MANDIBULAR OSTEOSYNTHESE DEPENDING ON THE APPROACH AND THE ATTACHMENT DEVICE. INDICATIONS AND CONTRAINDICATIONS. ADVANTAGES AND DISADVANTAGES

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Abstract: Some methods of mandibular osteosynthesis have been worked out and improved. The study comprised 142 patients with mandibular fractures. The fixation of the fragments was carried out by means of metallic thread, screws, screwed miniplates. Authors have assessed indications, contraindications, advantages and disadvantages of mandibular osteosynthesis depending on the approach and devices of the fragments fixation. Obtained results will direct the specialists toward the choice of the best treatment method of patients with mandibular fractures.

Key words: trauma, mandible, osteosynthesis.

INTRODUCTION

Incidence of mandibular fractures is still high and actually (70-80%), determined by its prominent position, form and existence of regions with diminished osseous resistance [1,2]. Treatment of mandibular fractures requires patients withdrawal from work for a long period of time, having negative consequences on psycho-emotional state. Traditionally these patients undergo a conservative orthopedic treatment, using different procedures and orthopedic devices [2,3,4]. In cases when reduction of displacement and fragments fixation in a correct position is impossible, osteosynthesis is carried out.

There are many surgical methods of fragments fixation. Some of them have only a historical interest. Even though at present some of them are underestimated, they served to a substantial accumulation of experience, contributing considerably to progress of oro-maxillo-facial traumatology. Nowadays the old methods are substituted with the new ones, created on the basis of the contemporary materials, technologies and scientifical researches in the domain of the reparative regeneration of the bone[5,6].

As a rule, mandibular osteosynthesis was carried out through exo-oral access which has a lot of disadvantages. They can be avoided if osteosynthesis is performed through endo-oral access [7,8,9,10,11,12]. Surgeons reticence concerning endo-oral access has been determined so far by the insufficient visual field, lack of the appropriate instrumentarium for the access and insufficient reflection in the medical literature of the algorithm of conduct, indications and contraindications, advantages and disadvantages of mandibular osteosynthesis depending on the approach and the attachment device.
We consider that we have avoided or reduced the incidence of complications due to improvement and due to elaboration of methods of osteosynthesis through endo-oral access. This affirmation is a synthesis of results of the surgical treatment through endo-oral and exo-oral access with different devices of fragments fixation.

PURPOSE OF STUDY
To assess the indications and contraindications, advantages and disadvantages of mandibular osteosynthesis depending on the approach and device of fixation.

MATERIAL AND METHODS
142 patients with mandibular fractures were examined, operated and followed up within 2002-2008. Depending on the access to the focus of fracture, the patients were divided into two groups: Study group was composed of 95 patients, operated through endo-oral access; reference group – 47 patients operated through exo-oral access. Fragments fixation was carried out by means of metallic thread, screws, screwed miniplates.

RESULTS AND DISCUSSIONS
Indications of mandibular osteosynthesis result from the fact that it is impossible to use appropriately only conservative orthopedic methods of fragments fixation or after patient’s examination. It is obvious that conservative orthopedic methods will not ensure an accurate reposition and stable fixation of the fragments. Having studied the data from the literature and having analysed our results, we can argue the priorities of endo-oral access versus exo-oral access:

- mandibular fractures within the limit of the dental arch, more often those with a marked displacement of the fragments, are accompanied by an endo-oral wound on the level of the fracture focus, thus arguing endo-oral access (Figure 1);
- hematoma located in the fracture focus leads to detachment of the mucoperiosteum off the vestibule, consequently through endo-oral access it will not detach additionally;
- fractured, mobile teeth with chronic periapical foci from the fracture line, have absolute indications for extraction, which is also performed by means of endo-oral access;
- fixation of the mandible in centric occlusion during the operation is also carried out by means of endo-oral access;
- correct fixation of fragments at the alveolar edge is performed more easily through endo-oral access;

Taking into consideration asepsis, it is not permitted work with instruments from the infected endo-oral wound in the exo-oral wound, that is in osteosynthesis by exo-oral access we will use one more set of instruments for manipulations in the oral cavity.

All the arguments mentioned before demonstrate that osteosynthesis through endo-oral access in mandibular fractures is more reasonable, thus being able to perform reposition and fixation of the fragments. If it does not have any indications for performing it, then it is not rational to use exo-oral access (classical
method) only for these stages. Comparison of advantages and disadvantages of access in the study group and the reference one has been done.

