# Endosseous Implants and Bone Augmentation in the Partially Dentate Maxilla: An Analysis of 17 Patients with a Follow-up of 29 to 101 Months

Jonas P. Becktor, DDS, PhD[1]/ Sten Isaksson, MD, DDS, PhD[2]/Lars Sennerby, DDS, PhD[3]

***Purpose:*** *The aim of this study was to analyze the survival rate of endosseous implants placed in the partially dentate maxilla treated with sinus inlay block bone grafts.* ***Materials and Methods:*** *Seventeen patients were subjected to bone augmentation procedures prior to or in conjunction with implant placement. Bone volumes were regarded as insufficient for implant treatment unless a bone grafting procedure was performed. The patients were treated with sinus inlay block bone grafts and endosseous implants in a 1- or 2-stage procedure. A total of 69 implants were placed in the patients who were followed for 29 to 101 months (mean, 53.1 months). The retrospective patient group was also prospectively followed using a standardized clinical and radiographic study design.* ***Results:*** *The implant survival rate was 91.3% (63/69). All implants were lost during the period from abutment connection to connection of the definitive prosthesis. All bone grafts were stable. Bone grafts supported 48 implants, of which 5 failed (10.4%). In the residual bone, 21 implants were placed, of which 1 failed (4.8%). All patients received a fixed partial prosthesis, which was stable during the follow-up period.* ***Conclusion:*** *The results of this investigation revealed a satisfactory clinical outcome of implant placement in grafted partially dentate maxillae after a mean follow-up of 53.1 months.* INT J ORAL MAXILLOFAC IMPLANTS 2007;22:603–608

**Key words:** *bone augmentation, bone graft, dental implants, endosseous implants, maxillary sinus, partially dentate maxillae*

Treatment with endosseous implants in patients with adequate bone volume in the jaws is a predictable method with high survival rates.[1] However, increased failure rates have been experienced in situations with inadequate bone volume and/or low bone density in partially dentate and edentulous patients, especially in the posterior part of the maxilla.[2–4] The severely atrophied posterior maxilla constitutes a therapeutic challenge, since bone augmentation is required to enable placement of a sufficient number and length of implants.

[1]Consultant, Division of Oral and Maxillofacial Surgery, Maxillofacial Unit, Specialisttandvården, Länssjukhuset, Halmstad, Sweden, and Department of Biomaterials, Institute for Surgical Sciences, University of Gothenburg, Sweden.
[2]Head, Division of Oral and Maxillofacial Surgery, Maxillofacial Unit, Specialisttandvården, Länssjukhuset, Halmstad, Sweden.
[3]Professor, Department of Biomaterials, Institute for Surgical Sciences, University of Gothenburg, Gothenburg, Sweden.

**Correspondence to:** Dr Jonas Peter Becktor, Strandvejen 116A, DK-2900 Hellerup, Denmark. Fax: +45 3940 7160. E-mail: jonas@becktor.dk

Bone augmentation procedures have been developed to increase bone volume in patients with advanced alveolar resorption and insufficient bone volume for implant placement. A number of different methods for grafting in the maxilla have been developed during the last 25 years.[5–12] The techniques have been used in different modifications, including alternate donor sites, alternate forms, and altered timing.

Protocols used have included the 1-stage procedure with simultaneous placement of implants and bone graft and the 2-stage procedure with bone blocks or particulated bone graft and healing before implant placement. Bone augmentation of the floor of the maxillary sinus is a frequently used method, since good implant survival rates have been achieved in such grafts.[5,8,13–15] Lekholm et al[16] reported a 3-year retrospective, multicenter study of bone grafting and implants that showed an overall implant survival rate of approximately 80%. A literature review by Esposito et al[2] reported a pooled failure rate of 15% after 3 years of loading in grafted edentulous and partially dentate patients. With regard to sinus augmentation, Tong et al[17] reported a failure rate of about 9% based on a literature review.

