localized in the area of the crown, neck and root of the tooth and can be complete or incomplete. Crown-root fractures of teeth are very rare (fig. 2).

Fig. 2. Tooth root fracture

Depending on the direction of the fracture line there are longitudinal, oblique, transverse and comminuted fractures of the roots of the teeth, which are located in the middle, lower or upper third of the tooth and can be displaced or not.

When a tooth root is fractured, it is characterized by painful percussion of the causative tooth, its mobility, spontaneous aching pain or pain when biting, possible bleeding from the tooth-gingival margin and discoloration of the crown due to intrapulpal hemorrhage. During palpation only the broken part of the tooth moves. If a root fracture occurs in the area of the upper third (apex), then its mobility is often not determined; only pain is detected upon percussion.

When the crown and root of a tooth are fractured, the patient experiences acute, often intense, constant pain when chewing food in the area of the causative tooth(s) and the adjacent area of the jaw; the causative tooth is either destroyed by a carious process, or under a filling, may be mobile, percussion is painful; The transitional fold of the vestibule of the oral cavity in the area of the lesion is swollen and hyperemic.

In case of fractures of the tooth root, crown and root of the tooth, a band of clearing between the fragments and a change in the position of the coronal fragment in relation to the root are determined radiographically.

A fracture of the tooth root can be combined with a fracture of the alveolar wall — in this case, radiography reveals disruption of the continuity of the cortical plate, limiting the surface of the alveolar process and a strip of clearing in the spongy substance.

When a tooth root is fractured in the cervical part, the crown of the causative tooth is removed. In case of a fracture of the tooth root in the middle part, provided that the pulp is viable (responses to temperature and electrical tests), reposition and immobilization of fragments using an interproximal connection and fiberglass tape Fiber–Splint, Ribbond, Glasspen systems is indicated for a period of 3 months. The stability of the splint is checked 30 and 60 days after injury.

If the root is fractured in the apical part with a viable pulp, the tooth is fixed with a splint and observed over time; If the pulp ruptures, the tooth is subjected to endodontic treatment and splinted. In case of longitudinal and comminuted fractures, the tooth must be removed.

In case of a superficial fracture of the tooth crown without damage to the pulp, the tooth is restored with composite materials or orthopedic structures. If the pulp of the causative tooth is damaged, its removal is indicated.

FRACTURES OF THE ALVEOLAR PROCESS

According to ICD-10:

S02.40 — fracture of the alveolar process of the upper jaw;

S02.60 — fracture of the alveolar process of the lower jaw.

Isolated fractures of the alveolar process occur when a traumatic force acts on a fairly narrow section of it, due to bending or shear (fig. 3). The following types of alveolar process fractures are distinguished:

– partial — the fracture line passes through the outer part of the alveolar process; a fracture of the outer compact plate occurs within the sockets of several teeth and part of the interdental septa;

– incomplete — the fracture line in the form of a crack passes through the entire thickness of the alveolar process, capturing the outer and inner compact plates and spongy substance; no displacement of fragments occurs;

– complete — two vertical fracture lines are united by a horizontal one and pass through the entire thickness of the alveolar process;

– comminuted — fracture lines intersect in several directions;

– with a bone defect — separation of a broken part of the alveolar process.

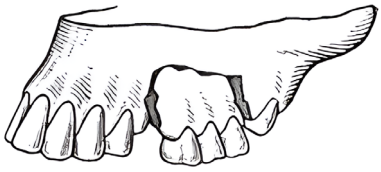

Fig. 3. Fracture of the alveolar process

The alveolar process of the maxilla is more often susceptible to fracture compared to the alveolar part of the mandible. The anterior part of the alveolar process of the upper jaw is predominantly broken, which is associated with anatomical features.

The upper jaw, as a rule, somewhat overlaps the lower jaw, its alveolar process is longer and thinner. The anterior part of the alveolar process of the upper jaw is not protected by anything except the elastic cartilaginous part of the nose. Its lateral sections are covered by the zygomatic arch. The frontal section of the alveolar part of the lower jaw is quite reliably protected by the anteriorly protruding upper alveolar process and teeth, the chin, its lateral sections — by the corresponding part of the body of the lower jaw and the zygomatic arch.

A fragment of the alveolar process is displaced into the oral cavity under the influence of the continued action of the applied force: posteriorly — in the frontal area and inward — in the lateral area. The displacement is sometimes so significant that the broken fragment may lie on the hard palate. In the upper jaw, it can shift outward when the impact on the alveolar process is indirect through the teeth of the lower jaw. This is usually combined with a fracture.

The fracture line often passes through the entire thickness of the alveolar process, extremely rarely — only through the outer compact lamina and spongy substance without damaging the inner lamina. The broken area more often retains contact with the periosteum and mucous membrane of the oral cavity, and is less likely to be torn off. A fracture of the alveolar part of the lower jaw is often accompanied by a fracture or dislocation of teeth.

The fracture line often has an arched shape, especially in the upper jaw, which is associated with the unequal level of the apexes of the roots of the teeth. It can be located outside the roots of the teeth, which creates favorable conditions for the healing of the fragment, or it can pass through the roots of the teeth, which is accompanied by their fracture. In this case, the conditions for healing of the fragment are poor and a favorable outcome of treatment is doubtful. When the lateral part of the alveolar process of the upper jaw is fractured, the bottom of the maxillary sinus often breaks off.

Patients complain of spontaneous pain in the upper or lower jaw, which intensifies when closing the teeth or trying to chew food, as well as in case of improper closing of the teeth or the inability to close the mouth.

During an external examination, pronounced swelling of the soft tissues of the perioral area or cheeks, the presence of bruises, abrasions, and wounds are noted, which is a sign of a previous injury. The mouth is half open.

When examining the oral cavity, there may be hemorrhages and lacerations on the mucous membrane of the lips or cheeks due to damage to the teeth. When a fragment is displaced, the mucous membrane of the alveolar process ruptures, exposing bone tissue along the fracture line. The configuration of the dental arch is

impaired, the bite is incorrect. If there is no clinical displacement of the fragment, the fracture line can be determined by carefully displacing the suspected fragment and palpating its mobility under the fingers of the other hand. By moving your finger along the border of the movable bone fragment, it is possible to accurately determine the size of the broken section of the alveolar process.

Percussion of the teeth between which the fracture line passes is usually painful. The teeth located on the fragment can also react to percussion and be mobile.

An intraoral radiograph clearly shows the fracture line and its relationship with the roots of the teeth.

Treatment. Under conduction (less often infiltration) anesthesia, it is necessary to place the fragment in the correct position under bite control. It can be immobilized using a smooth splint-brace if there is a sufficient number of stable teeth on the broken and undamaged area of the alveolar process.

In case of a central location of the fragment on an undamaged area, the splint should include at least 2–3 stable teeth. When a fragment of the upper jaw is displaced downward, it is advisable to secure the teeth to a wire splint with a special loop passing through the cutting edge or their chewing surface. The method of choice in such cases is a splint made of fast-hardening plastic. Monitoring the vitality of the pulp of teeth located on the fragment is mandatory. In case of pulp necrosis, which is established by repeated monitoring (electrometry), the teeth should be trepanned, and their canals should be sealed after appropriate treatment. If anatomical conditions do not allow the use of a smooth splint-brace, a dentogingival (supragingival) splint can be made on the broken area and fixed with a suture or polyamide thread to the undamaged area of the alveolar process.

If it is not possible to install the fragment into the correct position by hand, then the splint must be bent so that it can be pulled out using rubber rings. On the intact alveolar process it is bent in accordance with the stated requirements. The section of the splint located in the projection of the displaced fragment should be represented by an arch (on which hooks can be bent) to fix rubber rings attached with a ligature to the teeth in the broken area. After repositioning the fragment, it is fixed in the correct position with a smooth splint-brace or splint-guard.

The splint can be removed after 5–7 weeks. When a section of the alveolar process is torn off, the sharp bone protrusions are smoothed with a milling cutter, and the mucous membrane, after its mobilization over the bone wound, is sutured tightly with catgut. If it is not possible to suture the wound, it is closed with a tampon of iodoform gauze, which is changed no earlier than on the 7–8th day.

If the fracture line passes through the roots of the teeth, healing of the fragment often does not occur. This is due to poor blood supply to the broken fragment due to the fact that the fracture line runs very close to the gingival margin. The fragment turns out to be skeletonized over a significant extent. In addition, it is

almost impossible to remove broken roots from fragments of the alveolar process without additional incisions and detachment of the mucoperiosteal flap. This further impairs microcirculation in the broken area of the alveolar process. There is a high probability of its sequestration. Therefore, it is more rational to immediately carry out radical surgical treatment, similar to that for complete separation of the broken fragment.

FRACTURES OF THE LOWER JAW

According to ICD-10:
S02.6 — fracture of mandible;
S02.60 — fracture of the alveolar process;
S02.61 — fracture of the body of the lower jaw;
S02.62 — fracture of the condylar process;
S02 63 — fracture of the coronoid process;
S02.64 — fracture of the branch;
S02.65 — symphysis fracture;
S02.66 — angle fracture;
S02.67 — multiple fractures of the lower jaw;
S02.68 — fracture of the lower jaw of unspecified localization.
By etiology:
– traumatic;
– pathological.
According to the number of fracture lines:
– single;
– double;
– multiple.
According to communication with the external environment:
– open (not only with disruption of the integrity of the skin, but also within the dentition);
– closed (in the area of the lower jaw branch and its processes).
According to the displacement of bone fragments:
– with displacement;
– without displacement.
The displacement of fragments depends on:
– traction force of the masticatory muscles;
– location of the fracture and number of fragments;
– the force and direction of the impact, the mass (gravity) of the fragment.

In case of fractures of the lower jaw, patient complaints are determined by the nature and location of the fracture. Patients complain of pain and swelling

of soft tissues in the lower jaw; possible pain when swallowing and opening the mouth, clenching the jaw, pain in the ear canal; malocclusion, protrusion and/or mobility of teeth; the feeling of "numbness" in the area of the lower lip and chin; "crunching" in the lower jaw when it moves; bleeding from the oral cavity or from a gum pocket, sometimes from the external auditory canal. Biting and chewing food is painful or impossible. Also, as a result of injury, patients may experience loss of consciousness, nausea, vomiting, dizziness, disorientation in place and time in the presence of a bruise or concussion, which requires further examination and consultation with a neurosurgeon.

