Evaluation of the use of Self-reinforced Absorbable versus Metallic Plates and Screws in the Fractures of Symphysis and Parasymphysis Area

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Abstract: The aim of the present study was to evaluate the clinical and paraclinical results of the use of self-reinforced absorbable mini-plates and screws in the reduction of fractures of mandibular symphysis and compare them with the results of using routine non-absorbable titanium mini-plates and screws. Absorbable plates do not need a second surgical procedure to remove. Therefore, there is less cost for the patient and no need for the patient to be put under anesthesia, given its complications. In addition, there will be no interferences with radiographic techniques. Twenty patients with fractures of the mandibular symphysis or parasymphysis areas, who had referred to were randomly divide into two groups. Group 1 and 2 subjects underwent treatment with non-absorbable metallic mini-plates and absorbable mini-plates and screws, respectively. All the patients underwent general anesthesia. After injection of a local anesthetic agent with 1:100,000 epinephrine, a vestibular incision was used to access the fractured bone, which was reduced using the prepared mini-plates and screws. All the patients underwent intermaxillary fixation (IMF) for three weeks and evaluated at 1-, 3- and 8-week post-operative intervals. Data was analyzed wit chi-squared test and independent samples t-test using SPSS statistical software. The patients were evaluated in relation to infection, pain, presence of manifest exudate, fever, occlusion and limitations in mouth opening and mobility of the fractured fragments. At the end of 6-week and 8-month post-operative intervals the patients underwent panoramic radiography. No significant differences were observed in any of the above-mentioned variables between the two groups (P>0.05).Based on the results of the present study, it can be concluded that absorbable systems are good and efficacious alternatives for non-absorbable titanium systems and can be used without complications in the reduction of fractures of mandibular symphysis and parasymphysis areas; however, absorbable systems cannot completely replace non-absorbable systems at present.

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Introduction

Patients with fractures of facial bones due to various accidents frequently refer to maxillofacial surgery departments (1). One of the most common fractures of facial bones is fracture of the mandible, with a frequency of 49 60% (2). Techniques to reduce such fractures include closed and open reduction techniques; in the open reduction technique the most common procedure is the use of metallic mini-plates (2). Michelet and Collequce (1960) introduced the use of metallic mini-plates in the reduction of mandibular fractures. Although metallic mini-plates have many advantages, they have some disadvantages and limitations in some cases, including interference of metallic plates with CT scan, MRI and radiographic techniques (1). Use of metallic mini-plates can lead to major changes in the maxillofacial skeleton in children during growth periods or during surgeries of maxillofacial traumas (1). Another disadvantage of metallic mini-plates is that they are palpable on the skin (3). Areas of resorption have been reported beneath metallic mini-plates, resulting in disturbances in bone structure (3). In edentulous patents metallic mini-plates can disturb the process of manufacture and use of dentures (3). Osteoporosis, bone atrophy or re-fracture and patient pain and discomfort due to hypersensitivity to heat might be some other disadvantages of metallic mini-plates (3). In addition, metallic mini-plates can result in tissue damage if they are left in place for a long

time (3); therefore, a second surgery in necessary to remove them (1). In recent years, use of absorbable mini-plates has been considered as a solution to eliminate the above-mentioned disadvantages and avoid a second surgical procedure to remove the plates, given the complications mentioned above, including general anesthesia and costs of hospitalization (3). For more than three decades a lot of research has been carried out on absorbable mini-plates and screws. Ideally, materials which are used for reduction of fractures or for osteotomy procedures should not be toxic, carcinogenic or allergenic. Conversely, these materials should be biocompatible and should induce the least local reactions in human tissues; they should not have any systemic reactions and should be sufficiently stable to maintain fracture site or osteotomy integrity without any detrimental effects on bone healing and regeneration (4). Recently, absorbable mini-plates have been introduced, which lose their strength over time and gradually transfer stress to the underlying bone, preventing osteoporosis and bone atrophy (3). The advantages of absorbable mini-plates include predictability of absorption time, easy adaptation of the plate, easy insertion, flexibility and complete fixation. There are few research studies on quantitative evaluations of the use of absorbable mini-plates and screws for the reduction of mandibular fractures (4). A pilot study has evaluated the use of absorbable mini-plates and screws for reduction of fractures of anterior mandible, indicating that they are safe to reduce anterior fractures of the mandible (5). No studies to date have compared self-reinforced absorbable mini-plates and screws with the routine use of metallic mini-plates for the reduction of mandibular factures.

