
Retrospective Review of Grafting Techniques Utilized in Conjunction with Endosseous Implant Placement

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Bone resorptive patterns may prevent the ideal placement of endosseous implants. Numerous techniques have been described to create a more favorable surgical site for implant placement. This retrospective review was conducted to determine the frequency of need for implant site preparation in an outpatient clinical setting. In addition, different techniques of surgical site preparation were evaluated to determine their frequency of use and surgical outcome. A history review was conducted of all consecutively treated partially edentulous patients between January 1993 and December 1997. This review evaluated the number of implants placed, the age and gender of the patient, the type of graft used, and the status of the implant.

In all, 542 patients were seen in this time interval, with a total of 1,313 implants placed. Implant site preparation was needed in 4.4% of the patients, with the requirement for grafts occurring more frequently in the maxilla. Implant site preparation is a relatively infrequent requirement in the general population. Grafts are required more frequently in the maxilla than in the mandible. Complications following grafting were relatively infrequent and were not severe.

(INT J ORAL MAXILLOFAC IMPLANTS 1999;14:744-747)

Key words: grafting, implants, outcome assessment, site preparation

The treatment of patients with prostheses supported by endosseous dental implants has become a routine restorative option. Acceptance of this procedure depends upon predictable implant survival, prosthesis retrievability, and conservation of natural tooth structure.¹⁻⁶ Predictable survival of endosseous dental implants depends upon factors such as bone quality and quantity, location in the arch, and immediate stabilization of the

implant at time of surgical placement.⁷⁻⁹ Clinically, some situations may deviate from the ideal in that the patient's bone volume or contour is insufficient to provide adequate support for the implant.

Inadequate bone volume may be addressed by using implant site preparation procedures prior to or at the time of implant placement to provide a more favorable outcome. Bone grafting may be accomplished through the use of autogenous grafts,^{10,11} allografts,¹² or alloplastic¹³ grafting material. Guided bone regeneration (GBR) has also been described.¹⁴ This procedure incorporates a barrier membrane to create space for new bone formation while restricting the ingrowth of the epithelium. Procedures may be accomplished in one surgical phase, in which the implants and graft are placed simultaneously, or in two surgical phases, in which the graft is placed and allowed to heal before implants are placed.

The purpose of this study was to characterize the frequency of implant sites in need of preparation procedures that were employed in conjunction with implant placement in partially edentulous

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Table 1 Frequency of Grafting Procedures by Anatomic Area (Percentage by Category)

| Graft type | Anterior mandible | Anterior maxilla | Posterior mandible | Posterior maxilla |
|--------------------|-------------------|------------------|--------------------|-------------------|
| Autogenous local | 0 | 67 | 6 | 27 |
| Autogenous distant | 8 | 4 | 0 | 88 |
| Nonautogenous | 0 | 66 | 17 | 17 |

patients. The secondary purpose was to describe the outcome of these implants as compared to implants that did not receive grafting procedures. This information was gathered through a retrospective review of consecutively treated patients over a 5-year period.

Methods

A retrospective history review of patients receiving endosseous implants was conducted. Records from the implant registry at the Mayo Clinic in Rochester, Minnesota, demonstrate consecutively placed dental implants. Dental records of patients who received implants from January 1993 through December 1997 were reviewed to gather pertinent information regarding the number and location of implants, adjunctive surgical procedures, and surgical treatment outcomes. The implant patients included in this report were seen initially by prosthodontists and then referred for implant placement. Patients who self-referred to a particular surgical area and patients who refused to sign an authorization for release of information were excluded from this study.

Anatomic location was classified according to implant position in the anterior mandible, anterior maxilla, posterior mandible, or posterior maxilla. Surgical complications were recorded from the time of surgery and up to 6 months following the start of the prosthetic phase of treatment. These complications were divided into 3 categories: nonrecoverable (nonintegrated or removed implant), recoverable with intervention (secondary prescription for antibiotics or secondary surgical procedure), and recoverable without intervention (treatment by observation only). Hard tissue augmentation procedures were classified as autogenous grafts from a local donor site (oral cavity), autogenous graft from a distant site (nonoral cavity, eg, iliac crest), or nonautogenous graft (alloplastic, allografts, or heterografts).

Information was gathered for every registered implant patient who met the study inclusion crite-

ria listed previously and for every implant placed in these patients during the study period. Data were collected and analyzed statistically to detect differences in implant survival and graft type.

