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The Estimation of the Treatment of Fractures of the Bones of Jaw with the Use of Miniplates

Ocena leczenia złamań kości szczęk z zastosowaniem minipłytek

INTRODUCTION

The development of industry and motorisation caused sudden increase in the number of maxillo-facial fractures. The resulting problem of treatment of such complicated traumas made doctors look for new methods of management of jaw fractures. Various experiments had effect on modification of operative treatment of maxillo-facial fractures.

In search of a simple technique of osteosynthesis Michelet (8) modified and developed the method of practical use of metal plates. New techniques of producing materials for osteosynthesis were very valuable for him.

In highly developed countries metal plates and screws have been in constant use for osteosynthesis in maxillofacial region since 1973 (5, 6). Biomechanical principles of this method are based on mathematical and experimental researches conducted in Strasbourg (2). The choice of alloy for osteosynthesis was determined by anatomical data and biological tolerance of the material as a foreign body. A substance was needed which would be biologically well tolerated, adaptable, could be miniaturized and at the same time would be strong enough to withstand the bending and torsion forces exerted on a plate during osteosynthesis. A multi-component metal alloy was chosen. Plates and screws used (3) are made of an alloy of chrome, nickel and molybdenum with a trace of carbon which gives the alloy flexibility. The proportions of these metals can vary depending on technology used by a company producing plates.

Mechanical characteristics of materials used for osteosynthesis ensure neutralization of appearing tension and torsion forces. This means that a bone can tolerate physiological forces acting directly upon it. The produced plates can be of different size: most often the thickness of a plate is 0.9 mm, and the minimum

diameter of the hole is 2.1 mm. 4-hole to 16-hole plates can be used according to needs. Plates can be of different shapes adapted to requirements of healing of maxillo-facial fractures (7). Because of their structure (alloy, size) plates can be easily adapted to bones, because they are comparatively flexible. A plate is tightened to the bone by the use of screws. Screws are available in lengths of from 5 mm to 15 mm. The screw thread has a diameter of 2 mm. The thread core — a diameter of 1.6 mm. One turn of the screw corresponds to 1 mm penetration into the bone. The diameter of the screw head is 2.8 mm, which ensures perfect tightening in the hole of the distance of 2.1 mm. The drill has a diameter of 1.6 mm and so is 0.4 mm smaller than the screws used. The difference of diameter of 0.4 mm ensures firm anchorage of the screw in the bone. Due to their size the plates are called "miniplate" in English-language literature (4).

Miniplate osteosynthesis is indicated in majority of maxillo-facial fractures. It is used successfully for osteosynthesis of mandibula, especially the body of mandibula (1), as well as for fractures of maxilla and zygomatic bone. In children under the age of 13 years miniplates should be used very carefully because of the possibility of destroying permanent teeth germs.

OWN MATERIAL

Miniplates have been in use in the Clinic of Maxillo-Facial Surgery in Medical Academy of Lublin since 1978. In the first period they were used only occasionally, usually to make up a loss of bone to oncological surgeries. In the years 1978—1991 726 patients were treated by this method, among them 489 patients with maxillo-facial fractures. 312 patients had only mandibular fractures. The treatment of fractures of the body of mandibula seems to be a method of choice. The treatment of fractures of maxilla and zygomatic bones gives good results, too. This method ensures good stabilization of bone fragments, as well as good conditions for quick wound healing (Fig. 1). Another important advantage of this method is operative intra-oral approach in most of the cases.

We cannot forget about disadvantages of the method discussed and possible complications. The most often observed complications are postoperative inflammation changes in the region of the fracture line. There are different reasons of complications. One of the causes is inappropriate use of miniplates. The use of plates from different companies in one patient may cause the infection. Differences in metal ions can lead to redox reaction causing harmful effect on tissues. That is why all screws and plates used in one patient should be made of the same alloy (Fig. 2).

The use of miniplates together with intermaxillary wiring can lead to inflammatory changes on the basis of the same mechanism: there are differences in alloys, of which a plate and wire are made (Fig. 3).