Taking a case history, as with any injury, the doctor must find out the location and circumstances of the injury (according to the patient's words). Based on clinical signs (degree of consciousness, contact, breathing pattern, pulse, blood pressure level), the general condition of the patient is assessed. It is necessary to exclude damage to other anatomical areas, special attention should be paid to combined trauma of the jaw and brain, which may prevent the immediate initiation of specialized care and requires the involvement of other specialists, including a neurologist or neurosurgeon in the presence of symptoms characteristic of traumatic brain injury of varying degree of severity.

During the examination impairment of the facial configuration is determined due to swelling and hemorrhage in the perimaxillary soft tissues in the area of the fracture (it usually appears on the skin 8–12 hours after the injury, on the oral mucosa — almost immediately), malocclusion and limited mouth opening (due to severe pain or blockage by displaced bone fragments), displacement of teeth in relation to the occlusal plane and their mobility.

When palpating the lower jaw, a "step" symptom is determined along the lower edge of the jaw (palpation may be difficult due to swelling of the soft tissues) and the alveolar process; crepitation and mobility of fragments during bimanual examination of the lower jaw are observed. Two symptoms are usually distinguished: direct exertion — tenderness on exertion in the area of the fracture and indirect exertion (positive symptom of "indirect exertion" or "radiating pain") — tenderness in the area of the fracture when pressing on the chin and angles of the lower jaw.

If, as a result of damage to the jaw and displacement of fragments, a rupture or injury to the inferior alveolar nerve occurs, the phenomenon of paresthesia in the area of the lower lip and chin will be observed on the side of the fracture. To establish the fracture of the condylar process, the range of motion of the head in the glenoid cavity is determined. The heads are palpated during the jaw movement; the absence or "lag" of movement of the articular head when opening the mouth or the inability to palpate it indicates the fracture of the condylar process. During opening and closing of the mouth, a decrease in the amplitude of movement of the lower jaw, pain and displacement of the chin away from the midline (towards

the fracture) are determined. With a bilateral fracture of the ramus and condylar process, non-closure of the frontal group of teeth is possible (fig. 4). In the oral cavity, occlusal relationships are disrupted due to displacement of fragments. In this case, the teeth of a small fragment will be in contact with the antagonists, and on a larger fragment there will be no contact of teeth with them along almost the entire length, except for the molars.

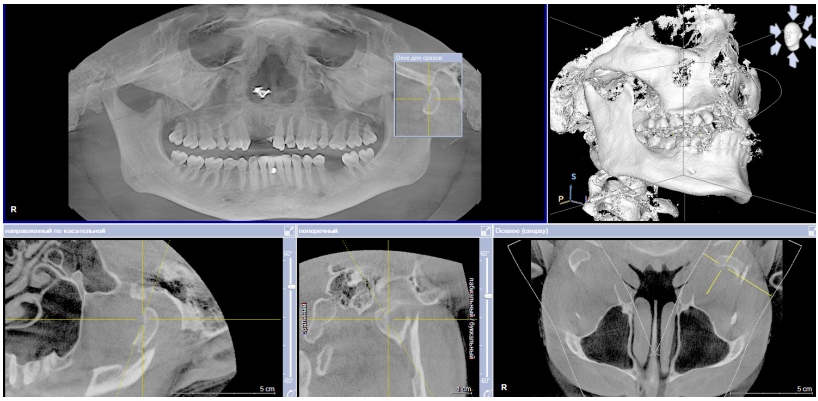

Fig. 4. Fracture of the condylar process of the lower jaw on the left with displacement of fragments

Percussion of teeth in the fracture area is painful. A special diagnostic sign of a fracture of the body of the lower jaw is the development of hemorrhage not only in the vestibule of the oral cavity, but also on the lingual side of the alveolar part. With soft tissue bruises, it is often determined only from the vestibular side. There may be ruptures of the mucous membrane that extend into the interdental space (in the projection of the fracture crack). An absolutely reliable sign of a fracture is a positive symptom of mobility of jaw fragments. The fracture of the lower jaw in the area of the articular processes is accompanied by arthritis of the temporomandibular joint with clinical symptoms of varying severity.

The clinical picture must be confirmed by the results of an X-ray examination. Radiographs in two projections (direct and lateral) make it possible to clarify the topography of the fracture, the severity of displacement of fragments, the presence of bone fragments, and the relationship of the roots of the teeth to the fracture line. Orthopantomography may also be performed. The most informative methods of radiological diagnosis of mandibular fractures are multislice computed tomography and cone-beam computed tomography.

The diagnosis is made taking into account the etiology (traumatic or pathological), connection with the external environment (open or closed),

localization (part of the lower jaw), the number of fracture lines and sides of the lesion, the nature of the displacement of fragments in the fracture of the lower jaw.

The basic principles of treatment of patients with fractures of the lower jaw are aimed at creating optimal conditions for reparative osteogenesis, reposition, stable fixation of bone fragments, immobilization of the lower jaw, as well as prevention of complications (traumatic osteomyelitis of the jaw, including the development of abscesses and phlegmons of the peri-maxillary tissues; delayed consolidation of bone fragments; improperly healed fracture; formation of a false joint; development of ankylosis of the temporo-mandibular joint; persistent neuropathy of the branches of the trigeminal nerve).

First medical aid for patients with fractures of the lower jaw is to immobilize the jaw with a sling or parietal-chin bandage. Transportation of patients with the fracture of the lower jaw and signs of alcohol or drug intoxication and/or traumatic brain injury is carried out in a sitting position with the head tilted forward or lying on the side.

The purpose of temporary immobilization is to ensure minimal mobility of fragments of the lower jaw, prevent pain as well as life-threatening and local complications.

First aid includes:

1. Temporary immobilization of the lower jaw.
2. Symptomatic drug therapy.
3. Referral to a specialized hospital.

For temporary immobilization of the lower jaw the Pomerantseva–Urbanskaya sling bandage, the parietal-chin bandage, the standard Entin sling as well as ligature simple binding of a group of teeth adjacent to the fracture line can be used.

For closed fractures in the area of the jaw branch without displacement of fragments, it is also possible to use a functional method of treatment or intermaxillary ligature binding according to Ivey.

Treatment methods for mandibular fractures can be divided into orthopedic (conservative), surgical (osteosynthesis) and surgical-orthopedic developed by Black. Conservative treatment methods include: bimaxillary splinting, dentogingival splints in combination with a sling bandage, ligature binding. Surgical treatment methods include transfocal osteosynthesis (extraosseous, intraosseous, transosseous) and extrafocal osteosynthesis (fixation and compression-distraction devices).

The main treatment method for mandibular fractures is bimaxillary splinting with intermaxillary traction. It includes the following stages: local anesthesia (conduction, infiltration, application), premedication or potentiated local anesthesia is carried out according to indications, antiseptic treatment of the fracture crack (gap) and the oral cavity, deciding the fate of the tooth in the fracture

crack (clinically it is necessary to assess tooth mobility, ruptures of the mucous membrane, integrity of the walls of the alveoli, degree of exposure of the tooth root). Teeth with periapical foci of infection and marginal periodontal pathology; teeth that are of no functional value; teeth with root fractures; impacted teeth (sometimes they are left for observation in order to prevent displacement of bone fragments); teeth that prevent the reposition of bone fragments are removed. Then the revision of the fracture crack is carried out: removal of loose bone fragments and tooth fragments, instillation of antiseptic solutions, isolation of the fracture line from the oral cavity — suturing of the hole and mucosal tears, fitting and fixation of dental splints on the dentition (fig. 5).

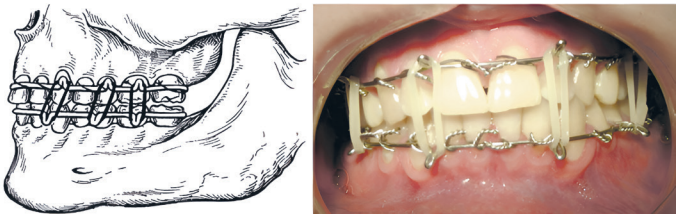

Fig. 5. Bimaxillary splinting

Tigerstedt, Rauer and Kruchinsky wire splints with hooking loops are used for lingual fixation. They are made of aluminum (1–2 mm) or orthodontic wire (0.6–1.2 mm) and fixed to the teeth with bronze-aluminum ligatures (0.3–0.5 mm). Standard Vasiliev splints are also used. The next stage is manual reposition of bone fragments and application of intermaxillary traction with fixation of the dentition in the bite (in patients with traumatic brain injury, it can be delayed by 1–2 days). The bite can be fixed with rubber, thread, or ligature (wire) traction. In direction it can be vertical, oblique, cross.

At the heart of reparative osteogenesis, in addition to precise reposition, fixation and immobilization of fragments, is early restoration of function, which is possible only after surgical treatment. So, in case of unsatisfactory reposition, lack of stable fixation of fragments or impossible bimaxillary splinting open reduction and osteosynthesis are indicated.

Osteosynthesis is a surgical method for treating fractures, aimed at firmly connecting fragments using various fixing devices.

Methods of osteosynthesis:

1. Extrafocal. It provides fixation of bone fragments with devices that extend outside the fracture gap (fixation and compression-distraction devices). It is used when conservative methods are ineffective and it is impossible to perform transfocal osteosynthesis (complicated fractures of the lower jaw (traumatic osteomyelitis), fractures of the lower jaw with a bone defect of up to 1.5–2.0 cm).

The essence of the method is the immobilization of fragments to the outer frame with fixing elements attached to the jaw (or in the jaw) away from the fracture gap. They provide fixation of fragments and keep them in a state of compression (compression or tight fit) or at a certain distance from each other in case of jaw defects. Compression-distraction devices (by O. P. Chudakov) provide fixation of fragments and keep them in a state of compression. For jaw defects up to 1.5 cm after the formation of a primary bone callus, distraction (traction or stretching) of bone fragments is possible due to the elasticity of the young bone regenerate.