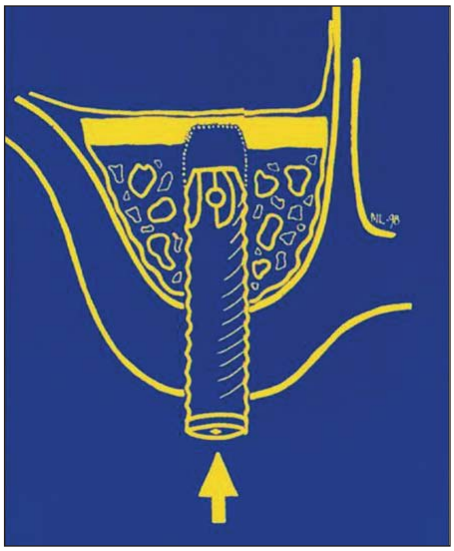

**Fig 1** One-stage surgery; technique where bone graft is fixed with dental implants.

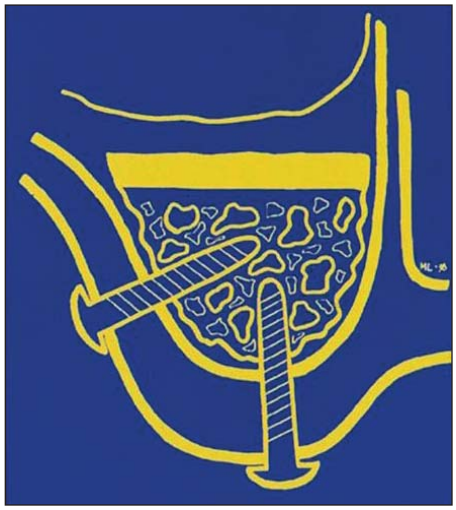

**Fig 2** Fig 2 Two-stage surgery; technique where bone graft is fixed with osteosynthesis screws.

The aim of this study was to analyze the clinical outcome of implant treatment in patients with partially dentate maxillae who were treated with block bone grafts prior to or in conjunction with implant treatment.

## MATERIALS AND METHODS

### Subjects

The study group included 17 patients, 4 male and 13 female, with a mean age of 58.8 years. Because of advanced horizontal and vertical bone loss of the alveolar processes and/or extensive pneumatization of the maxillary sinuses, the patients were considered to have insufficient bone volume for routine implant treatment in the posterior maxilla. All patients were consecutive admissions treated by 3 surgeons between January 1, 1990, and December 31, 1996. The choice of treatment was based on the amount of bone available for implant placement and determined by clinical and radiographic presurgical examination. A 1-stage grafting technique (n = 5, Fig 1) was used from 1990 to 1994, and a 2-stage grafting technique (n = 12, Fig 2) was used from 1994 to 1996. The goal of the treatment was to provide the patients with a fixed partial prosthesis. In all patients the bone of the posterior maxilla was considered Class V or VI according to Cawood and Howell.[18]

### Surgery

*Bone Grafting.* Bone augmentation was performed under general anesthesia with nasal endotracheal intubation supplemented with infiltration of local anesthetic agents with a vasoconstrictor for hemostasis. Patients were routinely given intravenous benzylpenicillin (3 g) and metronidazole (0.5 g) the day of the operation. All 17 patients received corticocancellous bone blocks harvested from the iliac crest, as previously described by Isaksson and Alberius.[11] A 40- to 50-mm bony lid, encompassing the iliac crest and attached only to the inner periosteum, was tilted medially, whereafter bone blocks of approximately 30 × 10 × 10 mm were harvested. The medial cortical layer of the iliac bone was left intact. The intraoral approach for the posterior maxilla was made by a crestal incision along the alveolar process. The alveolar crest was subsequently exposed by raising a buccal and palatal pedicle mucoperiosteal flap.

