USE OF OSSEOINTEGRATED IMPLANTS TO RETAIN OBTURATORS OF EDENTULOUS PATIENTS

Ashraf Abdel Monaem and Khaled Shaker

1. Assistant Professor, Faculty of Oral and Dental Medicine, Cairo University.

ABSTRACT

Five completely edentulous patients with acquired palatal defects were treated with implant retained obturators. Each patient received four implants in the maxilla to retain the obturator, and two implants in the mandible for retention of an overdenture. In the maxilla, the sites for implant placement were the remaining premaxilla, tuberosity and posterior alveolus. Maxillary implants were splinted together by a tissue bar, to which the obturator was retained by means of clip attachments. Patients were clinically and radiographically evaluated at time of obturator insertion, after six month and one year interval. All implants demonstrated marginal bone loss during the first and second follow-up periods. Bone loss around implants supporting obturator of the central defect, was close to the average marginal bone loss documented in the literature while that for maxillectomy obturator was slightly higher. Moreover, implants next to the defect showed a statistically significant higher bone loss than the other three implants supporting the obturator of the maxillectomy patients.

INTRODUCTION

Prosthetic rehabilitation of dentate patients with maxillectomy defect is usually effective and surgery is seldom indicated. The size and location of the defects influence the degree of impairment and difficulty in prosthetic rehabilitation. Lack of support, retention, and stability are common prosthodontic treatment problems for patients who have a maxillectomy defect. The retention of an obturator depends on factors such as direct or indirect retention promoted by the remaining teeth, defect size, tissue retention available around the cavity and development of muscular control. The presence of teeth facilitate prosthetic rehabilitation, however, fabrication of a prosthesis for an edentulous patient with a large maxillectomy defect will be challenging even to the most experienced clinician.

Overdentures provide improved stability, retention, function and patient satisfaction compared with conventional dentures. The later are unstable, as forces acting on conventional maxillary dentures for example cause its tissueward movement squeezing the tissues between it and the bone. The denture then rotates around
the supporting ridge crest forcing its palatal part to deform and move away from the supporting tissues.\textsuperscript{2,3,7} This behaviour on top of the instability of the denture affects the eventual ridge resorption described in the literature.\textsuperscript{28} The biomechanical behavior of implant supported overdentures differs from that of complete dentures. When functional force within the physiologic limit acts on overdenture, it tends to effect a tissueward movement on its supporting implants. These forces are counteracted by a resistance or pull back force that stimulates and preserves bone to a great extent. Implants also keep the denture from rotating around the ridge crest, improving its stability.\textsuperscript{6}

The introduction of osseointegrated dental implants by Branemark et al. has greatly enhanced the prosthetic prognosis for edentulous patients especially those with maxillectomy defects since they can be used as anchorage to provide support, stability and retention.\textsuperscript{4,1,22,15,29} It was found that implants placed in the residual alveolar bone provide more retention and stability than those placed in the bone around the maxillary defect.\textsuperscript{13,26} The key areas for placing implants is the premaxilla, tuberosity and in the posterior alveolus if adequate bone remains.\textsuperscript{21,22,12} The overall survival rate for implants supporting maxillofacial prosthesis was reported to be as high as 96.1%.\textsuperscript{29} The use of implants in patients who have received or may receive radiation therapy should be considered carefully because the failure rate of the implants may be increased in this patients.\textsuperscript{26}

Bar attachment had been used to splint implants supporting obturators for edentulous maxilla with no reported complication during the follow-up period.\textsuperscript{9,27,12} However, these implants are subjected to high levels of stresses that may affect bone density and resorption around them.\textsuperscript{8}

The aim of this study is to radiographically evaluate implants supporting obturators for edentulous patients with acquired maxillectomy defects.

### MATERIALS AND METHODS

Five completely edentulous patients were selected to participate in this study. All patients had acquired palatal defects. Surgical treatment was performed in the National Cancer Institute or the ENT department, faculty of Medicine, Cairo University. Patients were prosthetically treated in the Prosthetic Department, Faculty of Oral and Dental Medicine, Cairo University.

The patient profile consists of five males with mean age of 52 year. The criteria for inclusion in this study were the presence of remaining maxillary bone adequate to the placement of four implants, and no history or planning for radiation therapy. No sinus lift procedures were performed for any patient. The configurations of the defects include one central defect and four subtotal maxillectomies.

The total number of implants used was thirty (20 in the maxilla and 10 in the mandible). For each patient, four implants (Branemark implants, Noble Biocare inc. Sweden) were placed in the intact side of the maxilla to retain the obturator, and two implants in the mandible at the canine regions for retention of an overdenture through ball and socket attachment. In the maxilla, the sites for implant placement were the remaining premaxilla, tuberosity and posterior alveolus. Maxillary implants were always splinted together by a tissue bar, to which the obturator was retained by means of clip attachments.