![Fig. 1. Marked displacement of detached mandibular fragments](image1)

![Fig. 2 Optimum line of mandibular osteosynthesis (M.Champy et al. 2004, www.sorg-group.com)](image2)

Thus we have determined the following advantages of endo-oral access:

- it is less traumatic and does not require a massive detachment of the fragments, thus allowing to maintain the periosteal vascularisation from the lingual side, favoring healing of the osseous wound;
- probability of traumatisation of the important anatomical formations (e.g. marginal ramus of the mandible (n.VII), facial a. and retromandibular v., eventual paresis of mimic muscles, traumatisation of the parotid gland, submandibular gland) is ruled out;
- fragments fixation is carried out at the alveolar edge, which corresponds to biomechanics of the fractured mandible [9] (Figure 2);
- suturing of the endo-oral wound is performed more quickly and esthetically it is not pretentious, compared with the external wound;
- minimal hemorrhage;
- short time operation;
- esthetically it is more favorable because it does not let scars on the face skin;

![endo-oral access is more economical because the postoperative endo-oral wound does not require numerous daily bandages (less material and fewer antiseptic solutions), thus reducing the follow-up in the in-patient department; early functional rehabilitation of the patient.](image3)

Disadvantages of endo-oral access are the following ones:

- a smaller visual field makes surgical manipulations in the oral cavity more difficult compared with exo-oral access;
- difficulties in hemostasis in case of marked hemorrhage;
- control of the exact position of fragments at the basilar edge is more difficult;
- surgical intervention is performed in septic oral medium;
- difficulties in manufacturing or using mobile or partially mobile prostheses are observed to occur in patients with total or partial edentations.

Disadvantages of endo-oral access are disputable. The septic oral medium requires compulsory preoperative
sanitation, undertaking daily postoperative aseptic measures and efficient antimicrobial treatment. As a rule, in patients with edentations after fracture and osteosynthesis, prostheses must be adjusted to the new conditions, they must be corrected or new ones manufactured. In some cases fixation devices can be easily removed through endo-oral access. We have reduced marked hemorrhage through local anesthesia with vasoconstrictors even in patients operated under general anesthesia. Some other disadvantages can bound to accurate and fine surgical manipulations obtained and improved through much work.

Our study in the reference group has demonstrated a series of disadvantages of exo-oral access:

- during detachment of fragments, an exaggerated traumatism of the soft tissues takes place during the incision, which, due to underlying mechanic traumatism suffered before, depresses even more the local and general condition of the patient;
- increases the period of healing;
- enhances the probability of complications;
- occurrence of postoperative dermal scars which inevitably lead to an esthetic defect. The latter has a negative consequence upon the psycho-emotional state of patients (Figure 3A);
- traumatisation of important anatomical formations (e.g: marginal ramus of the mandible (n.VII), facial a. and v., retromandibular v., eventual pareses of mimic muscles (Figure 3B,C), traumatisation of parotid gland, submandibular gland) is possible;
- fragments fixation is carried out at the basilar margin, which does not correspond to the biomechanics of the fractured mandible [9], but the correct fixation at the alveolar margin requires a more marked detachment;
- a more prolonged time of surgery;
- stratified suturing of the exo-oral wound requires a more prolonged time, but adjustment of the wound margins is more pretentious from the esthetic point of view compared with the endo-oral one;
- when it is necessary to remove the means of fragments fixation through a repeated surgery, it is more difficult to perform it compared with endo-oral access.

Fig.3. Disadvantages of exo-oral access in treatment of fractures of the mandible:
A) Presence of postoperative scars;
B, C) Paresis of mimic muscles during traumatisation of marginal r. of the mandible (n.VII).
**Advantage of exo-oral access** results from the quite large operative field for surgical manipulations (Figure 4). This allows to do free surgical manipulations under a visual control superior to that endo-oral one. Despite all disadvantages of exo-oral access, in some clinical cases we can not neglect it.