Statistical Analysis. Graft frequencies were compared using chi-square tests. Complication rates were estimated using Kaplan-Meier curves and compared using Cox proportional hazard models. Possible dependence related to having multiple implants per subject was accounted for by using the robust standard error method of Wei et al.¹⁵

Results

A total of 542 partially edentulous patients presented for dental implant treatment during the period from January 1993 through December 1997. These patients received a total of 1,313 implants. Grafting procedures were performed in 58 (4.4%) of the implant sites. The distribution of grafts according to type was as follows: autogenous local 14 sites (25%), autogenous distant 25 sites (43%), and nonautogenous 19 sites (33%). Differences in terms of frequency by graft type were not significant ($P > .05$).

Graft type by anatomic location is shown in Table 1. The majority of autogenous local and nonautogenous grafts were performed in the anterior maxilla, while the majority of autogenous distant grafts were performed in the posterior maxilla (Fig 1). Maxillary areas were grafted more frequently than mandibular areas (Fig 2). This difference was statistically significant ($P < .001$).

Complications associated with grafts were minor in all categories (Table 2). Nonrecoverable complications (implant loss) occurred in the autogenous distant and nonautogenous groups, 8% and 5.5%, respectively, while nonrecoverable complications were not observed in the autogenous local group. The complications seen in the autogenous local group responded to conservative treatment. These complications accounted for 7% of the group total. Implants that were not associated with grafts had a complication rate of 3.1%, of

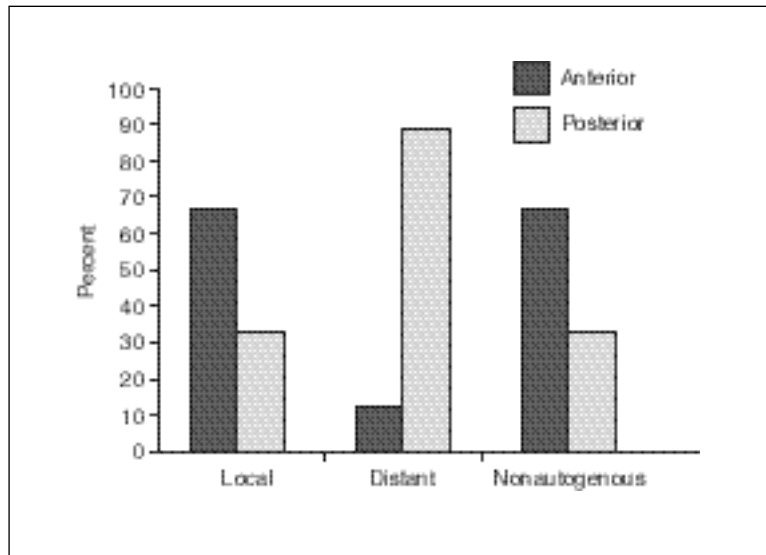


Fig 1 Placement (anterior or posterior) and type of grafts, expressed in percentages.

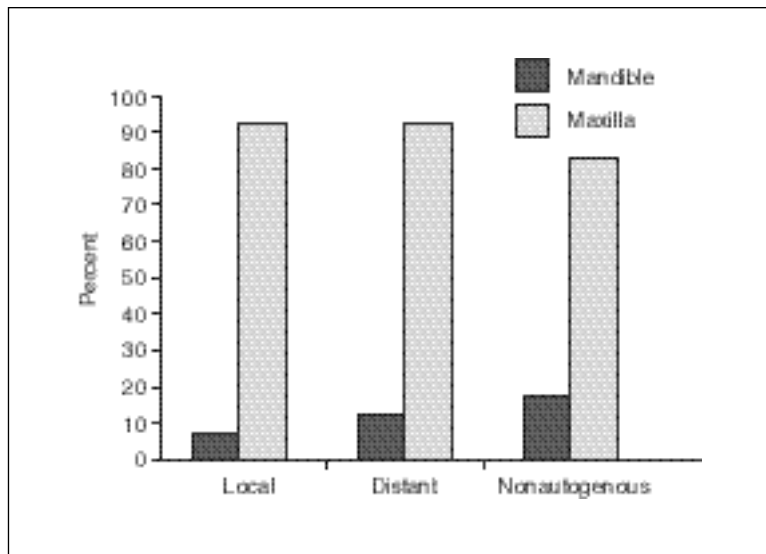


Fig 2 Location (by arch) and type of grafts, expressed in percentages.

| Table 2 Description of Surgical Complications with Grafted Sites | | | | |
|---|-------------------|---------------|--|-------------------------------|
| Type of complication | Location | Number | Graft type | Time to complication |
| Nonrecoverable | Posterior maxilla | 3 | Nonautogenous (1), autogenous distant (2) | 2 months (1), 6 months (2) |
| Recoverable with intervention | Posterior maxilla | 1 | Autogenous local | 1 week |
| Recoverable without intervention | — | 0 | — | — |

which 2.3% were nonrecoverable, 0.6% were recoverable with intervention, and 0.2% were recoverable without intervention. Differences in complication rates were not significant ($P > .05$).