The surgical inlay graft technique has been described in detail previously.[19,20] The bone blocks were positioned in contact with the floor of maxillary sinus. Great effort was made to place the cancellous surface of the bone graft in close contact with the maxillary bone. In the first 5 consecutive patients, fixation of the bone grafts was obtained by the immediate placement of endosseous implants (Brånemark Implant System, Nobel Biocare, Göteborg, Sweden; 1-stage grafting technique; Fig 3).[21] The 2-stage graft-

ing technique was performed in 12 patients in whom the bone grafts were fixed with titanium osteosynthesis screws 7 to 15 mm in length and 2 mm in diameter.[22] Wound closure was made with continuous, absorbable 4-0 suture (Monocryl; Ethicon, Somerville, NJ). Antibiotic prophylaxis was given for 7 days postoperatively; it consisted of 1 g of penicillin-V 3 times daily (Kåvepenin; Astra, Södertälje, Sweden) and 400 mg of metronidazole 3 times daily (Flagyl; Aventis Pharma, Stockholm, Sweden).

### Implant and Abutment Surgery

In the 2-stage procedure, the osteosynthesis screws were removed and the implants were placed after a graft healing period of 3 to 7 months (mean, 4.8 months). In total, 69 implants (Brånemark System; Nobel Biocare) 10 to 18 mm long were placed (mean, 13.7 mm) and in diameters from 3.75 to 4 mm. Abutment connection surgery was performed after a healing time of 6 to 12 months (mean, 7.4 months).[23]

### Prosthodontics

Temporary partial dentures were not used after bone grafting, implant surgery, or abutment connection surgery. Fabrication of gold-acrylic resin fixed partial prostheses followed the standard procedures for the Brånemark System, as described elsewhere.[23]

### Examinations and Follow-up

Data were collected from the time of bone augmentation or implant treatment until the last follow-up and retrospectively analyzed according to a research protocol. All patients were contacted for a further prospective follow-up examination. Seventeen patients underwent clinical and radiographic examination according to the prospective follow-up protocol. The follow-up period ranged from 29 to 101 months from the day of implant treatment, with a mean follow-up period of 53.1 months (4 years and 5 months). From obtained patient records, the following parameters were recorded: age and gender, jawbone volume according to Cawood and Howell,[18] type of bone graft and grafting technique, type and number of implants placed and lost, implant position, marginal bone level, and prosthetic outcome.

### Radiographic Examination

Radiographic examination was not consistently performed at the time of the abutment connection surgery or at the annual follow-ups. Radiographs used in this study were obtained at the last follow-up. An intraoral radiographic paralleling technique[24] was utilized at the time of the prospective patient follow-up. A single investigator used a magnifying lupe (×7) and measured the distance from a reference point on the implant to the most apical marginal bone level at the mesial and distal surfaces. Linear measurements were performed to the closest 1 mm. The reference point used was the junction between the implant and the abutment. The measurements were made by 1 investigator.

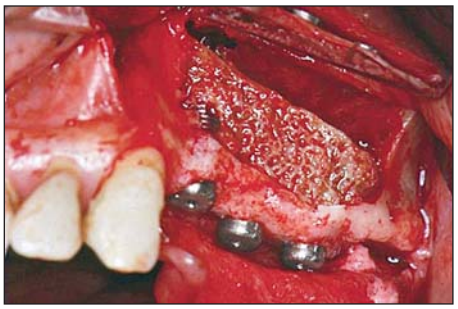

**Fig 3** One-stage surgery; technique where bone graft is fixed with dental implants.

Classification according to Cawood and Howell[18] was done retrospectively with the help of panoramic radiographs. It was used for classification in the region of the posterior maxilla, where 5 mm or less of bone in height corresponded to Class V or VI, 6 mm to 12 mm to Class III or IV, and 12 mm or more to Class I or II.

### Statistical Analysis

Differences between groups were analyzed with the Fisher exact text for dichotomous variables, the $\chi^2$ test for nonordered categorical variables, and the Mantel-Haenszel test for ordered categorical variables. All tests were 2-tailed and conducted at 5% significance level.

## RESULTS

### Implant, Graft, and Prosthesis Stability

Six (8.7%) of the 69 implants placed were lost. All implant failures occurred during the period from abutment connection surgery to connection of the definitive prosthesis. No implants failed during prosthetic loading, giving a cumulative survival rate (CSR) of 91.3% after a mean follow-up period of 53.1 (Table 1). Calculated from the date of definitive prosthetic loading, the percentage of functioning implants was 100%. The study showed better implant survival in the 2-stage grafting group (49/52, 94%) compared with the 1-stage grafting group (14/17, 82%).