2. Transfocal (intraosseous, extraosseous). It depends on the access — extraoral and intraoral. Intraoral is most appropriate for the treatment of fractures of the lower jaw within the dentition and angle of the lower jaw.

The advantage of the intraoral approach is the absence of damage to the branches of the facial nerve. The disadvantages of the intraoral approach are that it is technically more complex, as it requires an adapted set of instruments and a small surgical field, which makes it difficult to achieve precise reposition.

The disadvantages of the extraoral approach include the risk of damage to the marginal branch of the facial nerve, respectively, a cut in the muscles that lower the angle of the mouth, detachment of the masticatory muscle itself, which requires its subsequent fixation to the angle of the jaw through perforations along the lower edge, and the presence of a scar on the skin.

With external and intraoral approaches, only the vestibular surface of the lower jaw is skeletonized, and the skeletonization area is approximately the same from the intraoral and external approaches. From intraoral and external access, the miniplate is fixed taking into account the principles of biomechanics, i.e., closer to the upper edge of the angle of the jaw.

Indications for osteosynthesis of the lower jaw are: unsatisfactory reposition, lack of stable fixation of fragments, impossibility of performing bimaxillary splinting. These may be edentulous jaws with divergence of bone fragments; partially edentulous jaws with large loss of teeth; partial secondary adentia with the presence of severe marginal periodontitis; fractures with significant displacement of fragments, interposition of soft tissues into the fracture gap; fractures with damage to the skin; pathological fractures (for example through a cystic cavity); non-united fractures; fractures of the articular process with dislocation or subluxation of the articular head; fractures outside the dentition; fractures with bone tissue defect. General indications include epilepsy, mental disorders of the patient, and difficulty in nasal breathing.

Osteosynthesis methods:

1. Intraosseous (Kirschner wires, etc.).
2. Transosseous or intraosseous-extraosseous (wire bone suture).
3. Extraosseous (mini- and microplate systems).

Today, the most optimal treatment method is osteosynthesis with fixation of bone fragments with bone miniplates .

Methodology for transfocal osteosynthesis using external access. For relieving pain nasotracheal anesthesia is used. Next, an incision is made in the submandibular or the chin area, 1.5–2 cm away from the edge of the lower jaw — to reduce the risk of damage to the marginal branch of the facial nerve. Then the superficial muscle and fascia are dissected, the facial vein and artery are retracted or ligated, and the masseter or mentalis are cut off; the vestibular surface of the lower jaw in the area of the fracture is skeletonized; revision of the fracture gap is carried out — removal of small fragments not associated with the periosteum; the condition of the neurovascular bundle is assessed; interposition of soft tissues is eliminated. Next, reposition and compression of bone fragments is carried out under bite control; the selection of a miniplate and its fitting is carried out taking into account the principles of biomechanics and anatomical formations (mandibular canal, tooth roots). Then — fixation of the miniplate with screws (monocortical or bicortical) is performed. It is most optimal to place the miniplate perpendicular to the fracture line; the fixing screw should be located no closer than 3–5 mm to the fracture gap. This is followed by antiseptic treatment of the wound, layer-by-layer suturing with mandatory fixation of the severed masticatory muscle to the medial pterygoid or to the created perforations along the lower edge of the jaw and drainage of the wound.

Specific features of transfocal osteosynthesis of the lower jaw with intraoral access include: incision of the oral mucosa and periosteum, skeletonization of the lower jaw with isolation and mobilization (creation of mobility) of the mentalis neurovascular bundles in the area of the chin foramen, fixation of the plate in the area of the alveolar process or in the upper part of the body or angle of the jaw.

Patients with severe functional impairments, comminuted multiple fractures with displacement and/or with a defect in the bone tissue of the lower jaw of more than 0.5 cm have indications for immediate and delayed bone grafting with external osteosynthesis with miniplates or reconstructive standard or individual plates or extrafocal osteosynthesis.

After bimaxillary splinting and/or osteosynthesis control radiography is performed (main or additional methods of radiological diagnostics) to assess the reposition of bone fragments and, if necessary, choose another method of treatment if the condition of the bone fragments is unsatisfactory.

Time frame for immobilization of the lower jaw: for unilateral fractures, immobilization of the jaws with splints is carried out for 3–4 weeks (for closed fractures without displacement — up to 2 weeks), for bilateral fractures — from 4 to 6 weeks. The duration of immobilization of the lower jaw in patients after osteosynthesis can be reduced for the purpose of early functional loading.

If teeth are preserved in the fracture gap, electroodontodiagnosis of the teeth is performed 3 and 6 months after the injury.

According to indications, symptomatic drug therapy is prescribed: antibacterial therapy to prevent complications of a purulent-inflammatory nature (broad-spectrum,

osteotropic); for pain relief and reduction of postoperative swelling — non-steroidal anti-inflammatory drugs, antihistamines, corticosteroids; as a general strengthening therapy — vitamins, calcium supplements; for the treatment of traumatic neuropathy of the third branch of the trigeminal nerve — neuromidin, neurobex (B vitamins); to restore peripheral nerve endings — acupuncture, FTL (D'Arsanval currents, electrophoresis with calcium chloride).

FRACTURES OF THE UPPER JAW

According to ICD-10:
S02.4 — fracture of zygomatic and maxillary bones;
S02.40 — fracture of the alveolar process of the upper jaw;
S02.42 — fracture of the upper jaw;
S02.47 — multiple fractures of the zygomatic bone and upper jaw.

Maxillary fractures account for 5–16 % of all facial bone fractures. They occur when a blow is applied directly to the wide surface of the jaw, when falling on the face, compression between two solid bodies, or a reflected blow when it is applied to the lower jaw and transmitted through it to the upper jaw. In practice, it is customary to distinguish three types of non-gunshot fractures of the upper jaw, the lines of which run along the typical "weak spots of the jaw" according to Le Fort (fig. 6). Gunshot fractures occur in areas of direct impact of a wounding bullet and depend on the strength, density, shape, size and flight range of the wounding bullet.

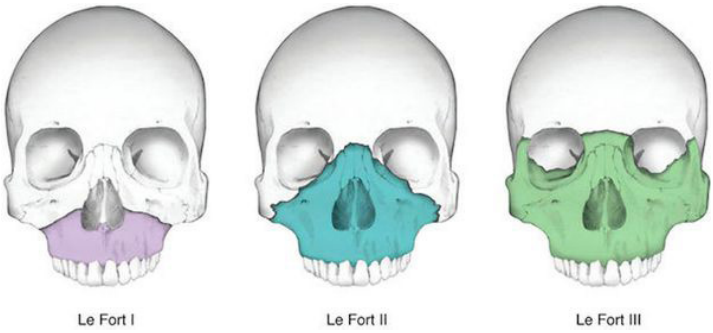

Fig. 6. Types of fractures of the upper jaw according to Le Fort

Classification:
By mechanism:
– transverse;
– sagittal;

According to etiology:
– traumatic;
– pathological;
According to the relationship of bone fragments:
– without displacement of fragments;
– with displacement of fragments;
According to the circumstances of the injury:
– occupational injury: industrial, agricultural;
– non-occupational injury: domestic, street, transport, sports;
Depending on the presence of traumatic brain injury:
– no concussion;
– with a concussion.

Typical symptoms for almost all of these fractures of the upper jaw are elongation of the face due to downward displacement of fragments of the upper jaw with malocclusion and hemorrhage in the conjunctiva, eyelids and subcutaneous tissue of the infraorbital region (symptom of "spectacles"). Often, the victims' mouth is half-open (open bite), and damage to the teeth and alveolar process is clearly visible.

On palpation mobility of the upper jaw is revealed. In cases of a fracture of the lacrimal bone in the area of the lacrimal canal, intense lacrimation is observed. When the fracture line passes in the area of the infraorbital foramen, loss of sensitivity of the skin of the upper lip and wing of the nose on the corresponding side is sometimes possible.

Symptoms of elongation and simultaneous flattening of the face indicate a downward displacement of the zygomatic and nasal bones along with fragments of the upper jaw. With bilateral fractures with downward displacement, the eyeballs descend along with the lower walls of the orbits, and enophthalmos is observed (especially with subbasal fractures), and with unilateral fractures, drooping of the eyeball and enophthalmos occur only on the damaged side and are accompanied by diplopia. In addition, with unilateral fractures of the upper jaw, sometimes there is a closure of the teeth on the damaged side due to the displacement of fragments downward and posteriorly and the formation of an "open" bite on the healthy side, which complicates the opening of the mouth. When the upper jaw drops downwards, the soft palate also drops, which can make oral breathing difficult (dislocation asphyxia).

With various types of fractures of the upper jaw, fragments may be displaced posteriorly, downward, inward, or to the side. It depends on the force of the mechanical impact causing the injury, as well as on the mass of the fragments themselves. For example, the downward displacement is determined by the traction of that part of the medial pterygoid muscle, which starts from the pterygoid process of the main bone (firmly connected with the tubercle of the upper jaw) and ends

at the angle and body of the lower jaw. To a much lesser extent, it depends on the traction of the facial muscles attached to the upper jaw.

The higher the fracture line is located and the more the bone mass is separated from the base of the skull, the more severe the clinical picture of a fracture of the upper jaw is. With all types of fractures of the upper jaw, bleeding from the nose and mouth is observed.

For the lower type of fractures of the upper jaw **(type I according to Le Fort)** the fracture line runs horizontally over the alveolar process and the vault of the hard palate, from the base of the pyriform foramen on both sides it goes posteriorly and above the bottom of the maxillary sinus, passes through the tubercle and the lower third of the pterygoid process of the sphenoid bone. With this type of fracture, the bottom of the nose, the bottom of the maxillary sinus are broken off, and a horizontal fracture of the nasal septum occurs.

The victim complains of pain in the upper jaw, which intensifies when closing the teeth and chewing; numbness of teeth and gum mucosa; improper closure of teeth; sensation of a foreign body in the throat, nausea; difficulty breathing through the nose and bleeding from the nose.

Upon external examination, the configuration of the face is changed due to swelling in the buccal areas and upper lip, and smoothness of the nasolabial folds. With a pronounced downward displacement of the upper jaw, the middle third of the face lengthens. There may be abrasions, bruises and lacerations on the face and oral mucosa. When examining the oral cavity, hemorrhage can be detected along the fold of the upper jaw within all teeth.