Fig. 1. X-ray picture. Correct immobilization of bone fragments by the use of miniplates

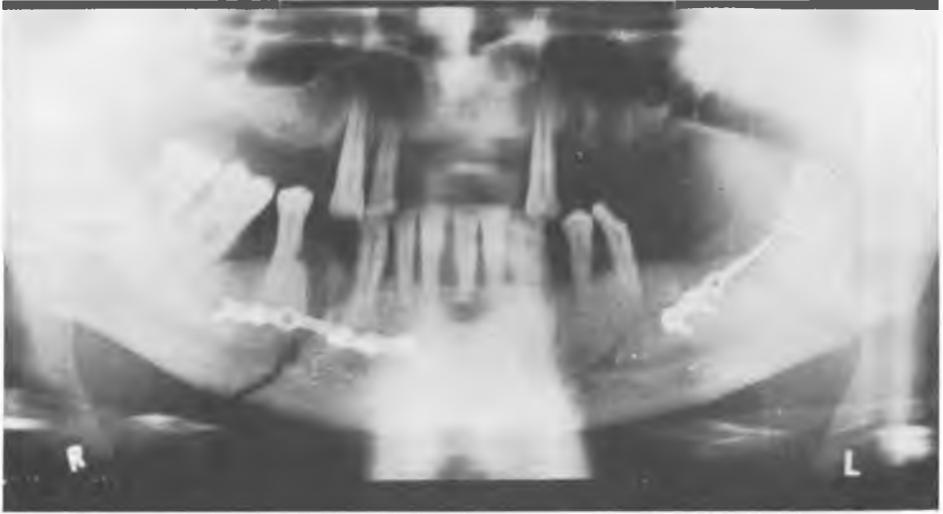


Fig. 2. X-ray picture. Miniplate osteosynthesis with plates produced by different companies. Visible osteolysis in the region of miniplates



Fig. 3. X-ray picture. The use of miniplate and wire made of different alloy. Osteolysis in the region of the miniplate