Materials and Methods

Twenty patients with single fractures of mandibular symphysis and parasymphysis areas, who had referred to the Department of Oral and Maxillofacial Surgery at Imam Hospital, were randomly divided into two groups. Patients in group 1 underwent reduction of fractures with non-absorbable titanium mini-plates and screws manufactured by Mondeal; patients in group 2 underwent reduction of fractures with absorbable mini-plates and screws manufactured by Inion. The time interval between trauma and hospitalization was 4 9 days. None of the patients had any systemic conditions or problems, including diabetes, use of alcohol or steroid therapy. All the patients underwent routine laboratory tests, including CBC (RBC, WBC, Hb, Hct platelet count), on the day of surgery. All the patients received 1 gram of intravenous cefazolin and 8 mg of intravenous dexamethasone 1 hour before surgery. The patients were put under general anesthesia and all the procedures, before, during and after the surgical operation, were the same for all the patients. Maxillary and mandibular arch bars were placed and the patients temporarily underwent intermaxillary fixation (IMF). Subsequently the patients received 4 mL of local anesthetic agent with 1:100,000 epinephrine. Ten minutes after injection of the local anesthetic agent a vestibular incision was made with the use of cautery and a scalpel blade at the fracture site. The fractured fragments were reduced after a full-thickness flap was elevated. A proper occlusion was established and the mini-plates and screw were placed, followed by fixation. The incision was sutured and the duration of surgery, from the incisions to the end of the last suture, was recorded with the use of a chronometer. All the patients were administered intravenous cefazolin every 6 hours for 48 hours and 8 mg of intravenous dexamethasone every 8 hours for 24 hours post-operatively. The patients were discharged after 48 hours and were visited regularly during the first week. Intermaxillary fixation was removed after 3 weeks and the patients underwent physiotherapy, elastic therapy and a soft diet. The patients were evaluated at 1-, 3- and 8-week and 3- and 6-month post-operative intervals for pain, infection and fracture repair. Visual analog scale (VAS) was used to measure pain at 12- and 48-hour and 1-week post-operative intervals. The patients were evaluated after the first week for rubor, fever and manifest exudate and the signs were recorded in the relevant form. The patients underwent a clinical and radiographic examination after 8 weeks. During the clinical examination, occlusion, mobility of the fractured site, pain, pain during function and inadequate stability during function were evaluated and the results were recorded. Chi-squared test was used for date analysis with SPSS.

Results

Males and females comprised 35% and 65% of the 20 patients under study, with a mean age of 33.5±1.5 years. In group 1 (metallic mini-plates and screws) 60% of the patients had mandibular symphysis fractures and 40% had mandibular parasymphysis fractures. In group 2 (absorbable mini-plates and screws) 70% of the patients had mandibular symphysis fractures and 30% had mandibular parasymphysis fractures. The time interval between the fractures and hospitalization was 4 9 days in both groups.

The duration of surgeries in group 2 was significantly longer than that in group 1, with means of 33 and 45 minutes in groups 1 and 2, respectively (P=0.005) .

Evaluation of the patients during the first post-operative week and at the end of the first week did not reveal any significant differences in rubor and inflammation, fever and manifest exudate between the two groups (P>0.05) (Table 1).

Table 1. Comparison of clinical evaluations of the patients in the two groups during the first week and at the end of the first week post-operatively

Variable		None-absorbable	Absorbable	P
Pain	No pain Mild pain	60% 40%	40% 60%	0.328
Rubor		20%	0	0.237
Fever		20%	0	0.237
Manifest exudate		20%	0	0.470

Evaluation of patients at the end of the third post-operative week did not reveal statistically significant differences in pain, rubor and inflammation, fever and occlusion between the two groups (P>0.05) (Table 2).

Table 2. Comparison of clinical evaluations of the patients between the two groups at the end of the third post-operative week

Variable	None-absorbable	Absorbable	P
Pain	20%	0	0.237
Rubor	0	0	-
Fever	10%	0	0.5
Occlusion	10%	0	0.5

Evaluation of the patients at 6- and 8-week post-operative intervals did not reveal any significant differences in pain severity, occlusion, limitations in mouth opening, pain during function, mobility at the fractured segments at fracture site and presence of exudates between the two groups (P>0.05). In this context, at the end of 8th week post-operatively there were no pain, no problems in occlusion, no limitations in mouth opening, no pain during function, no mobility of fractured segments at fracture site and no exudate in the two groups.