**Table 1 Distribution of Failed Implants in a Life Table**

| | No. of implants surveyed | No. of implants failed in interval | Cumulative failure rate (%) |
|---|---|---|---|
| Before abutment surgery | 69 | 0 | 0.0 |
| At abutment surgery | 68 | 1 | 1.4 |
| Before prosthesis loading | 63 | 5 | 8.7 |
| Prosthesis delivery to 1 y postloading | 61 | 0 | 8.7 |
| 1 to 2 y postloading | 48 | 0 | 8.7 |
| 2 to 3 y postloading | 28 | 0 | 8.7 |
| 3 to 4 y postloading | 18 | 0 | 8.7 |
| 4 to 5 y postloading | 14 | 0 | 8.7 |
| 5 to 6 y postloading | 8 | 0 | 8.7 |
| 6 to 7 y postloading | 6 | 0 | 8.7 |
| 7 to 8 y postloading | 6 | 0 | 8.7 |
| 8 to 9 y postloading | 3 | 0 | 8.7 |

**Table 2 Distribution of Failed Implants with Regard to Type of Bone and Tooth Region**

| | Total | | Tooth region | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Incisor | | Canine | | Premolar | | Molar | |
| | n | % | n | % | n | % | n | % | n | % |
| In residual bone | 1/21 | 4.8 | 0/13 | 0 | 1/8 | 12.5 | 0/0 | 0 | 0/0 | 0 |
| In inlay graft | 5/48 | 10.4 | 0/0 | 0 | 2/6 | 33.3 | 3/32 | 9.4 | 0/10 | 0 |
| Total | 6/69 | 8.7 | 0/13 | 0 | 3/14 | 21.4 | 3/32 | 9.4 | 0/10 | 0 |

**Table 3 Distribution of Failed Implants with Regard to Surgical Protocol and Type of Bone**

| | Surviving implants | Failures | Total |
|---|---|---|---|
| In residual bone | | | |
| 1-stage | 5 | 0 | 5 |
| 2-stage | 15 | 1 | 16 |
| Total | 20 | 1 | 21 |
| In inlay graft | | | |
| 1-stage | 9 | 3 | 12 |
| 2-stage | 34 | 2 | 36 |
| Total | 43 | 5 | 48 |

All bone grafts were stable. Forty-eight implants were supported by grafted bone, of which 5 failed (10.4%). In residual bone, 21 implants were placed, of which 1 failed (4.8%). The implant failure rate was evaluated in relation to implant position and implant length, as shown in Tables 2, 3, and 4.

No significant difference in implant survival was observed between the 1-stage group and the 2-stage group or among different dental regions, implant lengths, or implant diameters.

All patients received fixed prostheses, which were all stable throughout the observation periods.

### Radiographic Examination

The marginal bone level was on average 2.2 mm (SD: 1.01) from the reference point after a mean follow up of 53.1 months. All 17 patients were classified as class V or VI (Cawood and Howell) in the posterior part of the maxillae.

## DISCUSSION

A previous report from the clinic examined in the present study showed an implant survival rate of 96% in partially dentate patients treated without bone augmentation procedures.[25] Although there has been no comparative analysis of the 2 studies, the results of the earlier study were more positive, and it appears that treatment with endosseous implants is a more predictable method in patients with adequate bone than in patients with an inadequate bone situation where bone grafting is the treatment of choice. The overall survival rate of implants in this study was 91.3%. About 10% of the implants placed in augmented bone failed, while about 5% of the implants placed in residual bone were lost. It was also noted that more implants failed when implants were placed simultaneously with the bone graft (1-stage) than when a 2-stage procedure was used. These preliminary findings could indicate more favorable integration in residual bone and in well-incorporated bone grafts.