When palpating the upper jaw, pathological mobility of bone fragments and a positive symptom of a “bone step” along the zygomaticalveolar ridge, as well as a positive symptom of loading, are determined.

On percussion of the teeth of the upper jaw, a box sound is heard (Malevich’s symptom or “cracked pot”).

There is frequent displacement of the upper jaw posteriorly and downward in the distal sections due to the traction of the medial pterygoid muscles on the right and left.

A fracture of the upper jaw of the lower type must be differentiated from a fracture of the alveolar process, in which the load symptom is negative.

An X-ray in a semi-axial projection can reveal disruption of bone integrity in the area of the zygomaticalveolar ridges and the edge of the pyriform opening, as well as darkening of the maxillary sinuses due to hemorrhage in them.

Middle type of fracture **(type II according to Le Fort).** In a Le Fort type II fracture of the maxilla, the fracture line runs at the junction of the frontal process of the maxilla with the nasal part of the frontal bone and the bones of the nose (nasofrontal suture), then along the medial wall of the orbit down to the infraorbital fissure. Further along the lower wall of the orbit, the fracture line goes anteriorly to

the infraorbital margin, crossing it along the zygomaticomaxillary suture or close to it. The fracture line may pass through the infraorbital foramen. Along the anterior wall of the maxillary sinus along the zygomaticomaxillary suture, it passes posteriorly to the tubercle of the upper jaw and the pterygoid process of the sphenoid bone. With a bilateral fracture, the nasal septum and ethmoid bone may break.

The patient's complaints are largely similar to those in Le Fort type I fracture. In addition, patients may complain of numbness of the skin of the infraorbital region, upper jaw, upper lip and wing of the nose on the corresponding side. When the nasolacrimal duct is damaged, lacrimation sometimes occurs. There may be a decrease or loss of smell when the olfactory filaments that pass through the openings of the cribriform plate are ruptured or pinched.

An external examination reveals facial asymmetry due to post-traumatic swelling in the infraorbital region and the root of the nose. The skin is cyanotic due to hemorrhage, especially in the lower eyelid area. There are often hemorrhages under the conjunctiva and into the sclera of one or both eyes. There may be subcutaneous emphysema of the facial tissues due to air entering through the damaged walls of the maxillary sinuses. From the side of the oral cavity, upon examination, hemorrhage is determined along the fold of the upper jaw in the area of the large and small molars.

When the patient is in a horizontal position, the face is flattened due to the posterior displacement of fragments of the upper jaw; when the patient is in a vertical position, the face lengthens due to the downward displacement of the upper jaw. Often there is impaired pain sensitivity of the skin of the infraorbital region, lower eyelid, and wing of the nose. As a rule, bleeding occurs from the nose, mouth and nasopharynx.

When palpating the lower edge of the orbit, a bony protrusion is determined in the area of the zygomaticalveolar ridge — a positive symptom of a "bone step". In the area of the nasofrontal suture, crepitation of fragments can sometimes be determined. Pain sensitivity of the gum mucosa is reduced in the area of incisors, canines and premolars on both sides.

It is not damaged at the molar level. Palpation of the upper jaw reveals pain, pathological mobility of bone fragments, as well as synchronous displacement of bone fragments along the lower orbital margin and in the region of the root of the nose, as well as along the zygomaticalveolar ridge. The symptom of "indirect load" is positive. In this case, a fold of skin in the area of the root of the nose is often detected. The remaining symptoms are similar to those of a lower type fracture.

An X-ray in a semi-axial projection reveals disruption of bone integrity in the area of the lower edge of the orbits, zygomaticalveolar ridges and often in the area of the nasal bones

Upper type of fracture **(type III Le Fort).** The most severe clinical picture is observed with complete separation of the bones of the facial skeleton according to

the subbasal type. In this case, in addition to profuse bleeding from the nose, mouth and ears, a pronounced flattening and elongation of the face is almost always observed due to the downward displacement of the upper jaw and cheekbones, and, consequently, the bottom of the orbits along with the eyeballs.

The fracture line runs through the nasofrontal suture, along the inner wall of the orbit to the superior orbital or inferior orbital fissure, further — along the outer wall of the orbit to the frontozygomatic suture. Then it goes posteriorly and down the large wing of the sphenoid bone and reaches the upper part of its pterygoid process. The zygomatic processes of the temporal bones break. With this type of fracture, the facial bones are separated from the skull. This is often accompanied by a concussion or contusion of the brain, or a fracture of the base of the skull. The victim may have predominant symptoms characteristic of a traumatic brain injury: loss of consciousness, nausea, vomiting, retrograde amnesia, headache, tinnitus, mental disorders, otoliquorhea or nasoliquorhea .

The victim complains of double vision, painful or difficult swallowing, the presence of a foreign body in the throat, nausea, and difficulty opening the mouth.

On examination the victim's face is puffy, with a disturbed configuration. A positive symptom of "spectacles", which is characterized by hemorrhage in the tissue of the upper and lower eyelids, conjunctiva and tissue of the orbital region is observed. In a patient in a supine position, the face is flattened; when transferred to a vertical position, the face lengthens. Exophthalmos is determined due to hemorrhage into the retrobulbar tissue.

When palpating the tissues in the area of the nasal root, crepitation or bony prominence is determined, as well as a positive symptom of a "bone step" along the outer edge of the orbits. When opening the mouth, the pain increases due to the pressure of the coronoid process on the displaced area of the zygomatic arch or zygomaticalveolar ridge. Mouth opening is limited. Palpation of the upper jaw reveals pain and pathological mobility of bone fragments. The symptom of "indirect load" is positive. There is no hemorrhage under the mucous membrane of the vestibule of the oral cavity. The pain sensitivity is not changed. The remaining signs correspond to those of a lower type fracture.

The radiograph reveals disruption of bone integrity in the area of the zygomatic arches and the outer edge of the orbits.

Treatment of victims with fractures of the upper jaw should be carried out only in a hospital setting.

When providing first medical aid to victims with fractures of the upper jaw, it is necessary, if possible, to reduce bone fragments and temporarily fix them after arresting bleeding, anti-shock measures and preventing asphyxia.

The victim must be transported to the hospital lying on the side. Almost all victims with fractures of the upper jaw require transport immobilization. When providing assistance to patients with facial trauma, one must always remember

that fractures of the upper jaw may cause dislocation asphyxia. This type of complication occurs as a result of the closure of the airways when fragments of the upper jaw move posteriorly and downward.

We must not forget about bleeding from fractures of the upper jaw, which is especially dangerous during loss of consciousness. Even a small trickle of blood is gradually aspirated, imperceptibly filling the airways, and can lead to death (aspiration asphyxia).

All methods of temporary immobilization for fractures of the upper jaw include fixing its fragments to the base of the skull. As temporary immobilization of fragments of the upper jaw during first aid, fixation to the lower jaw, which in this case is used as a splint, can be recommended. Of course, this is only possible if the lower jaw remains intact.

Temporary immobilization of bone fragments is carried out using a sling-shaped bandage; chin sling, Pomerantseva–Urbanskaya sling bandage; transport immobilization according to Arzhantsev .

For fractures of the upper jaw, conservative (orthopedic) and surgical methods of immobilization are used.

Orthopedic immobilization methods include bimaxillary splinting with Tigerstedt splints with intermaxillary rubber traction and a sling-shaped bandage; Tigerstedt splints with Rauer modification; Vasiliev, Weber, Vankevich splints; Porta splint, which is used for complete secondary adentia of both jaws; Zbarzh apparatus.

Surgical methods for treating fractures of the upper jaw.

Craniomaxillary osteosynthesis according to Faltin–Adams and its modifications. Dental wire splints are preliminarily made from orthodontic wire with hooking loops, the correct bite is established and fixation is carried out with rubber traction. Under local or general anesthesia incisions are made along the outer edges of the right and left orbits, and the outer edges of the orbits are skeletonized. Using a bur at low speeds, one milling hole is made in the zygomatic processes of the frontal bone on each side for future ligatures, and then retrotuberally under the zygomatic bone, using special needles, wire ligatures are passed behind the zygomatic alveolar crest into the oral cavity and fixed to the splint in the area of the 5th and 6th teeth on each side. This ensures complete immobility of the upper jaw fragments.

Fixation of fragments of the upper jaw according to Federspiel–Dingman. A splint is applied to the teeth of the upper jaw. A thin steel wire is fixed to it, the end of which is pulled out of the mouth through the soft tissues of the cheek and upper lip (using a thick and long injection needle). The ends of the ligatures removed from the mouth are fixed to loops, hooks or an arch on a plaster headband. When the broken upper jaw is stiff, when it is impossible to reduce it manually, the wire removed from the mouth is fixed to the plaster cap through rubber traction

(ring), which provides traction of the jaws. Its strong and reliable attachment to the bones of the skull makes it possible to fix fragments of the lower jaw to the teeth of the damaged upper jaw with a simultaneous fracture of both jaws.

The method is simple, but it requires the application of a plaster cap, which is sometimes contraindicated in case of combined traumatic brain injury.

Osteosynthesis of the upper jaw with bone wire sutures. In case of a lower type of fracture, stitching ligatures are applied in the area of the zygomaticalveolar crest and pyriform foramen; in case of a middle type of fracture, bone wire sutures are applied in the area of the lower edge of the orbit and the zygomaticalveolar crest; in case of an upper type of fracture — in the area of the zygomatic arch and the upper outer edge of the orbit. For reliable fixation of a bone fragment, a wire suture must be applied in at least two places.

Osteosynthesis of the upper jaw with a Kirschner wire. Makienko's method of treating fractures of the upper jaw is based on metal osteosynthesis of fragments of the upper jaw with steel Kirschner wires. Under intravenous anesthesia, fragments of the upper jaw are reduced, while controlling the habitual bite; if necessary, the jaws are fixed with temporary immobilization according to Ivey. The location of the pin insertion is selected depending on the type of fracture. Thus, for type I fractures of the upper jaw according to Le Fort, to fix the fragments, a pin is inserted through the lower edge of the zygomatic bone from back to front towards the anterior nasal protrusion, first on one side and then on the other. In case of type II fracture of the upper jaw according to Le Fort, for osteosynthesis of bone fragments, the wires are inserted symmetrically horizontally from one zygomatic bone to the other through the body of the upper jaw, the maxillary sinus and along the bottom of the nasal cavity. In the postoperative period, the patient is given combined anti-inflammatory therapy. The intermaxillary fixation is removed after 2–3 days, and the wires are removed after 2–3 months.