Discussion

The results of the present study did not show any significant differences in pain severity at 12-and 48-hour and 1-week post-operative intervals between the two groups. In a study carried out by Laughlin et al (2007) post-operative pain of the patients was evaluated in the same manner. In that study, pain in patients treated with absorbable mini-plates and screws disappeared at the end of second post-operative week (6). In some studies, patients treated with non-absorbable mini-plates and screws have reported severe pain and in 3.6% of the cases the mini-plate have been removed as a result (3,4). Severe pain in such cases might be attributed to resorption of bone beneath the plate and pressure on tooth roots subsequent to this phenomenon. Lack of adequate expertise on behalf of the surgeon might result in improper placement of the mini-plate, resulting in damage to tooth roots and pain. On the whole, incidence of post-operative pain in the present study is almost similar to the results of other studies. Although the severity of post-operative pain was similar in both groups, the need for a second surgery with non-absorbable mini-plates and screws and the resultant pain makes it logical to use absorbable mini-plates and screws.

Infection was evaluated in the present study by examining the patients for rubor, inflammation, fever and manifest exudates at the surgery site. In this context, 2% of patients treated with non-absorbable mini-plates and screws had rubor at surgery site up to the end of the third post-operative week; however, none of the patients in group 2 exhibited any signs and symptoms of infection. The results of the present study are consistent with the results of studies carried out by Laughlin, Yerit, Yelikontiola and Kim (5,6,8,9). The incidence of post-operative infection in patients treated with non-absorbable mini-plates and screws has been 10.3 24.6% in various studies (9 12); the incidence of infection in the present study was less than those reported previously. The differences might be attributed to differences in population sizes, expertise of the surgeon and surgical team, follow-up period, criteria used to diagnose infection, a history of background medical conditions, use of medications and alcohol, type and severity of fractures involved and the type of the absorbable material used (13 16).

In the present study clinical and radiologic criteria, occlusion, mobility of the area involved, atrophy or resorption of bone, sclerosis, presence of pain or an increase in pain severity and stability during function at the end of follow-up (the 8th week) were used to evaluate fractures. Success rate was 100% in both groups during the follow-up period. In a study carried out by Laughlin success rates were 100% and 96.1% with the use of absorbable and non-absorbable mini-plates, respectively (6). In a study carried out by Yelikontiola success rate was 90% with absorbable mini-plates (5). Kim reported a success rate of 100% with absorbable mini-plates (8). In the present study the duration of surgery was significantly longer in the group treated with absorbable mini-plates compared to the group treated with non-absorbable mini-plates. Lopez-CedrumCambranos reported that the duration of surgery with absorbable mini-plates and screws is significantly longer than that with non-absorbable mini-plates (10). Tiainen and Serlo reported the same results (11,12).

Various factors might be involved in lengthening the duration of surgery with the use of absorbable mini-plates and screws, including extra steps during placement of absorbable mini-plates and screws, the need to heat the plate and the screws, the need for temporary drainage and finally the need for precise adjustment of the holes necessary for screw placement (11). On the other hand, since the use of absorbable mini-plates and screws is a relatively new technique in many surgical centers, including ours, the surgeons do not have sufficient expertise in using this technique, leading to a significant increase in the duration of the procedure (17,18). It appears an increase in the experience and expertise of surgeons, resolution of technical and educational problems and the use of newer reinforced mini-ates and screws might be useful in decreasing the duration of the surgical procedure.
Considering what discussed it can be concluded that only the differences in the duration of the surgical procedure cannot be considered a reason for not recommending the use of absorbable mini-plates and screws (6).

Conclusion

On the whole, the results of the present study showed that absorbable mini-plates and screws are good and efficacious alternatives for non-absorbable mini-plates and screws in reduction and fixation of fractures of the mandibular symphysis and parasymphysis areas given the success rate and satisfaction with the results and they can be used without any problems and worries. However, their routine use in all the maxillary and mandibular fractures requires more long-term studies with greater population sizes. Nevertheless, satisfaction of patients with the absorbable system in the reduction of the fractures in the present study is an incentive for us to use these plates in future again.

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