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Intraoral extra-mucosal fixation of fractures in the atrophic edentulous mandible

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Abstract. Atrophy of the mandible leads to a decrease in the bone mass, making it more vulnerable to fractures. A direct relationship has been demonstrated between the height of the bone in the area of the fracture and the incidence of postoperative complications of bone healing. Basic principles of fracture management in both edentulous and non edentulous patients are open reduction and internal fixation with osteosynthesis of the fracture to achieve restoration in terms of aesthetics and functionality. Several authors have discussed the advantages and disadvantages of the transoral and extraoral approaches. Between January 2007 and June 2011, 13 patients affected by bilateral fractures of atrophic mandibles were treated by extra-mucosal intraoral stabilization with satisfactory results. This approach reduces the risks of damage of the marginalis mandibulae nerve with low operation time, while avoiding unsightly scars.

Key words: extramucosal osteosynthesis; mandibular fracture; atrophic edentulous mandible.

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Atrophy of the mandible leads to a decrease in the bone mass, making it more vulnerable to fractures. Maxillary atrophy can be considered as the end stage of edentulism (total teeth loss). Treatment of fractures in old patients with bone atrophy are characterized by high morbidity due to local and general factors. A direct relationship between the height of the bone in the area of the fracture and the incidence of postoperative complications of bone healing has been demonstrated.[1]

The most common site of fracture in the edentulous mandibles is the mandibular body. Fibrous union or non union occurs most frequently at this site, especially when the amount of the residual mandible is less than 20 mm (particularly <10 mm).[2]

Basic principles of fracture management in both edentulous and non edentulous patients are open reduction and internal fixation with osteosynthesis of the fracture to achieve restoration in terms of aesthetics and functionality. Several authors have discussed the advantages and disadvantages of the transoral and extraoral approaches. The purpose of this study was to introduce the authors' approach to fractures occurring in atrophic mandibles. Their preoperative hypothesis was that extra-mucosal intraoral osteosynthesis can achieve adequate mandibular restoration in terms of aesthetics and functionality. The specific aims were to review the surgical outcomes of this approach.

Materials and methods

A case series study was designed and a sample of patients affected by fractures of the atrophic mandible was enrolled. Inclusion criteria were bilateral fracture of atrophic mandibular body, edentulism, and bone height less than 20 mm. Patients were excluded if they had previously treated or untreated mandibular fractures.

Causes of fractures included accidental falls in six cases; three patients had fallen to the ground after a syncope; and four

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patients had been involved in a motor vehicle accident. Two patients had no associated systemic comorbidities, eight had hypertension, two had diabetes associated with hypertension, and one patient reported hypertension and a previous transient ischaemic attack. Despite these comorbidities, all patients were able to undergo general anaesthesia (Table 1).

All patients had edentulous and atrophic mandibles. The maximum height of the mandibular body, measured on computed tomography (CT) scan slides, was 16 mm. The average height was 11.5 mm (min 8.5 mm; max 14 mm) at the site of fracture. The time of surgical treatment after injury ranged from 1 to 6 days, with an average time of 3.5 days. Orthopantomography was the first level diagnostic imaging technique. The second level investigation was a mandibular CT scan to analyse the degree of fracture displacement and the height of the atrophic body (Fig. 1).

Patients who underwent surgery were discharged from the maxillofacial department on the second postoperative day with 6 days' antibiotic therapy (amoxicillin 875 mg plus clavulanic acid 125 mg) twice a day and pain medication if needed. During the postoperative follow-up, which lasted 40 days or more, the patient was checked once a week. 8 weeks after surgery the patients underwent orthopantomography to verify the stability of osteosynthesis after the formation of primary callus. Once it had been confirmed that bony union had occurred, the plate was removed from each patient under local anaesthesia (optocain 20 mg/ml plus adrenalin 1:100,000).

Surgical technique

The osteosynthesis proposed is based on the application of a preformed extra-mucosal reconstruction plate. The operation is performed under general anaesthesia following the usual procedure of induction. The steps of the operation are simple and easily repeatable. In the first step, a short (about 3 cm) bilateral mucosal incision is performed, followed by subperiosteal dissection of the lateral aspect of the mandibular angles to allow insertion of the end portions of the osteosynthesis plate previously modelled on the shape of the mandibular arch. The plate is fixed to the mandibular angles by one bicortical screw on each side. The plate used belongs to a locking system 2 mm in diameter (Fig. 2).

The second step is the manual reduction of the fractured body and its stabilization.

Table 1. Characteristics of the patients who underwent extra-mucosal intraoral osteosynthesis.

Patients	Gender	Age	Causes of fractures	Comorbidities	Complications
A.P.	M	78	Accidental fall	No	None
B.B.	F	80	Motor accident	Hypertension plus diabetes	None
D.V.	M	84	Accidental fall	Hypertension	Pseudarthrosis
F.A.	M	74	Syncope	No	None
B.F.	F	79	Motor accident	Hypertension.	None
B.C.	M	82	Accidental fall	Hypertension	None
C.N.	F	76	Accidental fall	Hypertension	None
L.P.	M	72	Motor accident	Hypertension	None
O.D.	F	86	Motor accident	Hypertension	None
G.Z	M	82	Accidental fall	Hypertension	None
D.U.	F	76	Accidental fall	Diabetes	None

Fig. 1. CT scan. 3D reconstruction of a double fracture in an atrophic mandible.