In case of lower type multiple fractures of the upper jaw it is proposed to fix the fragments of the upper jaw with several pins to the intact zygomatic bones.

Craniomaxillary fixation according to Billet–Vigneul is used in victims with fractures of the upper jaw and frontal bone. This type of injury is quite often accompanied by the formation of an intracranial hematoma. Diagnostic burr holes placed by a neurosurgeon in the area of the parietal and frontal bones can be used to immobilize the upper jaw. The ligature wire is passed through the burr holes with a guide needle under the temporal muscle, zygomatic arch, brought into the oral cavity along the transitional fold and attached to the dental wire splint. Burr holes can be applied specifically only for fixing bone fragments of the upper jaw. In case of craniotomy for a depressed fracture, the edge of the bone defect can be used to fix the ligature.

According to the clinic of the Department of Maxillofacial Surgery and Facial Plastic Surgery of Belarusian State Medical University, the most commonly used

surgical method for treating fractures of the upper jaw is currently osteosynthesis with a system of titanium mini-plates.

For a fracture of the upper jaw according to Le Fort I, an incision is made in the mucous membrane of the oral cavity along the transitional fold from 1.5 to 2.5 teeth, the alveolar process of the upper jaw, the anterior wall of the maxillary sinus and the zygomaticalveolar ridge are skeletonized. In order to fix the fragment in a Le Fort I fracture, the plates are placed on the anteriolateral surface of the jaw and the alveolar process in the area of the incisors and the first molar or second premolar.

In a Le Fort II fracture, in order to avoid subsequent lymphostasis, the tissues are dissected along the ciliary edge of the lower eyelid. They are carefully dissected and reach the infraorbital margin, from which the periosteum is peeled off for 1.5 cm on both sides of the fracture gap. The same is done on the other side. Then the fracture gaps in the area of the glabella and zygomaticalveolar crest are exposed. After repositioning the fragments mini-plates of suitable shape and size are selected, with the help of forceps they are made to fit tightly to the bone and fixed with screws, the length of which corresponds to the depth of the drilled bone canals.

For fixing fragments in Le Fort III fractures soft tissue in the area of fractures of the facial bones (the glabella, the upper outer corner of the orbit and the zygomatic arch) are dissected, the bone is skeletonized, the fracture gaps are found and manual reduction of the fragments is performed under visual control. To avoid noticeable scars on the face, some authors suggest making a coronal incision, peeling away the soft tissue from the vault of the skull and moving the soft tissue forward (on the face), which makes it possible to expose all fracture sites through one wound. A mini-plate selected by shape and size is applied to the bone in the area of the fracture and fixed with mini-screws.

When treating fractures of the upper jaw, you should always remember the need to prevent traumatic sinusitis of the maxillary and frontal sinuses, as well as traumatic osteomyelitis of the upper jaw. The ability to prevent these complications in case of facial injuries directly depends on the correct diagnosis. When making a diagnosis, the doctor must take into account the likelihood of damage to the bone walls and mucous membrane of the maxillary and frontal sinuses, hemorrhage within these structures, the possibility of foreign bodies, as well as fragments of bones and teeth entering the sinuses.

The surgeon must carefully check whether there is communication between the maxillary sinuses and the oral cavity, as well as perforation of the hard and soft palate into the nasal cavity and nasopharynx due to trauma. Therefore, when providing specialized care in the above cases, there may be direct indications for revision of the maxillary sinuses with the subsequent anastomosis with the lower nasal passage. If there is communication between the maxillary sinuses and the oral cavity, plastic closure with local tissues is required.

Drug therapy of patients with fractures of the upper jaw.

When treating victims with fractures of the upper jaw, it is necessary to create conditions for the consolidation of bone fragments and prevent the development of possible inflammatory complications. This is facilitated by timely and effective fixation of fragments, combined anti-inflammatory and restorative therapy, physiotherapeutic methods of treatment and oral hygiene.

Victims with fractures of the upper jaw are prescribed antibiotics with tropism for bone tissue (lincomycin, fusidine sodium, dolocin, doxycycline, dalmatim, etc.), cephalosporins (ceftriaxone, cefazolin, cefotaxime, cephalexin), aminoglycosides (gentamicin, kanamycin, monomycin).

Along with antibiotics, according to indications, sulfonamides and nitrofuran drugs can be prescribed. General restorative therapy includes the use of B vitamins, ascorbic acid, methyluracil, calcium containing drugs, respiratory and hygienic exercises, balanced nutrition and oral hygiene.

FRACTURES OF THE ZYGOMATIC BONE AND ARCH, ZYGOMATIC-ORBITAL AND ZYGOMAXILLARY COMPLEXES

According to ICD-10: S02.41 is a fracture of the zygomatic bone (arch).

Currently, not just fractures of the zygomatic bone or the upper jaw are distinguished by the surgeons, but they also identify complexes damaged during trauma, including fractures of the zygomatic-orbital and zygomatic-maxillary complexes, fractures of the zygomatic bone itself and the arch.

The bony orbit consists of 7 bones shaped in the form of a pyramid with the apex directed upward and posteriorly: the zygomatic bone, the upper jaw, the frontal bone, the greater and lesser wings of the sphenoid bone, the orbital process of the palatine bone, the lacrimal bone and the orbital process of the ethmoid bone. The lower and medial walls of the orbit are thin bony plates. Fractures of these walls are difficult to assess with radiography in standard projections. Rotation of the body of the zygomatic bone, especially with displacement of the lateral wall of the orbit, increases the volume of the orbit and is considered to be a common cause of enophthalmos.

The zygomatic bone is attached to the skull in 4 sites. Displaced fractures at one junction are accompanied by fractures at other junctions of the zygomatic bone. It is noted that injuries of various severity can lead to different types of fractures of the middle face area involving the zygomatic bone — from non-displaced fractures of the zygomatic bone in low-energy injuries to multiple fragmentations of the entire middle face area in cases of high-energy injuries.

Fractures of the zygomatic bones account for 6–20 % of all fractures of the facial bones. According to Nizovoy, they are classified into fractures of the zygomatic bone and zygomatic arch.

The causes of zygomatic bone and arch damage are most often household, sports, transport or work injuries.

Fractures of the zygomatic bone and arch can be open or closed, linear or comminuted, with or without fragments displacement, gunshot and non-gunshot.

Typical locations of zygomatic bone fractures are the following: from the infraorbital suture to the zygomatic-alveolar ridge (palpated from the outside and from the side of the oral cavity in the form of a 'step') and in the area of the front and temporal zygomatic sutures. When it is damaged, the body of the zygomatic bone moves inwards and backwards, which leads to disruption of the integrity of the orbital outer wall. In cases when the fragment rotates along the axis, the damage is caused to the maxillary sinus with rupture of the mucous membrane and nose bleeding.

When the zygomatic arch is fractured, the continuity of the zygomatic process of the temporal bone and the temporal process of the zygomatic bone is disrupted, three fracture sites (cracks) and two fragments are formed, moving inward and downward and causing pressure to the mandible coronoid process thus complicating its movement (fig. 7).

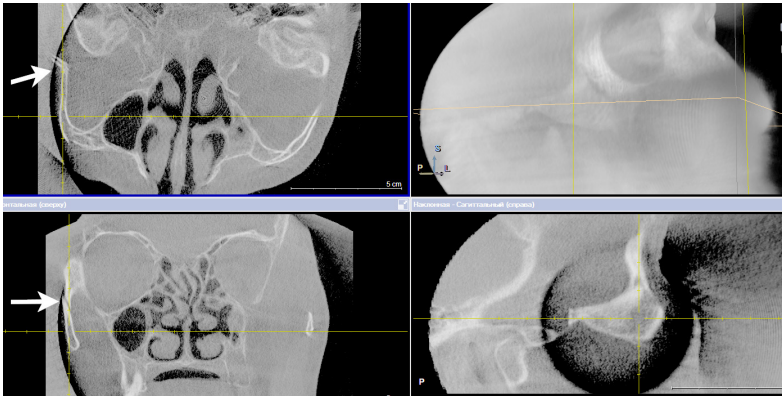

Fig. 7. Fracture of the zygomatic arch

Depending on the duration of the injury, fractures of the zygomatic complex are considered to be fresh (up to 10 days), old (from 11 to 30 days), incorrectly fused/not fused (more than 30 days).

Clinical picture. When assessing the patient's complaints, attention should be paid to the pain in the bones of the nose, jaws, orbit, zygomatic bone, facial soft tissue structures, changes in the bite, presence of the sensitivity impairment areas on the face, nose bleeding and visual deterioration. On clinical examination, attention should be first paid to the symmetry of the zygomatic protrusions location,

presence of collateral edema, post-traumatic hematomas, bone steps along the lower edge of the orbit, zygomatic arch, alveolar ridge and frontal suture, pain on palpation of the bone contour in the orbit, zygomatic bones, upper jaw, nasal bones and dysfunction. In the presence of severe collateral edema, it is often difficult to determine the presence of bone steps during palpation. Fractures of the upper jaw cause much more serious edemas and hematomas than isolated injuries of the zygomatic or nasal bones. Fractures of the midface bones of different severity are often similar in appearance, and the severity of collateral edema and post-traumatic hematomas does not correlate with the severity of the existing injuries.

The following signs are characteristic of fractures involving the zygomatic bone:

1) impaired sensitivity in the zone of innervation of the trigeminal nerve second branch — numbness in the cheek, nose, upper lip, alveolar process on the affected side;

2) flattening of the face on the affected side;

3) visual impairment, especially in the form of diplopia;

4) hematomas along the orbit perimeter;

5) swelling in the orbital area;

6) subconjunctival hemorrhages;

7) restriction of the eyeball movement;

8) changes in pupillary reflexes;

9) restriction of the mouth opening;

10) hematomas in the area of the buccal groove;

11) enophthalmos;

12) limitation of mobility of the lower jaw.