**Table 4 Distribution of Failed Implants with Regard to Dental Region, Implant Length (mm), and Implant Diameter (mm)**

| Dental region | 10 | | 13 | | 15 | | 18 | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | 3.75 | 4.0 | 3.75 | 4.0 | 3.75 | 4.0 | 3.75 | 4.0 | |
| 1 | 0 | 0 | 3 | 0 | 1 | 0 | 1 | 0 | 5 |
| 2 | 0 | 0 | 3 | 1 | 4 | 0 | 0 | 0 | 8 |
| 3 | 2(2) | 0 | 5 | 1 | 5 | 0 | 1(1) | 0 | 14(3) |
| 4 | 1 | 0 | 6 | 1 | 7 | 0 | 1(1) | 0 | 16(1) |
| 5 | 0 | 1(1) | 7 | 1 | 7(1) | 0 | 0 | 0 | 16(2) |
| 6 | 1 | 1 | 5 | 0 | 2 | 0 | 0 | 0 | 9 |
| 7 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| Total | 4(2) | 2(1) | 29 | 4 | 27(1) | 0 | 3(2) | 0 | 69(6) |

The number of implant failures is shown in parentheses where applicable.

Biologically, a 2-stage surgery is preferable, because it enables revascularization, maturation, and incorporation of the grafted bone before the implants are placed. If the residual bone height beneath the maxillary sinus is at least a couple of mm and of good quality, initial stability of the implants can be achieved by either approach. In cases with insufficient bone volume where primary implant stability cannot be achieved, delayed implant placement is the treatment of choice.[26,27] However, simultaneous placement is less invasive, more cost-effective, and more time-efficient.

In spite of differences in implant failures, the fixed prostheses were stable throughout the observation period in all 17 cases. The present study indicated a better clinical outcome with bone grafting procedures in the partially dentate patient than a previous study from the same center[15] of the restoration of completely edentulous patients. This is in agreement with the study of Esposito et al.[2] A possible explanation of early failure in grafted patients could be occlusal overload of the implant site, because of the use of a temporary prosthesis during the healing period. Factors of significant importance for overload of the bone graft and submerged implants are denture stability, fit, occlusion, bite force, and opposing dentition. Becktor et al[28] reported that opposing dentition was correlated with implant failure in grafted patients, since more failures occurred in patients with inadequate premolar and molar support. In contrast to edentulous patients, the partially dentate patients in the present study did not wear dentures during the healing phase, which probably eliminated the risk of occlusal trauma. Moreover, in partially dentate patients, occlusal forces on the definitive prosthetic restoration are reduced because of transfer to the natural dentition. In most studies, the results of bone grafting and implant placement in the partially dentate and edentulous maxilla have not been analyzed separately, but there are indications that the survival rate is higher for partially dentate patients.[29,30]

In the present material, no signs of sinusitis or other infections were diagnosed. Other authors have reported transient sinusitis in 5% to 27% of their patients.[26,30,31] Different kinds of grafting material have been evaluated for maxillary sinus floor augmentation.[32,33] Autogenous bone graft from the iliac crest was used in the present study. Autogenous bone grafts are advantageous because of their space-maintaining properties as well as their osteoconductive and osteoinductive properties.

In this study, all patients were treated with bone graft from the iliac crest. Currently, donor sites are chosen depending on the amount of bone required. The advantages of harvesting bone from, for instance, the mandibular ramus/body are the use of local anesthesia, reduced operating time, elimination of postoperative hospitalization, and reduction of morbidity at the donor sites.[34–36]

Although the bone volume can be sufficient by particulating the bone, there are still cases where large amounts of bone graft are needed to gain adequate bone augmentation of the maxillary sinus. This may be the case in bilaterally edentulous patients or in combination with a reconstruction of the width of the alveolar crest.

## CONCLUSION

The results of this investigation revealed satisfactory clinical outcomes for sinus inlay block bone grafts and endosseous implant placement in partially dentate maxillae after a mean follow-up of 53.1 months.

## ACKNOWLEDGMENTS

The authors thank Dr Hadar Hallström, Dr John-Erik Blomqvist, and Dr Lennart Linnér for their participation in this study; Dr Kjell-Arne Sämfors and his staff at the Dento-Maxillofacial Radiology Division for their help with the radiological task; and Ms Inger Persson for her help in the clinical trial.

