Review Article

Peculiarities of Nickel-Titanium Mini-Plates Osteosynthesis in Facial Bones Fractures

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Abstract:
Retrospective analysis of 360 maxillo-facial trauma patients have seen a medical assistance to the “Dar-Al Shifa” Hospital, Gaza-Palestine, has revealed they meet more frequently (in 74.7%) in male persons, in children and teenagers (in 71.8%). Between maxillofacial trauma teeth (in 32.2%) and soft tissues (in 38.6%) trauma prevailed, and between facial bones the mandible fracture was (23.4%). In the number of cases, maxillo-facial traumatizing were a fallings, including falling from height (in 53.9%) and road traffic accidents (in 15%). Connected with the particular regional situation the bullet wounds of maxillofacial area were met in 11.7% cases. The peculiarities of facial bones fractures have been studied, including combined maxillo-facial and cranial traumas were observed in 5.7%. Bullet wounds are meriting especial attention, including soft tissue’s injures (in 83.7%), and facial bones’ injuries (in 16.7%) were observed. Has been revealed a different clinic of the bullet wounds depending on the injury localization, wounded arms, and possible contaminations in patients. Peculiarities of clinical cause of maxillofacial injures have influenced the choice of treating method of patient with trauma of such localization.

Introduction:
In the age of science-technical progress, increasing of cars quantity, industrial-urbanism type of life, and constant armed disputes in the different areas of the world, has been noted an absolute increasing of trauma including a maxillofacial localization being as an open part of the human body. Recently, was also noted a complicated nature of the maxillofacial traumas owing to the combined injuries, in particular, with cranial traumas or gunshot wounds. Anatomy-physiological peculiarities of the facial bones raised difficulties in diagnosis of the bimaxillary and zygomatic complex bones fractures as well as a series of difficulties during treatment (see. 9, 10, 11, 12). The principal method of facial bones' fractures treatment is an orthopedic method, i.e., using different types of wires, arch bars and apparatus but up to 23% cases have an indications to the surgical method of treatment of bimaxillary and zygomatic complex bones fractures. There are different methods of osteosynthesis, every one has its own indications and contra-indications. Surgical methods of fixation more frequently used when the mandible or zygomatic complex bones' fractures, rarely when maxillary fractures. But the principal shortcomings of osteosynthesis with wire sutures, rod, and another devices are the disturbance of bone blood-supply in area of fracture, development of suparative infection complications up to the traumatic osteomyelitis, demanding to remove the stitch materials, needles, devices, plates as foreign bodies (6,7,8).

Aim of the study:
Establishing and using the Nickel-Titanium Mini-Plates in the surgical methods of treatment the facial bone fractures and to proof that it is the ideal technique in the surgical fixation of the bones fragments due to its several advantages.

Materials and methods:
Properties of titanium
Titanium the more frequently used for metallic plates and splints implantation manufacturing. This metal has the advantages as follows:
* high wear-and-tear resistance.
* has easy machine processing; 1/16 of plates are transparent for X-rays, unyielding.
* according to unyielding titanium is in the intermediate position.
* (cobalt-chrome alloy>titanium>welding cobalt-chrome, steel).
* resistant to corrosion; even titanium it-self is high corrosive, the layer oxide titanium covering its outside surface and prevents from corrosion.
* non-toxicity.

Corrosion:
* titanium is the more bio-inert material.
* titanium’s resistance to oxidation in the chloral medium is high.
* titanium and its alloys form surface oxide layer faster than chrome-contained alloys as well as cobalt-chrome alloys and steel.
* this active metal form oxide surface layer in every medium; oxide adhesiveness to the down bedded metal not so high as at chrome oxide to its substratum; additionally, chrome oxide layer is more dense than of titanium oxide.

Comparative characteristic of the titanium’s and steel’s mechanical properties.
Fixation titanium system could be used in surgical

<table>
<thead>
<tr>
<th>Property</th>
<th>Steel</th>
<th>Titanium alloy</th>
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<tbody>
<tr>
<td>Solidity</td>
<td>30 Rc</td>
<td>35 Rc</td>
</tr>
<tr>
<td>Pliability</td>
<td>790 MPa</td>
<td>900 MPa</td>
</tr>
<tr>
<td>Limit tensile strength</td>
<td>960 MPa</td>
<td>960 MPa</td>
</tr>
<tr>
<td>Flexibility module</td>
<td>200 GPa</td>
<td>110 GPa</td>
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procedures, when is demanding an inner fixation by metal for reposition and stabilisation of bones pieces, including but not limited to the skull-facial restoration and skull's traumatic fractures restoration. A number of surgical techniques could be used for the skull-facial fixation as well as another materials. Choice of fixing means type, its composition, size, and shape would be made by surgeon after estimation anatomic and functional necessities of patient. The follows specific contra-

dictions, collateral effects, and precautions should be understood by surgeon and explained to patient. Conventional surgical risk, not included there, should be explained to patient before operation too. In our practical work we used mini-plates system from Austrian firm "Bio plate" (see, fig.1).