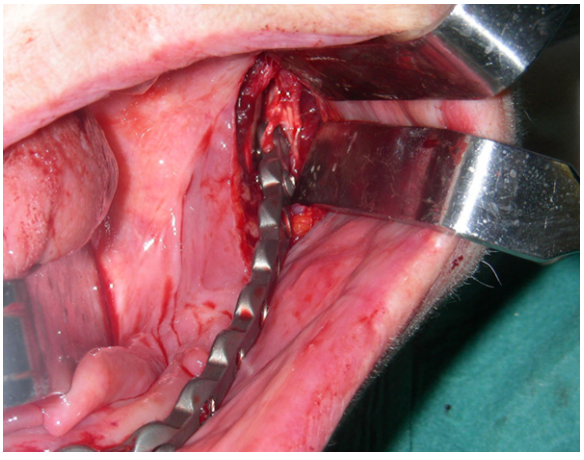

Fig. 2. Intraoperative view showing subperiosteal insertion of the terminal portion of the plate.

The accuracy of the reduction is verified by intraoperative radiography. If doubts remain, a small mucosal window can be produced to examine the alignment of bone fragments. Once the correct reduction is obtained, the bone fragments are locked to the plate by one or two transmucosal titanium screws at the symphysis and two additional screws at the mandibular angles (Fig. 3). The surgical incisions are sutured. The operative time usually ranges from 35 to 75 min.

The removal of the plate is usually performed at postoperative week 9. Lateral screws are removed with an angulated screwdriver after subperiosteal dissection along the terminal part of the plate. Anterior extramucosal screws are easily removed by the appropriate screwdriver (Fig. 4a and b).

Results

13 patients (8 males; 5 females) with a mean age of 79 years (range 72–86 years)

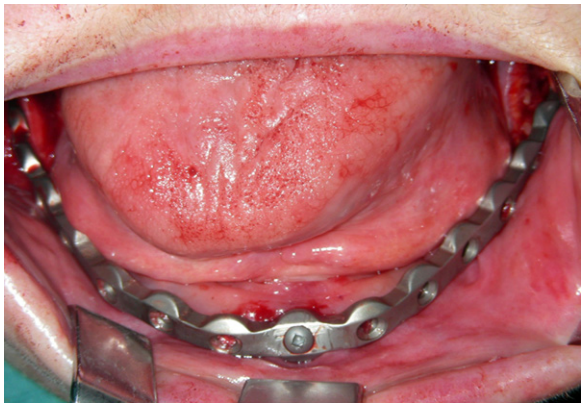

Fig. 3. Intraoperative view showing extramucosal fixation of the plate.

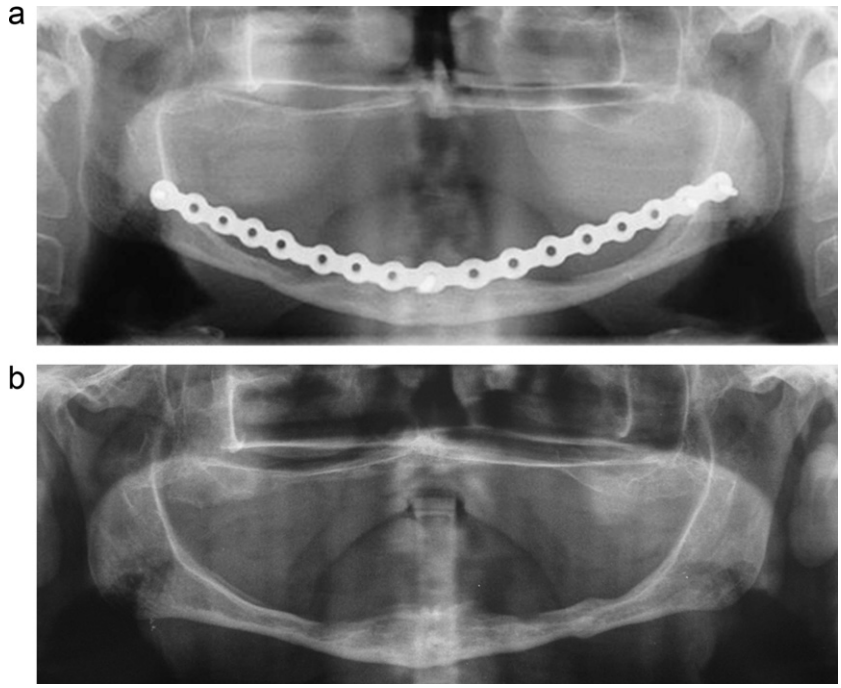

Fig. 4. (a) Radiographic image of the fractures. (b) Radiographic image of healing after removal of the plate.

met the inclusion criteria. They were hospitalized in the maxillofacial department of the Novara Major Hospital between January 2007 and June 2011. Two patients did not accept the proposed surgical protocol, so in both cases an extraoral approach with internal fixation was used. 11 patients were treated surgically by extra-mucosal osteosynthesis.