## REFERENCES


1. Adell R, Eriksson B, Lekholm U, Brånemark P-I, Jemt T. Long-term follow-up study of osseointegrated implants in the treatment of totally edentulous jaws. Int J Oral Maxillofac Implants 1990;5:347–359.
2. Esposito M, Hirsch JM, Lekholm U, Thomsen P. Biological factors contributing to failures of osseointegrated oral implants. (I). Success criteria and epidemiology. Eur J Oral Sci 1998;106:527–551.
3. Esposito M, Hirsch JM, Lekholm U, Thomsen P. Biological factors contributing to failures of osseointegrated oral implants. (II). Etiopathogenesis. Biological factors contributing to failures of osseointegrated oral implants. (I). Success criteria and epidemiology. Eur J Oral Sci 1998;106:721–764.
4. Esposito M, Hirsch JM, Lekholm U, Thomsen P. Biological factors contributing to failures of osseointegrated oral implants. (I). Success criteria and epidemiology. Eur J Oral Sci 1998;106:527–551.
5. Blomqvist JE, Alberius P, Isaksson S. Sinus inlay bone augmentation: Comparison of implant positioning after one- or two-staged procedures. J Oral Maxillofac Surg 1997;55:804–810.
6. Boyne PJ, James RA. Grafting of the maxillary sinus floor with autogenous marrow and bone. J Oral Surg 1980;38:613–616.
7. Jensen J, Sindet-Pedersen S, Oliver AJ. Varying treatment strategies for reconstruction of maxillary atrophy with implants: results in 98 patients. J Oral Maxillofac Surg 1994;52:210–218.
8. Keller EE, Eckert SE, Tolman DE. Maxillary antral and nasal one-stage inlay composite bone graft: Preliminary report on 30 recipient sites. J Oral Maxillofac Surg 1994;52:438–447.
9. Lundgren S, Nystrom E, Nilson H, Gunne J, Lindhagen O. Bone grafting to the maxillary sinuses, nasal floor and anterior maxilla in the atrophic edentulous maxilla. A two-stage technique. Int J Oral Maxillofac Surg 1997;26:428–434.
10. Misch CM. The harvest of ramus bone in conjunction with third molar removal for onlay grafting before placement of dental implants. J Oral Maxillofac Surg 1999;57:1376–1379.
11. Isaksson S, Alberius P. Maxillary alveolar ridge augmentation with onlay bone-grafts and immediate endosseous implants. J Craniomaxillofac Surg 1992;20:2–7.
12. Kent JN, Block MS. Simultaneous maxillary sinus floor bone grafting and placement of hydroxylapatite-coated implants. J Oral Maxillofac Surg 1989;47:238–242.
13. Raghoebar GM, Brouwer TJ, Reintsema H, Van Oort RP. Augmentation of the maxillary sinus floor with autogenous bone for the placement of endosseous implants: A preliminary report. J Oral Maxillofac Surg 1993;51:1198–1203.
14. Keller EE, Tolman DE, Eckert SE. Maxillary antral-nasal inlay autogenous bone graft reconstruction of compromised maxilla: A 12-year retrospective study. Int J Oral Maxillofac Implants 1999;14:707–721.
15. Becktor JP, Isaksson S, Sennerby L. Survival analysis of endosseous implants in grafted and nongrafted edentulous maxillae. Int J Oral Maxillofac Implants 2004;19:107–115.
16. Lekholm U, Wannfors K, Isaksson S, Adielsson B. Oral implants in combination with bone grafts. A 3-year retrospective multicenter study using the Brånemark implant system. Int J Oral Maxillofac Surg 1999;28:181–187.
17. Tong DC, Rioux K, Drangsholt M, Beirne OR. A review of survival rates for implants placed in grafted maxillary sinuses using meta-analysis. Int J Oral Maxillofac Implants 1998;13:175–182.
18. Cawood JI, Howell RA. A classification of the edentulous jaws. Int J Oral Maxillofac Surg 1988;17:232–236.