**Advantages and disadvantages of devices of fragments fixation (miniplates, metallic thread, screws)**

**Characteristic of titanium devices (miniplates, screws) for fragments fixation**

Nowadays the most widely used biomaterial is titanium and its alloys. Titanium devices (miniplates, screws) used by us (Figure 5) for fragments fixation are covered with a thick, dense and homogeneous layer of titanium oxide (TiO2). It renews spontaneously and independently in the biological environment even after its application. This oxide is very resistant, forming a coat which protects the metal from the aggressive chemical attack of the organism’s environment. The dense layer of oxide in contact with the tissues is practically insoluble; ions, that could react with the organic molecules, are not released. Therefore the following characteristics of titanium devices should be considered:

- their hardness is high, resembling stainless steel;
- titanium miniplates have a a higher plasticity versus alloys from other metals, they are modelled and adapted easily, accurately at the bone outline;
- due to high hardness and malleability of the metal, miniplates resist to shock stress;
- compared with other alloys, titanium miniplates keep their configuration rendered by the bone outline within a period of time (does not detach off the bone or does not return to its initial form), as a result the titanium screws are kept anchored intimately to the bone, resisting to pressure;
- transmission of some micro-movements toward the fragments in consolidation takes place due to elasticity resembling the bone elasticity;
- reflection of X-rays by the titanium alloys is smaller than that of some other alloys, as a result the image (contour) is clearer.

These characteristics of the devices of titanium fragments fixation, described in the medical literature [2,3,8,9,12] and analysed by us in patients within the study, have demonstrated that miniplates and titanium screws are easily modelled according to the bone outline. They are well tolerated by the organism, they do not cause any inflammatory complications, but their mechanical properties allowed to perform osteosynthesis functionally established through endo-oral and exo-oral access, with an early recovery of the functions of the stomatognathic system.
We have also used the metalic thread from stainless steel as a device of fragments fixation. As a rule, these alloys contain chromium, nickel, cobalt in different proportions. Thus, a series of drawbacks occurs compared with those made of titanium:

- some allergies of contact and body sensitising to metals are possible;
- they are not resistant to corrosion, as a result ions of the metal penetrate and accumulate in the tissues (their accumulation depends on the retention period);
- they are toxic, causing local and general reactions.

Some complications have been revealed in patients from both basic group and reference group, where the metalic thread was used as a device of fragments fixation (thread breakage, secondary detachment of fragments, wounds dehiscence, suppuration of the osseous wound). These complications can be also caused by the mentioned drawbacks of alloys from stainless steel.

**Indications and contraindications of osteosynthesis of the mandible with titanium miniplates through endo-oral access**

On the basis of our own clinical observations and literature data [7, 8, 9,10, 11,12], we have determined that osteosynthesis through endo-oral access with titanium miniplates can be indicated in the majority of cases of mandibular fractures (Figure 6). It is an improvement of the method of osteosynthesis with metalic thread through endo-oral access. We confirm that this method of mandibular osteosynthesis has much more indications than osteosynthesis through endo-oral access with metalic thread. A more stable fragments fixation with an early recovery of functions of the mandible allows to use titanium miniplates in cases when use of the metalic thread is impossible. Indications for use of this method are determined by:

- minimal traumatism (surgery is less traumatic, the periosteum detaches only from the external cortical part, thus the circulation disturbances being minimal);
- short time surgery;
- minimal hemorrhage in case of use of anesthetics with vasoconstrictors, even in
case of osteosynthesis under general anesthesia;
➤ important anatomical formations (mandibular canal, teeth roots) are not obstacles for application of a miniplate, because monocortical screws can be used;
➤ absence of facial scars;
➤ stable fixation of the fragments in the correct anatomical position during surgery;
➤ stable maintainace of the fragments in this position during the whole period of consolidation;
➤ compared with the metallic thread, the miniplate ensures a tridimensional immobilization of fragments, but two miniplates applied in each focus of fracture enhance the tridimensional stability;
➤ it is not required a prolonged intermaxillary immobilization;
➤ it is not required an intermaxillary immobilization when two miniplates are used in each focus of fracture;
➤ an early recovery of functions of the dento-maxillary apparatus is possible as well as patient’s integration into the society (when using one miniplate bimaxillary immobilization is removed on the 10th, 14th day, but when using two miniplates in each focus of fracture can be removed immediately, postoperatively);
➤ titanium miniplate is well tolerated by the body and does not require its removal (an additional surgery is avoided).

![Fig. 6. Patient D](image)

(A) A marked displacement in the left angular region on OP is determined after the conservative orthopedic treatment,
(B) Fragments were fixed with a miniplate Y-shaped,
(C) OP of patient B. On the 21st day from osteosynthesis.

We will enumerate the indications for use of this method of osteosynthesis:
➤ unilateral, bilateral and multiple mandibular fractures, without any signs of osseous wound suppuration, within the limit of the dental arches and angular regions, with or without fragments detachment from 14 to 21 days after the fracture.