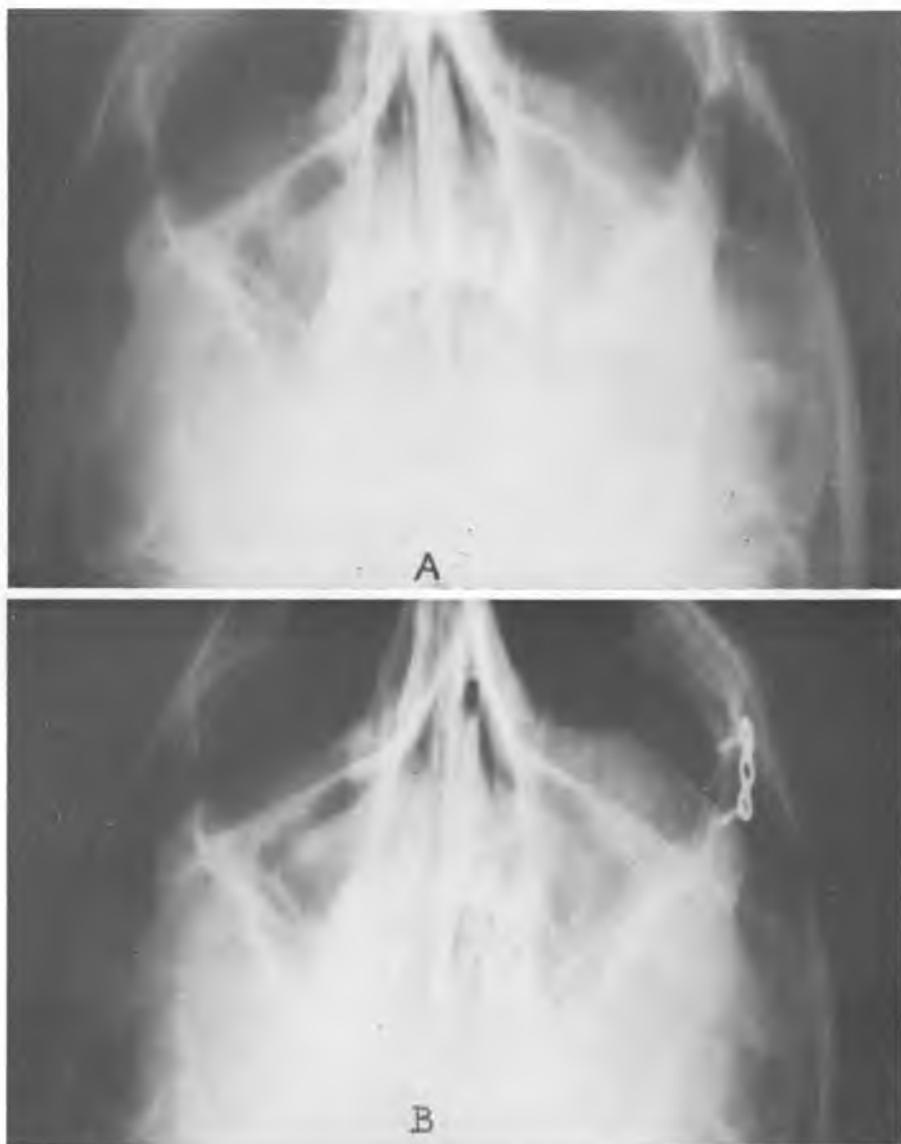


Fig. 4. X-ray picture. A. State after maxillo-facial fracture with dislocation of bone fragments. B. State after reduction of the fracture and osteosynthesis with a too small plate. Visible slipping of the screws out of the bone

Stabilization of bone fragments is an important thing in proper wound healing. The appropriate use of miniplates guarantees this possibility, but if a plate is used in a wrong way, for example inadequately tightened, results of treatment may be dubious. By tightening of screws one should remember, that a drill used should have a diameter of 1.6 mm, that is equal to that of a core of a screw. During procedure of making holes a drill should be in vertical position to the bone surface to ensure good anchorage of the screw. A hole in the shape of a cone can restrict the anchorage of the screw to 2 or even 1 turn of the screw.

One should also remember that one bone fragment should be immobilized by at least 2 screws, which protects against muscle forces acting on bone. If one plate cannot guarantee proper immobilization of fracture, another parallel plate should be used in the distance of 4—5 mm from the first one. This way they can withstand the forces exerted on them. Although a plate of greater thickness could have stood these tensions, it seems easier to use 2 easily adaptable "flexible" plates instead of "rigid" one. Sparing use of both screws and plates may lead to slipping of screws from bone and eventually to movement of fragments and improper wound healing. Sometimes 6-hole miniplates were divided into 2 to save material. It proved that these plates were too short to ensure appropriate immobilization of fragments, which caused complications (Fig. 4).

Complications were observed also in patients in whom both operative technique and use of instruments were correct. These complications occurred in patients who reported for treatment several days after trauma and in the meantime no antibiotics were used. If it is possible, the osteosynthesis should be performed within the first 12 hrs after trauma. Postoperative disturbances of the occlusion can result from inadequate fixation of fractures during osteosynthesis.

Large errors in occlusion require operative correction, but when the error is minimal, it can be treated orthodontically. We can avoid such errors by careful immobilization of the occlusion during surgery by inter-maxillary fixation. However, intermaxillary fixation during surgery is indicated and an experienced operative team is able to establish the occlusion manually during the osteosynthesis.

Injuries of dental apices were observed occasionally and resulted from application of the plate at too low level.

The method of miniplate osteosynthesis used in the Clinic of Maxillo-Facial Surgery of Medical Academy of Lublin since 1978 proved to be very efficient, especially in treatment of maxillo-facial fractures.

Conclusions

1. Miniplate osteosynthesis is simple and effective.
2. Miniplates are well tolerated biologically as a foreign body.

3. Miniplates are relatively flexible and easy to adapt to bone shape.
4. Miniplates possess characteristics of a material resistant to torsion and bending.
5. Miniaturization of plates is very important.
6. Occurring complications are results of errors in technique rather than disadvantages of the method discussed.
7. Connecting the fragments by miniplate enables spreading of physiological forces helping in healing.
8. There is a possibility of intra-oral approach in most of the cases.
9. There are comfortable conditions of patients recovery in comparison with traditional intermaxillary fixation.

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STRESZCZENIE

Podano główne zasady używania miniplatek do osteosyntezy złamań twarzo-czaszki i oceniano ich przydatność na materiale własnym. Miniplateki są stosowane w Klinice od r. 1978, początkowo tylko do uzupełnień po operacjach onkologicznych, a od r. 1985 — do rutynowych zabiegów osteosyntezy po złamaniach.

Stwierdzono, że miniplateki charakteryzuje elastyczność i łatwość modelowania na kości, a także duża wytrzymałość, która może oprzeć się siłom skręcania i zginania. Jednocześnie cechuje je zminiaturyzowanie i dobra biologiczna tolerancja. Efektywność osteosyntezy z zastosowaniem miniplatek powoduje, że tradycyjne metody leczenia złamań stosuje się coraz rzadziej.

Powikłania, jakie czasem występują, są najczęściej wynikiem błędnej techniki wprowadzania miniplatek.