Implants were installed according to the submerged protocol described by Branemark\textsuperscript{4} (Fig 1and 2). After a healing period of four months, implants were exposed using a 4mm punch, and healing abutments were connected (Fig.3). Two weeks later a transfer impression was made (Fig.4 and 5) using addition silicone impression material (Express 3M ESPE Dental products, St. Paul, USA). An occlusion block was constructed that incorporated the impression copings to allow its screw fixation to the implants during jaw relation registration. Upper and lower models were mounted on a semi-adjustable articulator; teeth were set and tried in the patient mouth.
A silicone rubber index was made for the facial aspect of the cast and the set up. The trial denture was removed and plastic burn-out sleeves were screwed to the implant analogues. Hader bar plastic patterns (Attachments International Inc. USA) were cut, adjusted and connected to the sleeves with inlay wax. The denture teeth were removed from the set-up and attached in their imprints in the silicone index. The index with the teeth was returned to the model to verify clearance around the bar. The bar was casted in a hard noble alloy and checked on the master model, then in the patient mouth and if not passively seated it was cut and soldered (Fig. 6). After fit has been approved, the bar was fastened to the model and undercuts were blocked out with plaster, then a duplicate model was made for acrylic resin processing. The teeth were reset on the blocked out master model and carefully transferred to the duplicate model.

Flasking and wax elimination was done, then the obturator was processed, deflasked, finished and polished as regular. The bar was screwed to the abutments in the patient mouth in an alternating pattern to insure even screw tension (Fig 7 and 8). The obturator as well as the lower overdenture was inserted, pressure indicating paste (Mizzy, Inc. Cherry Hill, NJ) was used to detect and relief any pressure areas. Gross undercuts in the obturator were removed for the prevention of tissue irritation during the removal and placement of the prosthesis. Occlusion was checked and adjusted and the patient was given oral and denture hygiene instructions.
Patients were clinically and radiographically evaluated at time of obturator insertion, after six month and one year interval. Each time the mucosa was checked for signs of irritation, denture occlusion was reviewed and dentures were adjusted if indicated. The bars were detached and implants were examined for the absence of clinical mobility and signs and symptoms of pain or infection. A standardized periapical radiographs were made, using the long cone technique, to evaluate proximal peri-implant bone level. Using the Digora software (Orion Corporation, Soredex Medical Systems, Helsinki, Finland), marginal bone height was measured mesially and distally to each implant from the edge of the implant platform to the point of first contact between the implant and the bone (Fig 9). The change in proximal marginal bone level was calculated; results were tabulated and statistically analyzed.
RESULTS

A total of 20 implants were inserted in the edentulous maxillae, 11 in the premaxilla and 9 in the posterior area. All the implants were clinically and radiographically successful except one in the posterior area that was removed and replaced by another implant after 4 months. However, all the implants survived the follow-up period with 100% prosthetic success and patient satisfaction regarding retention, function and phonation. There were also little complaints and adjustments during the follow up period.

All implants demonstrated marginal bone loss during the first and second follow-up periods. After one year, the mean marginal bone loss for implants supporting the obturator of the central defect was 0.95 mm, which is close to the average marginal bone loss reported in literature for maxillary implants supporting overdentures.14

For maxillectomy obturator, after one year, the mean marginal bone loss was 1.195mm which is higher than values reported in literature for implants supporting maxillary overdentures. However, implants next to the maxillectomy defect showed mean marginal bone loss of 1.63mm which was significantly higher than the mean marginal bone loss of the other three implants supporting the obturator, which was 1.05mm (Table1).

DISCUSSION

This study was conducted mainly on males, as poor individual bone quality may be suspected to occur more frequently in females, leading to a less favorable implant prognosis.25 Patients received chemotherapy or irradiation were also excluded, as the effect of irradiation on implant prognosis appears to be contradictory.22,42

The main objective for treating patients with obturators is to achieve closure of the defect area and to separate the oral cavity from the sinus and nasal cavities. Moreover, the obturator must be comfortable for the patient, eliminate speech difficulties, restore masticatory function, and achieve esthetic results. All these functions are directly related to the retention and stability. Retention and stability of the obturator is governed by the location and size of the defect, the number of remaining teeth, and the supporting surface of the remaining palate.18 In addition, large obturators are heavy compromising retention and stability.