In cases of the zygomatic bone fractures, the following clinical signs are most often detected:

1) collateral edema in the orbit and midface area;

2) post-traumatic hematomas of the infraorbital region;

3) subconjunctival hemorrhages;

4) flattening of the face;

5) step symptoms along the lower edge of the orbit, and/or the zygomaticalveolar ridge, and/or the zygomaticofrontal suture, and/or the zygomatic arch;

6) neuropathy in the area of innervation of the trigeminal nerve second branch, resolving on its own within 3–5 days after injury.

Fractures of the zygomatic-orbital complex are classified as medium-energy fractures. During clinical examination of the zygomatic-orbital complex fractures, in addition to the symptoms characteristic of the zygomatic bone fractures, the following symptoms are revealed:

1) diplopia;

2) external or internal ophthalmoplegia;

3) persistent impairment of sensitivity in the zone of the trigeminal nerve second branch innervation, not resolving without surgical treatment.

The presence of expressed post-traumatic collateral edema and hematomas often makes it difficult to determine the bone steps in the orbit and zygomatic bone. Fractures of the zygomatic-orbital complex are characterized by presence of bone steps in the area of all junctions of the zygomatic bone with the adjacent bones. During clinical examination, bony steps are determined along the lower edge of the orbit, frontal zygomatic suture, alveolar zygomatic ridge and zygomatic arch. Determining the impairment of integrity in the area of the frontal zygomatic suture is difficult in the majority of cases.

Fractures of the zygomatic maxillary complex are referred to high-energy fractures. In cases of the zygomatic maxillary complex fractures, there are difficulties in determining all clinical signs, since almost always the patient with such types of injury has a moderate or severe TBI or associated injuries. It is often required to install the endotracheal tube for artificial ventilation of the lungs and the nasogastric tube for a patient's feeding. With this type of damage, multiple damages of the face bone contour are determined in the areas of the orbit, zygomatic bones, and zygomatic arches. The mobility of the upper jaw is determined according to Le Fort (type I, II or III) in attempts to move it. Presence of sedation makes it impossible to assess visual function and sensory pathology of the trigeminal nerve second branch due to the lack or impairment of consciousness. Function assessment of the other cranial nerves in the initial period after injury is often impossible.

Fractures of the zygomatic bone can damage the walls of the maxillary sinus and the lower wall of the orbit, while fractures of the zygomatic-orbital and zygomatic-maxillary complexes are always accompanied by fractures of the maxillary sinus and the lower orbital walls. Damage to the maxillary sinus walls can lead to the development of maxillary sinusitis.

Clinical examination is not sufficient to diagnose fractures of the midface bones, therefore it is necessary to use the following radiological examination methods:

1) radiography of the facial part of the skull;

2) multislice computed tomography (MSCT);

3) cone beam computed tomography.

Planar radiography is also an acceptable diagnostic method to detect serious midface trauma. However, radiography in standard projections is often insufficient to determine the existing damage.

If a patient is suspected of having a head injury or a fracture of the cervical spine, it is necessary initially to perform MSCT. MSCT is useful if there is a suspicion of craniofacial trauma or fractures of the skull bones base in cases when X-ray shows no signs of damage.

MSCT, as well as CBCT, gives a simple 3-plane reconstruction of the skull, providing comprehensive data on the volume and location of the damaged bones, easy visualization and perception.

Treatment. Brain and ophthalmic injuries are of primary concern in terms of medical care. It is necessary to perform primary surgical treatment with wounds suturing in cases when the existing wounds are not required for the access during open repositioning of the midface bones. It is advisable to perform specialized surgical treatment even if the patient is in the intensive care unit, since fractures of the midface bones tend to consolidate faster than other fractures.

Delayed treatment of patients with non-life-threatening conditions can be performed simultaneously with repositioning of the facial bones. If a patient has indications for drainage of intracranial hematomas, presence of a maxillofacial surgeon during neurosurgery is required to assess the existing injuries to the facial skull and provide specialized care. If possible, the neurosurgeon should choose the approach allowing him to completely reposition the bones of the facial skeleton.

Among all craniofacial traumas, requiring surgical treatment, primary attention should be given to the penetrating injuries of the eyeball, with the exception of the life-threatening ones. Delayed care for the damaged eyeball is justified only if the patient is transported to a specialized center, where such care will be provided at a higher professional level (i.e. to the hospital Ophthalmology Department).

All currently described methods of treatment of zygomatic bone, zygomatic-orbital and zygomatic-maxillary complex fractures can be divided into closed and open reposition techniques.

Fractures of the zygomatic bone without displacement do not require surgical treatment.

Usually standard general anesthesia is applied when performing repositioning of fractures of the zygomatic bone, zygomatic-orbital and zygomatic-maxillary complexes. In cases of closed bone reposition, a number of professionals use mini- or micro-plate systems to fix bone fragments in a stable position without osteosynthesis.

A widely used method of the zygomatic bone reposition via a spot incision in the cheek area was proposed by L. Stromeyer (L. Stromeyer, 1844). Although a closed bone reposition method has a number of disadvantages and does not allow the surgeons to perform rigid fixation of the zygomatic bone after repositioning, it is currently commonly applied. The use of a hook-type tool (the Limberg hook) for repositioning is a simple and not expensive method, especially in patients with isolated zygomatic arch fractures (fig. 8).

An alternative to this method is to perform closed reposition using the 3D-CR method, developed at the Department of Maxillofacial and Plastic Surgery, Belarusian State Medical University (BSMU) (A. V. Glinnik, O. M. Pavlov).

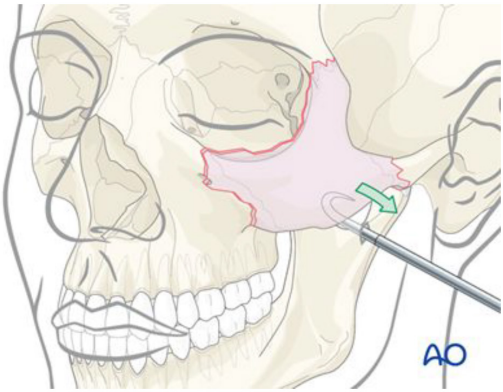

Fig. 8. Closed reposition of the zygomatic bone with the Limberg hook

The 3D-CR method provides significant advantages in positioning the zygomatic bone, but at the same time it requires a longer surgical intervention and, therefore, endotracheal anesthesia. To perform reposition with the help of Limberg hook it is sufficient to apply intravenous anesthesia due to the shorter operation time.

For questionable zygomatic bone fractures that may require open reposition, it is advisable to begin reposition with the 3D-CR method, since the patient will initially be under endotracheal anesthesia.

The development and implementation of the 3D-CR method in clinical practice was associated with the limitation of the ability to accurately reposition the body of the zygomatic bone with application of the traditional technique of closed reposition using a Limberg hook.

When performing open position, rigid fixation of bone fragments is most often applied with a system of 1 mm thick mini-plates and 5–19 mm long screws. Subciliary, intraoral or eyebrow incisions can be used to provide surgical access. When making a subciliary incision, it is required to step back 2 mm from the ciliary edge of the lower eyelid. The subciliary incision is used most often to access the inferior wall of the orbit. In case of the zygomatic bone with individual titanium implants reconstruction, it is sufficient to use an intraoral incision for their installation. To perform the Dingman approach, it is necessary to make 2 incisions — one incision is made under the eyebrow to have access to the zygomaticofrontal suture and the other, ciliary incision, provides a good revision of the lower and lateral edges of the orbit. To improve the aesthetic outcome and reduce the risk of postoperative lower eyelid retraction associated with the skin incision a transconjunctival incision is made.

A specific feature of fractures of the zygomatic bone, zygomatic-orbital and zygomatic-maxillary complexes treatment is that the bones must be fixed

using abutments (counterforts). There are 2 vertical abutments passing through the middle zone of the face — the maxillary lateral and medial ones — and one horizontal — the upper transverse maxillary. The increase in the fixation stability is achieved by performing 3-point fixation, however, a number of authors note that this deteriorates the blood supply to bone fragments.

FRACTURE OF NAZAL BONES

According to ICD-10: S02.2 is a fracture of the nasal bones.

A fracture of the nasal bones is impairment of the integrity of the nose osteochondral structure as a result of mechanical trauma. It manifests itself as intense pain, disruption of the nose shape, bleeding, mucous discharge from the nasal passages, difficulty in nasal breathing, swelling and cyanosis of nearby soft tissues. Diagnosis is made on the basis of anamnestic data, examination and palpation data, anterior rhinoscopy, radiography of the nasal bones in frontal and lateral projections. A fracture of the nasal bones is a common injury of the nasal cavity due to the organ protrusion and the fragility of its osteochondral base. It ranks first in terms of prevalence among injuries of the facial part of the skull. It is more often diagnosed in boys and young men. The ratio of male to female patients is approximately 3 : 1. In 20 % of cases the fracture is accompanied by damage of the skin integrity. No significant seasonal fluctuations are detected; the number of domestic and criminal injuries slightly increases in summer.

Etiology. Fractures of the nasal bones occur as a result of a direct or, less often, lateral blow. Damage may occur in case of falling face down on a hard surface. The most common causes are the following:

1. Sports injury. Typically, fractures are diagnosed in boxers, athletes involved in other active traumatic sports with a high probability of falls.

2. Domestic trauma. This group includes criminal fractures (got in a fight), injuries from a fall as a result of loss of consciousness, epileptic seizures or severe alcohol intoxication. In children the cause of injury is often a fall during active games, especially on hard surface areas (asphalt, etc.).

3. Road accident. Fractures of the nasal bones occur when hitting glass or a front panel as a result of collision with an obstacle or a vehicle. They are often accompanied by the head injuries and fractures of other skull bones and are detected as part of a combined injury.

4. Damage at work. It usually occurs as a result of breaking safety regulations. It is often detected in construction and agricultural workers (e.g. as a result of being hit by an animal's hoof) or when a person is struck by a broken part while working on the machine — tool.