Note! Fractures of the mandible within the limit of the dental arches without fragments detachment, are traditionally treated through conservative orthopedic methods, which require
maintaining intermaxillar immobilization during the period of formation of the bone callus (21-28 days). Modern tendencies of treatment of mandibular fractures provide early recovery of functions of the mandible, reducing the period of work incapacity. Only functionally stable osteosynthesis corresponds to modern requirements of treatment of mandibular fractures.

- mandibular fractures with total or partial edentation, but the remaining teeth cannot allow use of the conservative orthopedic methods;
- mandibular fractures with interposition of the soft tissues or compression of the inferior alveolar nerovascular fasciculus as a result of fragments detachment;
- oblique mandibular fractures;
- mandibular fractures with insignificant bone defects;
- multifragmentary mandibular fractures which allow recovery of the osseous continuity (small fragments or those which do not concern the integrity of the mandible);
- mandibular fractures in patients with contraindications for intermaxillar immobilization (psychic patients with cranio-cerebral traumas, with cerebrovascular pathologies etc.).

Limiting of the indications for mandibular osteosynthesis through endo-oral access with titanium miniplates is determined by certain conditions and factors:

- difficulty of application of the device of attachment in some clinical cases;
- application of the device of attachment in the focus of the fracture with suppurative can maintain or aggravate the inflammation, thus prolonging the period of recovery;
- unjustified additional traumatism (when external wounds are present).

**Contraindications** of this method are:

- mandibular fractures localised in the ramus region, coronoid and condylar processes;
- inflammatory complications of the focus of the fracture (suppurative of the bone wound).

**Note!** Patients with signs of suppurative of the bone wound will be operated after successful management of the acute inflammatory phase.

- massive defects of the bone in the region of the alveolar processes;
- patients with pathologies of the oral cavity mucosa;
- patients with limitation of mouth opening (microstoma, pathologies of TMJ, constrictions etc.);
- fractures viciously consolidated;
- multifragmentary fractures which do not allow restoration of the bone continuity (big fragments or those which concern the mandible integrity);
- interposition between fragments of the soft tissues, fragments, fractured teeth, which impede reposition;
- pathological fractures of the mandible (in inflammations, tumors, pseudotumors);
- presence of the external wounds (externally opened fracture);
- general diseases (cerebral hemorrhage, infarction, malignant tumors etc.).

**Indications and contraindications of mandibular osteosynthesis with titanium mini-plates through exo-oral access**
Indications of mandibular osteosynthesis through exo-oral access with titanium miniplates result from contraindications of mandibular osteosynthesis with titanium miniplates through endo-oral access:

- mandibular fractures with diverse localization, when the unfavorable situation of the fragments does not allow their satisfactory reposition through endo-oral access;
- mandibular fractures with localization in the ramus region, coronoid and condylar processes;
- mandibular fractures with diverse localization in patients with pathologies of the oral cavity mucosa;
- mandibular fractures in patients with limitation of the mouth opening (microstoma, pathologies of the temporo-mandibular joint, constrictions etc.);
- fractures viciously consolidated;
- multifragmentary fractures;
- interposition of soft tissues, fragments, fractured teeth, which impede reposition;
- presence of the external wounds (externally opened fracture);
- pathological mandibular fractures (in inflammations, tumors, pseudotumors);

Mandibular osteosynthesis with titanium miniplates through exo-oral access does not have any contraindications if we exclude the general ones (stroke, infarction, malignant tumors etc.). Any mandibular fracture can be solved through this method, but there are some drawbacks of the exo-oral access. Thus we will limit exo-oral access resulting from the clinical reasoning of each individual case.

Indications and contraindications of mandibular osteosynthesis with metallic thread through endo-oral and exo-oral access

Endo-oral access will have essential indications depending on the clinical reasoning. Only in case that endo-oral access is contraindicated, exo-oral access will be undertaken.

Indications of osteosynthesis with metallic thread through endo-oral access will be the same as in case of osteosynthesis with miniplates through endo-oral access, except for oblique fractures, fractures with osseous defect and multifragmentary fractures. In case of multifragmentary fractures, small fragments, which have lost any connection with the soft tissues, will be removed, otherwise they will extend. Fixation of fragments with bone defect leads to their approach to the mandible distortion, occlusion disorder and esthetic distortions. In oblique fractures, when we twist the metallic thread, reciprocal sliding of the fragments takes place being accompanied by shortening of the mandible which also leads to occlusion disorder and esthetic distortions. Fractures with osseous wound suppuration also represent a relative contraindication.