One patient, initially treated by extra-mucosal fixation, was converted into an extraoral approach. She developed a mycotic infection around the plate, resistant to therapy with fluconazole 150 mg/day and oral washing with nystatin three times a day for 14 days. Mucosal burning and pain reported by the patient were intolerable, so the plate was removed during the fourth week after surgery. The patient continued antimycotic therapy and the symptoms regressed in 6 days. The early plate removal led to pseudarthrosis. Bilateral submandibular access was performed to apply a 2.0 mm locking reconstruction plate with satisfactory results in terms of aesthetics and functionality. She complained of a transient reduction of function of the right marginalis mandibulae nerve, but this regressed spontaneously in 5 months.

Three patients complained of permanent food debris in the holes of the plate and between the plate and the gingival mucosa. In two cases there was a mucosal ulcer of the lip corresponding to the upper edge of the plate.

Radiography performed 8 weeks after surgery showed good alignment with bone consolidation in nine cases. In one patient, bony consolidation after 8 weeks was not satisfactory on the left side. The patient was reassessed after 1 month and bony union was stable. The removal of the plate was performed at week 9 in nine patients. In one case (the case previously described) it was removed at week 13. No major intraoperative surgical complications were seen in any patient.

Discussion

Physicians have described many techniques for treating mandibular fractures but only in the second half of the 20th century, following the developing of radiographic methods and surgical instruments, have the results of treatment been improved.[3]

The development of open reduction and rigid internal fixation has not led to the abandonment of the initial idea of external fixation. Several surgeons use an external mandibular fixator following recommendations by Spiessl[4] regarding infected pathological fractures, heavy comminutions, the emergency care of open fractures in polytrauma cases, and bridging of defects until secondary reconstruction.

According to the literature, external fixators are neither employed in fractures of non-tooth-bearing segments, nor in the edentulous and atrophic mandible. Until now, application of external fixators has been focused on transcutaneous systems. The authors' aim is to introduce a less bulky extra-mucosal device with an efficacy comparable to an internal plate for atrophic/edentulous fractured mandibles.

Load-bearing osteosynthesis is indicated in the treatment of atrophic/edentulous mandible fractures; currently the locking reconstruction plate is recommended. The plate must be long enough to place screws in adequate bone.

When dealing with bilateral fractures, the plate must span from angle to angle, covering the entire vestibular surface of the mandible. At least three screws on either side of the mandible, at the angles, are recommended[5–7] except for cases of severe atrophy in which the risk of nerve damage and the poor quantity and quality of bone forces the surgeon to reduce the number of the screws (Fig. 4a).

The plate covers the whole vestibular face of the mandibular body and plays a fundamental role in sharing the biomechanical mastication forces. In 2011, Wood et al.,[5] described eight patients treated by a

transmucosal fixation of the plate over the alveolar ridge. The technique described in the present paper is based on the same principles but differs in the position of the plate. The vestibular cortex of the mandible allows a more accurate and easier adaptation of the plate with better resolution of the fractures.

Causes of delayed healing in treated fractures of the atrophic/edentulous mandible are multiple. There is lack of bone which is generally cortical with a lower healing potential. There are no teeth, which help to reduce the fractures. Often, the patients are elderly and medically compromised. The authors think it is possible to reduce displaced fractures of the edentulous mandible by closed manipulation of the bone fragments in a high percentage of cases.

In summary, the authors consider that the use of a 2.0 mm locking system as extra-mucosal fixator is a good option for the treatment of fractured atrophic mandibles. This system, originally designed as an internal fixator, offers mechanical and biological advantages. It guarantees adequate stability while preserving blood supply to the bone and mucosa. Theoretical disadvantages are contamination with possible infection and an imperfect alignment of the bone segments. Serious complications such as non-union or fracture of hardware have been widely reported in the standard management of atrophic mandible fractures with rates ranging from 4% to 20%.[6] The extra oral route often causes an undesirable scar, and the possibility of injuring the mandibular branch of the facial nerve is always present, associated with the potential creation of salivary fistulas. This technique reduces operative time, while obtaining adequate fixation. This is important in patient with comorbidities who are not suitable for prolonged general anaesthesia.

In conclusion, the patients treated were satisfied, particularly with the rapid positioning and removal of the plate. They were also able to eat a soft diet with minimal discomfort immediately after surgery. Although the submandibular approach is still the gold standard for the treatment of atrophic mandibular body fractures, it extends the operating time and can increase surgical complications. For these reasons this peculiar approach to treat atrophic mandibular fractures can be a valid alternative.

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Competing interests

None declared.

Ethical approval

Not required.

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