5. War injuries. They are diagnosed in military personnel, taking part in military training or combat operations.

Pathogenesis. Fracture of the nasal bones and/or the septum is possible in case of a blow to the face. High-intensity traumatic effects can be accompanied by a damage to the sinus walls and break of the integrity of the maxillary bones frontal processes, less often — the vomer, nasal concha, orbital walls, and the ethmoid bone. In the latter case, there is a risk of severe bleeding due to the ethmoid artery damage. A characteristic feature of nasal bone fractures is the formation of a large number of fragments. The typical direction of fragments displacement is posteriorly, outwardly and inwardly. With a direct blow to the lower part of the organ, a separate damage to the cartilage of the septum is sometimes revealed. In the first years of life, fractures of the nasal bones are rare due to the elasticity of the hard base of this area. In children of the older age group the sutures between the bones may come apart.

Classification. Taking into account presence or absence of skin damage, open and closed fractures are distinguished. To assess the nature of the injury the Volkov's classification is used, according to which the following types of nasal bone fractures are defined:

1. Without displacement. They are considered the mildest fractures and are not accompanied by changes in the shape of the nose in the remote period.

2. With displacement. They occur due to the intense traumatic effects. Without reposition such injuries may result in deformation of the nose of various severity.

3. Damage to the nasal septum. It can be single or combined with fractures of the nasal bones and adjacent structures.

Just after injury acute pain appears and some patients hear a crunching sound. Bleeding of different intensity is observed. In cases when bone fragments are displaced the shape of the nose changes. As a result, rapidly increasing nose and lower eyelids swelling followed by cyanosis occurs in these areas. When the nasal mucosa is ruptured, subcutaneous emphysema can be detected. Subsequently, the pain syndrome persists; upon touching and palpation the pain increases sharply. Bleeding may continue and mucous discharge may appear. With a simultaneous fracture of the skull base bone liquorrhea is observed. A fracture of the nasal bones is accompanied by the increasing nasal breathing disorders caused by swelling and changes in the nasal structures. Some patients complain of nausea and dizziness, which should be a reason to rule out concussion.

During the first hours after injury profuse bleeding is possible, especially in case of severe injuries with the impairment of integrity of the ethmoid bone. Early complications include hematomas, abscesses, and soft tissue suppuration. In severe open fractures there is a danger of the purulent process spreading to the bones, including the anterior cranial fossa. After fusion, in the absence of bone reposition, an aesthetic defect may be revealed. A deviated nasal septum is often observed. It is accompanied by nasal breathing disorder, which increases the likelihood of developing sinusitis and rhinitis. Less commonly, breathing through the nose is completely blocked.

Diagnosis. To confirm the diagnosis and determine treatment tactics, the following diagnostic measures are carried out:

1. Consultation with an otolaryngologist. It includes clarification of complaints, the mechanism and duration of injury, external examination and palpation. During examination significant swelling of the nasal area, spreading to the lower eyelids, is noted; hemorrhages in the skin and conjunctiva may also be detected; in case of open fractures, skin damage is visible. Palpation can detect pain, deformation, bone crepitation; sometimes the edges of fragments can be defined.

2. Anterior rhinoscopy. The examination makes it possible to reveal the location of the bleeding source, identify ruptures in the mucous membrane, disruption of the shape of the nasal septum, and damage to the turbinates.

3. X-ray of the nasal bones is performed in frontal and lateral projections. It is recommended to confirm the fracture, determine its type and location, assess the direction and severity of the fragments displacement (fig. 9).

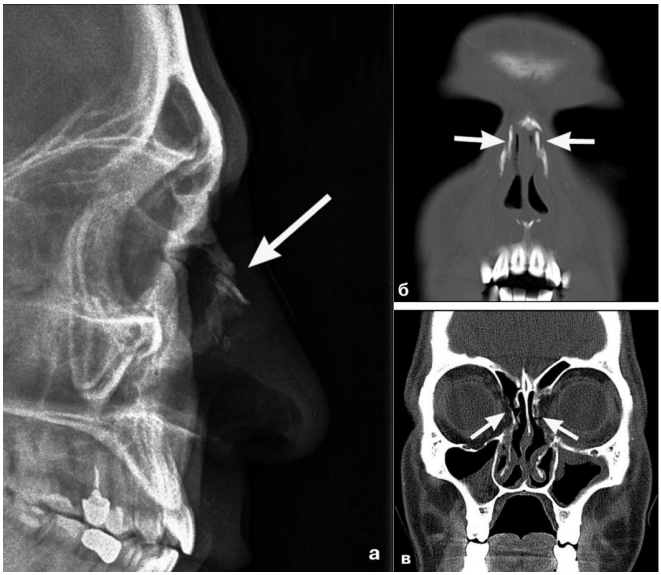

Fig. 9. Fracture of the nasal bones with fragments displacement

Treatment. In case of minor injuries treatment is carried out on the outpatient basis while in severe fractures patients are hospitalized to the otolaryngology department. Patients with non-displaced fractures undergo wound treatment, treatment with antibiotics, and physical therapy. If there is bone displacement,

reposition of the nasal bones is performed on the day of admission. For patients with basal skull fractures and liquorrhea, reposition is performed 2–3 weeks after the injury. Lateral displacement is eliminated by finger pressure from the side opposite to the curvature. Correction of posterior displacement of fragments is carried out using a narrow elevator.

To keep the fragments in the correct position, reposition is completed with tamponade of the middle and upper nasal passages. Rubber tubes for breathing are installed in the lower passages. If necessary, external fixation of fragments is used with rollers attached with an adhesive plaster or a collodion bandage. Sometimes fixation is not required. In cases of severe comminuted fractures, impossibility of conservative reposition and repeated displacement, rhinoplasty, combined with septoplasty is indicated if the septum is damaged. To keep the bones in the correct position, a bandage is applied for two weeks.

DRUG THERAPY OF PATIENTS WITH FRACTURES OF THE FACIAL SKELETON

Patients with fractures of the facial skeleton undergo complex anti-inflammatory and restorative therapy, physiotherapeutic treatment, physical therapy and oral hygiene.

It is recommended to prescribe antibiotics with tropism for bone tissue (lincomycin, fuzidin sodium, dolocin, doxycycline, dalmatim etc.), cephalosporins (ceftriaxone, cefazolin, cefotaxin, cephalexin), aminoglycosides (gentamicin, kanamycin, monomycin); sulfonamides and nitrofuran drugs according to indications. General restorative therapy includes the use of vitamins (group B), ascorbic acid, methyluracil, and calcium-containing drugs. On the second or third day after injury, the use of UHF therapy (up to 8 sessions), UV irradiation (up to 10 sessions) is indicated; on the 12th day calcium chloride electrophoresis is prescribed (8–10 sessions).

If there are wounds, tetanus preventive measures are mandatory. For this purpose, wounds are treated and injected with antitetanus serum (ATS) in doses of 3000–10,000 IU. For therapeutic purposes, ACC is administered intramuscularly in a dose of 1500–2000 IU/kg per day (daily dose 100,000–200,000 IU) for 2–4 days. In severe cases serum is administered intramuscularly in a dose of 100,000 IU and intravenously — 50,000 IU (diluted in saline in a ratio of 1 : 10 at a temperature of 37 °C). When injecting ACC, a medical care provider must follow the instructions. Tetanus toxoid is also administered intramuscularly (subcutaneously) in a dose of 1–2 ml and repeated after 3–5 days; 3–5 % solution of chloral hydrate in enemas in a dose of 50–150 ml is applied for adult patients.

COMBINED CRANIOFACIAL TRAUMA

Currently, the work to develop a unified classification of the maxillofacial area combined injuries is underway. Combined injuries are divided into 4 groups:

1. Severe traumatic brain injury (brain contusion of severe and moderate severity, fracture of the vault and base of the skull, intracranial hematomas) and severe damage to the facial skeleton (fractures of the upper jaw according to Le Fort II and Le Fort III, multiple fractures of the facial skeleton).

2. Severe traumatic brain injury and minor injuries to the facial skeleton (fractures of the nasal and zygomatic bones, unilateral fractures of the upper and lower jaw).

3. Mild traumatic brain injury and severe damage of the facial skeleton.

4. Mild traumatic brain injury and minor injuries of the facial skeleton.

This classification most fully includes the localization of injuries in the maxillofacial region, their possible combinations with brain damage. It is widely used in maxillofacial surgery and neurosurgery clinics.

Clinical and functional changes in patients with combined craniofacial traumas. Specific features that distinguish maxillofacial trauma from other types of combined brain injuries and contribute to the diagnosis and surgical tactics include:

1. Possibility of severe external respiration disorders caused by occlusion of the upper respiratory tract with blood, fragments of oral mucosa soft tissue and sometimes bone fragments of the jaws.

2. Presence of severe traumatic edema and facial deformation, which complicates diagnosis with an adequate assessment of the cranial nerves functions.

3. Combined damage to the sense organs, including vision, hearing, smell, taste, the peripheral branches of the trigeminal and facial nerves.

4. Possibility of heavy blood loss due the blood vessels integrity impairment in the soft tissues of the maxillofacial area and the bones of the facial skeleton.

5. A constant threat of retrograde meningoencephalitis in case of liquorrhea, due to the direct communication of the damaged paranasal sinuses with the anterior and middle lobes of the brain during fractures of the skull base.

6. Development of asthenohypochondriacal and asthenoapathic syndromes in the remote post-traumatic period after maxillofacial injury, caused by the presence of traumatic defects and facial deformations.

7. The syndrome of “mutual aggravation and overlap” develops in cases when a traumatic brain injury worsens the clinical course of the injury to the maxillofacial region causing an adverse effect on the regenerative processes of the bone, and the injury to the maxillofacial region, in its turn, aggravates the course.

After fractures of the skull base and the upper jaw, the gate opens for infection of the brain and its membranes from the side of the oral cavity and paranasal sinuses.

It has been established that 90 % of patients with combined injuries of the maxillofacial and other areas of the body develop bronchopulmonary complications. The same patients may have a specific oropulmonary syndrome in the absence of thoracic trauma. According to some authors the main cause of such a syndrome is constant aspiration of the oral content, purulent wound discharge and limitation of natural ventilation.

Mild cerebral contusion, unlike concussion, is characterized by a longer duration of the loss of consciousness (up to an hour), presence of vague focal symptoms that do not disappear during the first week after the injury, possibility of subarachnoid hemorrhage and damage to the skull bones without impairment of the vital functions and a relatively favorable course of the acute period.