Discussion

This retrospective review evaluated the frequency of implant placement with and without bone grafting procedures. Although grafting is often discussed in treatment planning, this study shows that it was not performed with great frequency in this patient population. When grafting procedures were used, they were associated with relatively few complications and relatively high implant survival rates.

The low percentage of implants that were associated with grafting procedures may indicate that the majority of patients had adequate bone volume or that alternative prosthodontic treatments were chosen when the bone volume was inadequate. This conservative treatment approach may be a factor in the overall high success rate of the dental implants seen in this review. It is hypothesized that less stringent patient selection procedures may result in decreased overall success, but this factor was not studied in this patient series.

The majority of autogenous distant grafts were placed in the posterior maxilla. This may indicate the presence of larger edentulous areas that required increased graft volume to accommodate the number of implants required for fulfillment of the prosthetic treatment plan. In other anatomic areas, such as an interdental edentulous area in the anterior maxilla, a smaller volume of bone was required, making autogenous local or nonautogenous grafts the favored choices. A significantly higher percentage of grafts was placed in the anterior maxilla; this situation may reflect a demand for ideal bony architecture in the "esthetic zone."

As in any retrospective study, this study shows only associations and not causality. There are many confounding variables, including the effect of size of the defects and size of the grafts, as well as any effect the implant itself played in complications. Surgical complications can also occur from improper surgical technique irrespective of the type of graft used.

Conclusions

The results of this study should be considered as an incidence review of grafting need. Although the results are primarily descriptive, it is interesting to note that there was a significant difference ($P < .001$) in the need for grafts in the maxilla versus the mandible.

References

1. Van Steenberghe D, Lekholm U, Bolender C, Folmer T, Henry P, Herrmann I, et al. The applicability of osseointegrated oral implants in the rehabilitation of partial edentulism: A prospective multicenter study on 558 fixtures. *Int J Oral Maxillofac Implants* 1990;5:272-281.
2. Buser D, Belser UC, Lang NP. The original one-stage dental implant system and its clinical application. *Periodontol* 2000 1998;17:106-118.
3. Albrektsson T, Lekholm U. Osseointegration: Current state of the art. *Dent Clin North Am* 1989;33:537-554.
4. Albrektsson T. A multicenter report on osseointegrated oral implants. *J Prosthet Dent* 1988;60:75-84.
5. Adell R, Lekholm U, Rockler B. A 15-year study of osseointegration in the treatment of the edentulous jaw. *J Oral Surg* 1981;10:387-416.
6. Ahlqvist I, Borg K, Gunne J, Nilson H, Olsson M, Åstrand P. Osseointegrated implants in edentulous jaws: A 2-year longitudinal study. *Int J Oral Maxillofac Implants* 1990;5:155-163.
7. Lekholm U, Zarb GA. Patient selection and preparation. In: Brånemark P-I, Zarb GA, Albrektsson TA (eds). *Tissue-Integrated Prostheses: Osseointegration in Clinical Dentistry*. Chicago: Quintessence, 1985:199-210.
8. Misch CE. Dentistry of bone: Effect on treatment plans, surgical approach, healing, and progressive bone loading. *Int J Oral Implantol* 1990;6:23-31.
9. Spiekermann H. *Implantology*. New York: Thieme, 1995: 91-124.
10. Riediger D. Restoration of masticatory function by micro-surgically revascularized iliac crest bone grafts using endosseous implants. *Plast Reconstr Surg* 1988;81:861-877.
11. Åstrand P. Onlay bone grafts to the mandible. In: Worthington P, Brånemark P-I (eds). *Advanced Osseointegration Surgery*. Chicago: Quintessence, 1992:123-128.
12. Nevins M, Mellonig JT. Enhancement of the damaged edentulous ridge to receive dental implants: A combination of allograft and the Gore-Tex membrane. *Int J Periodontics Restorative Dent* 1992;12:96-111.
13. Masters DH. Bone and bone substitutes. *CDA Journal* 1988;16(1):56-65.
14. Buser D, Dula K, Heso D, Hirt HP, Belser UC. Localized ridge augmentation with autografts and barrier membranes. *Periodontol* 2000 1999;19:151-163.
15. Wei LJ, Lin DY, Weisfeld L. Regression analysis of multivariate incomplete failure time data by modeling marginal. *J Amer Statist Assoc* 1989;84:1065-1073.