Indications to the facial bones fracture osteosynthesis

The different types of osteosynthesis when facial bones fractures in the structure of operations are using in 19.1% apropo to different maxillofacial pathologies. Between them the more frequently realises mandible fracture osteosynthesis, when orthopaedic method of treatment not provide for a desired effect. Indications of facial bones fractures osteosynthesis are follows:
* considerable displacement.
* presence of bone's defect.
* insufficient teeth quantity or its full adentia.
* patients' psychic inferiority.
* sever form of pardontontits and avitaminosis C.
* considerable interposition of soft tissues into the fracture line.
* incorrectly knitted fractures.
* false articulation.
* combined radioactive affections.
* bullet wounds.
* higher fractures of ramus of the mandible with dislocation or fragmentation of the condyler head.
* some type of mandible fracture in children.

Osteosynthesis provides advantages like:
a-comparatively a reliable process of fixation.
b-preservation of the maxillary function.

C-oral hygiene and nursing are not impaired. There are different methods of osteosynthesis each has its own advantages and disadvantages, worldwide, known method of osteosynthesis is titanium mini-plates.

Advantages of osteosynthesis by using nickel-
titanium mini-plates:
1-Inert (non corrosive, no metal release), capability of osteointegration, in comparison with steel ones
2-Small size, variable shapes
3-Adaptable i.e. can be shaped to fit in different places and follow bone contour
4-minimally traumatize the injured site
5-good and rubbed fixation of fragments where function can be restored immediately after placement and fixation of the muscles and TMG on the other hand in case of wire fixation Difficulties associated with this extended period of immobilization include airway problems, poor nutrition, weight loss, poor hygiene, phonation difficulties, insomnia, social inconvenience, patient discomfort, work loss, and difficulty recovering normal range of jaw function
6-it causes minimal esthetical problems mini-plates adaptability Due to minimal incision.
7-no need for following removal besides it provides osteointegration.
8-Decrease the number of complications compare to orthopedic methods of piece fixation

Figure1: Right mandibular sub-condylar fracture
I. Summery:
The more widely use of Titanium mini-plates in the facial bones fracture osteosynthesis by new modification will achieve the followings:
* reliable piece fixation avoiding rough bone intervention providing minimal vessel injury;
* good cosmetic results;
* early active muscle and tempromandibular joint functioning;
* in most cases to the monocortical piece fixation by mini-plate (bicortical in case of the great piece displacement);
* osteointegrated contact with bone tissue without following removal.
* to decrease the number of complications in 2.7 times compared to orthopedic methods of piece fixation;
* introduction into reconstructive osteosynthesis of the small facial bones defects in bullet and non-bullet bone injury.

II. Conclusion:
1. Facial bones fractures are characterized by different clinical features which in 5.7% cases with skull-brains trauma combined. Has been established that in mandible fractures in 15% patients unfavourable prognosis defines, in 20% doubtful prognosis of disease trend that increase a risk of infection-contaminations.
2. Ni-Ti mini-plates osteosynthesis, including intraoral access, permits to achieve a reliable fixation facial bones fragment when fractures, decreases bone's tissue injury and provides minimal bones' blood-supply disturbance, permits an early active muscle and temperomandibular joint functioning, realize reconstructive osteosynthesis in a small facial bones' bullet and non-bullet defects, decrease the number of contaminations in 2.7 times compare to orthopedic methods of piece fixation, and achieve good cosmetic results.
3. At whole, a different contaminations when facial bones' fractures were met in 8.5%. Particularly, when use an orthopedic mandible piece fixation methods, in 9.1%, wire stitch osteosynthesis - 27.3%, Ni-Ti mini-plates osteosynthesis - 3.4% patients, which confirm a high effectivity of Ni-Ti mini-plates osteosynthesis.

III. Recommendations:
1. Modification of the Ni-Ti mini-plates osteosynthesis in facial bones' fractures provide for tight screws fastening, reliable facial bones' fragment fixation by principle of compression.
2. Ni-Ti mini-plates could be used as a reconstructive osteosynthesis when small bone's tissue defects due to gunshot or any type of injury.

References:

* PhD Oral and Maxillo-facial Surgery