In the period immediately after a combined injury, three neurological syndromes can be observed: astheno-vestibular-vascular dystonia, angiodystrophic paroxysm, diencephalic syndrome (manifested by vegetative, endocrine, metabolic and trophic disorders). These syndromes are characterized by functional disorders and in some cases, despite their long duration, by reversibility of the processes. In the late period after moderate and severe brain injury, the following syndromes of organic brain damage often occur in the form of traumatic arachnoiditis, chronic hypertensive pseudotumoral syndrome, late subdural hematoma and traumatic epilepsy. With brain contusions, mental dysfunction is observed much more frequently than with concussions.

Diagnosis of closed craniocerebral injuries accompanying fractures of the facial skeleton should be based on the data obtained from a comprehensive examination of the victim, neurological, EEG, ECHO-ES and other findings.

Endolumbar puncture should be considered only in cases of strict indications including presence of mild meningeal signs, increased intensity of headaches, or manifestation of other signs of moderate or severe brain injury.

To assess the severity of the injury in patients with combined craniofacial traumas, it is important to examine the fundus. Severe brain injuries are mostly characterized by congestion in the eye retina — from mildly dilated veins to significant swelling of the optic nerve papillae. It is equally important to assess the condition of the pupils (anisocoria, reaction to the light) and dysfunction of the oculomotor and optic nerves in such patients.

Diagnosis of liquorrhea. Liquorrhea is leakage of the brain fluid through the damaged areas of the brain or facial skull. Liquorrhea is divided into obvious and hidden; according to localization it is divided into rhinoliquorhea and otoliquorrhea.

Indirect signs of liquorrhea are fractures of the skull bones, as well as the upper jaw (according to Le Fort I–II). Diagnosis of liquorrhea with simultaneous bleeding from the fracture lines is especially difficult.

Due to the leakage of cerebrospinal fluid, hypotensive syndrome subsequently develops.

The diagnostic criteria for liquorrhea are as follows:

1. A positive symptom of Gurdian and Webster, who described the "handkerchief" symptom in 1944 (with cerebrospinal fluid the handkerchief dries soft, while without cerebrospinal fluid it looks starchy).

2. A positive "medical napkin" symptom is checked up using the following method: the discharge is dripped onto two layers of a medical napkin and the appearance of a yellow spot around the blood clot is noted.

3. Laboratory determination of brain fluid ingredients in the discharge: glucose (2.8–3.9 mmol /l.), chlorides (120–130 mmol /l) and protein (0.12–0.2 g/l).

4. Endolumbar administration of uronine. Methodology: cotton balls are inserted into both external auditory canals, after that 1.0 ml of a 1 % uronin solution is injected endolumbarally and 1 hour later the cotton balls turn pink in the presence of otoliquorrhea.

5. Endolumbar injection of phosphorus isotopes (32P) 30–40 microcuries into the subarachnoid space of the spinal canal. After 1 hour, cotton balls from the external auditory canals are brought close to a Geiger–Muller counter and thus radioactive phosphorus in them is determined.

Treatment of the maxillofacial combined trauma. Treatment of combined facial injuries differs significantly from isolated ones. The therapy involves restoration of impaired functions of both, the brain, organs and tissues of the maxillofacial area, including the damaged organs of other areas of the body and prevention of possible complications. The time passed from the moment of injury to the start of specialized treatment is a decisive factor in determining the outcome of combined craniofacial injuries.

The treatment plan is drawn up by an oral and maxillofacial surgeon with the mandatory advisory participation of a neurosurgeon. Doctors of other specialties (ophthalmologist, otolaryngologist, traumatologist) are invited for consultation depending on the nature and severity of multitrauma.

With combined maxillofacial and craniocerebral injuries, specialized surgical care is often delayed. This, in turn, leads to a significant prolongation of inpatient treatment, an increase in the percentage of complications, functional disorders in the remote period, and a significant prolongation of the overall time of medical rehabilitation.

The mandatory provision of specialized surgical care in full volume is considered to be justified during the first hours after admitting the patient with a mild brain injury. However, with a combined moderate and severe brain injury, specialized surgical care for fractures of the facial skeleton is carried out within a few days and only when the neurosurgical status has improved. In case of a combined traumatic brain injury of mild severity orthopedic and surgical methods of fixation remain the same as for the patients with isolated injuries of the facial skeleton bones. An indispensable condition for such patients is to carry out

therapeutic interventions when a patient is in a horizontal position under adequate anesthesia; preference is given to surgical methods of treatment (osteosynthesis with a Kirschner wire, wire suture, miniplate system, craniomaxillary osteosynthesis, etc.).

When treating fractures of the facial skeleton bones combined with the damage to the musculoskeletal system, the following tactics should be recommended: patients with the musculoskeletal system fractures who do not need surgical treatment are consulted by an orthopedic traumatologist and receive orthopedic care (reposition and fixation of bone fragments with a plaster cast) and continue treatment at the department of maxillofacial surgery. Patients with fractures of the musculoskeletal system who require surgical treatment, after specialized medical care for the maxillofacial trauma, should be hospitalized for further treatment to the traumatological department.

SELF-CONTROL OF TOPIC COMPREHENSION

1. Surgical methods of immobilization of the upper jaw fractures:

1) Angle's arch;
2) Adams method;
3) osteosynthesis according to Makienko;
4) application of bimaxillary splints with a sling-like bandage.

2. Miniplates are fixed to jaw fragments by:

1) a pin;
2) screws;
3) paper clips;
4) splint.

3. Vincent's symptom occurs in fractures of:

1) zygomatic complex;
2) nasal bones;
3) lower jaw along the midline;
4) bodies of the lower jaw in the area of the molars.

4. The main symptom of a mandibular fracture is:

1) limitation of lateral movements;
2) malocclusion;
3) post-traumatic edema;
4) pain when swallowing.

5. Temporary type of immobilization for fractures of the lower jaw:

1) splint with spacer bend;
2) Vasiliev splint;
3) Rudko apparatus;
4) intermaxillary ligature binding according to Ivey.

6. In case of the lower jaw fracture against the background of complete secondary adentia, the following splint is used:

1) Vasilyev;
2) Port;
3) Weber;
4) Tigerstedt.

7. Indications for the use of a smooth brace splint are:

1) fracture of the condylar process;
2) fracture of the angle of the lower jaw;
3) impacted tooth dislocation;
4) fracture of the alveolar process.

8. The Tigerstedt hooking loop on bimaxillary splints should be located to the vertical axis of the tooth at an angle of:

1) 10–15º;
2) 35–45º;
3) 50–55º;
4) 80–90º.

9. When performing compression-distraction osteosynthesis, the period for the formation of primary callus is:

1) 5–7 days;
2) 14–16 days;
3) 21–28 days;
4) 30–40 days.

10. The main symptom of the zygomatic complex fracture is:

1) dizziness;
2) nosebleeds;
3) diplopia;
4) post-traumatic edema.

11. The main symptom of the skull base bones fracture is:

1) dizziness;
2) nosebleeds;
3) liquorrhea ;
4) lengthening the face.

12. Fracture of the bones of the skull base most often occurs in:

1) subalveolar fracture of the upper jaw;
2) subbasal fracture of the upper jaw;
3) fracture of the zygomatic complex;
4) fracture of the nasal septum.

13. Transportation of a patient with a combined head and spine injury is carried out in a position lying on the:

1) side;
2) stomach;
3) back;
4) side with bent knees.

14. The symptom of indirect load for fractures of the upper jaw is determined by pressure:

1) on the cheek bones from bottom to top;
2) on the chin with teeth closed from bottom to top;
3) on the canines of the upper jaw with the mouth half open from bottom to top;
4) on the projection of the pterygoid processes of the sphenoid bone from bottom to top.

15. To arrest bleeding from the posterior parts of the nasal cavity, the following procedure is used:

1) anterior tamponade;
2) posterior tamponade;
3) pressure bandage;
4) ligation of the facial artery.

16. Limitation of lateral movements of the lower jaw during the fracture of the zygomatic complex is due to:

1) contracture of the masticatory muscles;
2) blocking the coronoid process;
3) damage to the temporomandibular joint;
4) blocking the condylar process.

17. Gaping of facial wounds is caused by:

1) abundance of fatty tissue and pronounced traumatic edema;
2) attachment of facial muscles to the skin of the face;
3) anatomical features of the masticatory muscles;
4) anatomical features.

18. The advantage of intraoral access is:

1) absence of damage to the branches of the facial nerve;
2) a technically simpler method;
3) consolidation of the fracture occurs faster than with extraoral access;
4) does not require the application of intermaxillary traction in the postoperative period.

19. Damage to the lower jaw with impairment of its integrity is:

1) arthritis of the temporomandibular joint;
2) osteomyelitis of the lower jaw;
3) fracture of the lower jaw;
4) dislocation of the lower jaw.

20. Indications for osteosynthesis of the lower jaw are:

1) impossibility of performing bimaxillary splinting;
2) precise reposition of bone fragments;
3) stable fixation of fragments;
4) the absence of one tooth at the fracture site.

Answers: 1 — 3; **2** — 2; **3** — 4; **4** — 2; **5** — 4; **6** — 2; **7** — 4; **8** — 4; **9** — 2; **10** — 3; **11** — 3; **12** — 2; **13** — 3; **14** — 4; **15** — 2; **16** — 3; **17** — 2; **18** — 1; **19** — 3; **20** — 1.

REFERENCES

1. *Maxillofacial* surgery : textbook / ed. A. Yu. Drobysheva, O. O. Yanushkevich. – M. : GEOTAR-Media, 2021. – 880 p.

2. *Timofeev, A. A.* Maxillofacial surgery : textbook / A. A. Timofeev. – Molodechno : Victory, 2020. – 832 p.

3. *Pavlov, O. M.* Fractures of the zygomatic bone, zygomatic-orbital and zygomatic-maxillary complexes / O. M. Pavlov, A. V. Glinnik, F. A. Gorbachev. – Minsk : BSMU, 2019. – 34 p.

4. *Lukashevich, N. A.* Fractures of the lower jaw : educational manual / N. A. Lukashevich. – Minsk : BSMU, 2023. – 32 p.

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