Thus, on the basis of the literature study and analysis of the results obtained by us, we have stated that osteosynthesis through endo-oral access with metallic thread has restrictive indications. Limitation of indications is conditioned by presence of the teeth on the fractured fragments. Creation of canals of osteosynthesis can impair the teeth roots. Therefore this method can be used in case of presence of sufficient bone mass at the alveolar edge for application of the thread.
(presence of edentation or extraction of the tooth from the fracture line) (Figure 7).

Fig. 7. Radiography of patient B. Mandibular osteosynthesis in the left angular region with metallic thread. A) mandibular fracture in the left angular region with a marked displacement, B) postoperatively, the second day after osteosynthesis, C) in a month postoperatively, D) in 6 months postoperatively, E) in a year postoperatively, F) in 4 years postoperatively.

Advantages of osteosynthesis through endo-oral access with metallic thread result from the fact that it is possible to be performed even at patient’s admission. The method is simple, rapid, little traumatic and it does not require special instrumentarium. However this method can be used only in short time after traumatism, when those two bony surfaces which are close to each other maintain through still present interdigitations.

Advantages of osteosynthesis through exo-oral access with metallic thread reduce to the possibility of manipulation on a larger surgical field and possibility of biocortical fixation of the fragments. Biocortical fixation is safer, but through exo-oral access, it is performed at the basilar edge, this does not correspond to biomechanical laws of the fractured mandible. Disadvantages of this method are the instable fixation of the fragments and drawbacks of the exo-oral access.

Metalic thread does not ensure a stable fixation of the mandible fragments, therefore it can be used only in association with other systems of immobilization.

Instable fixation of the fragments, physico-mechanical drawbacks of the alloy, impossibility of early restoration of the mandible functions prove imperfection of the method of mandibular osteosynthesis with metallic thread through both exo-oral access and endo-oral access (Figure 8). An additional, unjustified massive traumatism is added to exo-oral
access, having some consequences and possible complications. Therefore the method of mandibular osteosynthesis with metallic thread through both endo-oral and exo-oral access has to be little used, promoting osteosynthesis with miniplates, which is superior due to its advantages.

Moreover the method of osteosynthesis with metallic thread has powerful „roots” provided by a rich experience accumulated in the past by the specialists, due to simplicity and rapidity of the surgical manipulations.

![Radiography of patient P. Mandibular osteosynthesis in the left angular region and right menton region with metallic thread. A) mandibular fracture in the left angular region and right menton region with a marked displacement, B) on ortopantomography the secondary displacement of the fragments is postoperatively determined in a month time.](image)

Contraindications of endo-oral and exo-oral access with metallic thread are similar to contraindications of endo-oral and exo-oral access with miniplates.

**Indications and contraindications of mandibular osteosynthesis with screws detached through endo-oral and exo-oral access**

Detached screws in mandibular osteosynthesis through both endo-oral and exo-oral access will be used in oblique transversal fractures of the mandible [2,11], where it is not possible to use the metallic thread because a reciprocal sliding of the fragments takes place (Figure 9). Detached screw does not substitute the metallic thread or the miniplate. It has a concrete indication namely oblique transversal fractures of the mandible. Choice of endo-oral access will be preferable too. Only when endo-oral access is contraindicated, exo-oral access will be used.
Fig. 9. Radiographies of patient G., A) it is determined the oblique mandibular fracture in the angular region with marked displacement which maintains after the conservative orthopedic treatment, B) postoperatively, on the 28th day, fragments are reduced in correct anatomical position and they are fixed rigidly with detached screw, a monocortical screw and metallic thread.

Contraindications of endo-oral and exo-oral access with detached screw are similar to contraindications of endo-oral and exo-oral access with miniplates.

CONCLUSIONS
1. Having analysed the facts mentioned before, it is necessary to state that the methods described by us depending on the approach and attachment devices have both concrete indications and contraindications, advantages and disadvantages.
2. Indications are limited by a series of conditions which refer to physico-mechanical characteristics of the attachment devices, operative technique and clinical picture of the patient with mandibular fractures.
3. Obtained data will direct specialists toward the choice of the best method of treatment of patients with mandibular fractures.
4. Mandibular osteosynthesis through endo-oral access contributes to creation of the best conditions for fracture consolidation, ensuring satisfactory follow-up treatment.
5. Endo-oral access is superior to exo-oral access for its advantages, but it is limited by some factors such as: time of referral, localisation and severity of the fracture.
6. Exo-oral access has a series of drawbacks, but it must not be neglected. It will be undertaken when osteosynthesis through endo-oral access is not possible.
REFERENCES