19. Isaksson S, Alberius P. Comparison of regenerative capacity elicited by demineralized bone matrix of different embryonic origins. J Craniomaxillofac Surg 1992;20:73–80.
20. Loukota RA, Isaksson SG, Linner EL, Blomqvist JE. A technique for inserting endosseous implants in the atrophic maxilla in a single stage procedure. Br J Oral Maxillofac Surg 1992;30:46–49.
21. Blomqvist JE, Alberius P, Isaksson S. Retrospective analysis of one-stage maxillary sinus augmentation with endosseous implants. Int J Oral Maxillofac Implants 1996;11:512–521.
22. Blomqvist JE, Alberius P, Isaksson S. Two-stage maxillary sinus reconstruction with endosseous implants: A prospective study. Int J Oral Maxillofac Implants 1998;13:758–766.
23. Brånemark P-I, Zarb G, Albrektsson T. Tissue-Integrated Prostheses: Osseointegration in Clinical Dentistry. Chicago: Quintessence, 1985.
24. Hollender L, Rockler B. Radiographic evaluation of osseointegrated implants of the jaws. Experimental study of the influence of radiographic techniques on the measurement of the relation between the implant and bone. Dentomaxillofac Radiol 1980;9:91–95.
25. Johansson LA, Ekfeldt A. Implant-supported fixed partial prostheses: A retrospective study. Int J Prosthodont 2003;16:172–176.
26. Block MS, Kent JN. Sinus augmentation for dental implants: The use of autogenous bone. J Oral Maxillofac Surg 1997;55:1281–1286.
27. Lundgren S, Rasmusson L, Sjostrom M, Sennerby L. Simultaneous or delayed placement of titanium implants in free autogenous iliac bone grafts. Histological analysis of the bone graft-titanium interface in 10 consecutive patients. Int J Oral Maxillofac Surg 1999;28:31–37.
28. Becktor JP, Eckert SE, Isaksson S, Keller EE. The influence of mandibular dentition on implant failures in bone-grafted edentulous maxillae. Int J Oral Maxillofac Implants 2002;17:69–77.
29. Mazor Z, Peleg M, Gross M. Sinus augmentation for single-tooth replacement in the posterior maxilla: A 3-year follow-up clinical report. Int J Oral Maxillofac Implants 1999;14:55–60.
30. Raghoebar GM, Timmenga NM, Reintsema H, Stegenga B, Vissink A. Maxillary bone grafting for insertion of endosseous implants: Results after 12–124 months. Clin Oral Implants Res 2001;12:279–286.
31. Kaptein ML, Hoogstraten J, de Putter C, de Lange GL, Blijdorp PA. Dental implants in the atrophic maxilla: Measurements of patients' satisfaction and treatment experience. Clin Oral Implants Res 1998;9:321–326.
32. Hallman M, Sennerby L, Lundgren S. A clinical and histologic evaluation of implant integration in the posterior maxilla after sinus floor augmentation with autogenous bone, bovine hydroxyapatite, or a 20:80 mixture. Int J Oral Maxillofac Implants 2002;17:635–643.
33. Wiltfang J, Schlegel KA, Schultze-Mosgau S, Nkenke E, Zimmermann R, Kessler P. Sinus floor augmentation with beta-tricalciumphosphate (beta-TCP): Does platelet-rich plasma promote its osseous integration and degradation? Clin Oral Implants Res 2003;14:213–218.
34. Hirsch JM, Ericsson I. Maxillary sinus augmentation using mandibular bone grafts and simultaneous installation of implants. A surgical technique. Clin Oral Implants Res 1991;2:91–96.
35. Raghoebar GM, Louwerse C, Kalk WW, Vissink A. Morbidity of chin bone harvesting. Clin Oral Implants Res 2001;12:503–507.
36. Clavero J, Lundgren S. Ramus or chin grafts for maxillary sinus inlay and local onlay augmentation: Comparison of donor site morbidity and complications. Clin Implant Dent Relat Res 2003;5:154–160.