| S.D. = Standard deviation. |
| dt = Duncan’s Multiple Range Test. (Means with the same letter within each column are not significantly different at p≤0.05) |
| P = Probability level for the effect of time within each group. |
| ** = the bone height changes during that interval are statistically significant |

| TABLE (1) Descriptive statistics and test of significance for the effect time on bone height around implants supporting maxillectomy obturators |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 – 6 months | 6 -12 months | 0 -12 months |
| Mean | S.D. | dt | p | Mean | S.D. | dt | p | Mean | S.D. | dt | p |
| Implant # 1 | 0.955 | 0.597 | a | ** | 0.669 | 0.143 | a | ** | 1.624 | 0.554 | a | ** |
| Implant # 2 | 0.732 | 0.133 | b | ** | 0.376 | 0.339 | b | ** | 1.108 | 0.353 | b | ** |
| Implant # 3 | 0.695 | 0.041 | b | ** | 0.364 | 0.250 | b | ** | 1.059 | 0.253 | b | ** |
| Implant # 4 | 0.596 | 0.148 | b | ** | 0.394 | 0.064 | b | ** | 0.990 | 0.129 | b | ** |
Edentulous patients with maxillectomy defects present a significant challenge for prosthetic rehabilitation and the adaptive capabilities of the patient as retention is usually compromised. Obturators for the edentulous patient are retained through optimum engagement of the available soft tissue undercuts found within the defect space. The ability to fully engage these undercuts can be limited by the path of insertion for the prosthesis and by the mouth opening. Hence, other treatment modalities that rely on endosseous implants to increase obturator retention have been introduced. The use of implants in tumor patients has been documented in a number of studies with success rates up to 99%, even in bone grafts.

Osseointegrated implants better tolerate axial occlusal forces. Thus, they should be relied on primarily for retention. To reduce lateral forces on the implants, close adaptation of the obturator, with maximal lateral extension into the defect was demanded. Moreover, implants were splinted using precision-fitted tissue bar to which the prosthesis is attached through clips. The complex forces of dislodgment and chewing mandate that endosseous implants should be of sufficient number, length, and distribution to resist these forces. Ideally, at least four implants should be placed in a nonlinear relationship to maximize stability, support, and retention. One implant should be placed adjacent to the surgical site anteriorly, one in the contralateral cuspid region, and two posteriorly.

The rate of bone resorption around implants supporting the central defect obturator was similar to that reported in literature for implant supporting overdentures. The quadrilateral support of the central defect obturator explains its behavior as a totally implant supported maxillary overdenture. The mean marginal bone resorption for implants supporting maxillectomy obturators was found to be higher than that reported in the literature for implants inserted in edentulous maxilla. This could be attributed to the fact that loads are probably magnified by the long lever arms present as a consequence of the maxillary resection which may cause a resorptive remodeling response of the bone around implant necks. The presence of cantilevers increases the forces distributed to implants, possibly up to 2 or 3 times the applied load on a single implant, due to moments.

The number of implants used and their location was limited by the nature of the defect and the available bony sites. The premaxillary segment was a key site for implant placement because of the quantity of bone. However, it was found that the amount of bone resorption for implants inserted adjacent to the maxillectomy defect was significantly higher than that of implants inserted next to them. This was matching with the results of the study conducted by Roumans et al. (1995).

This observation can be explained biomechanically (Fig 10); in this case, one side of the obturator is supported by the bar while the defect side rests on soft tissue, which is considered as a cantilever. During function, contacts at the defect side tend to rotate the obturator. In this situation the terminal implant next to the defect (implant 1) acts as a pivot. Movement of the obturator is resisted by the gripping action of the clips around the bar that generate a pulling force \( r_2, r_3 \), and \( r_4 \) on implants \( 2, 3 \), and \( 4 \) respectively. This tension on the implants is resisted by a counter force from the bone pulling the bar in the ridge direction with implant (1) again as a fulcrum. Thus implant (1) will be under the effect of a compression force \( F \) resulting from the pivoting of the obturator plus a counteracting force \( R \) that equals the summation of \( r_2, r_3 \), and \( r_4 \) but opposite in direction i.e. compressive force.

In summary, the bar system rearrange the displacement of the obturator by distributing the load in the sense that the fulcrum implant will be always under compression and experiencing the maximum amount of load. Meanwhile, the other implants will be under a pullout and/ or compressive loads, so they show a lesser rate of bone resorption.
CONCLUSIONS

Implants are valuable treatment options for edentulous patients with acquired maxillary defects. In the maxillectomy patients and due to the nature of obturator rotation, the rate of marginal bone loss for implants next to the defect is higher than that for implants inserted posterior to them. For that reason it is recommended, whenever possible, to install wide and long implants in that position to have a predictable long term implant success.

REFERENCES


