
Analysis of Surgical Referral Patterns for Endosseous Dental Implants

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Endosseous implants have traditionally been surgically placed by oral and maxillofacial surgeons, periodontists, and general practitioners. The purpose of this study was to examine surgical referral patterns for patients receiving implants in the treatment of partial edentulism. The records of 542 patients who received 1,313 implants between 1993 and 1997 were analyzed. Data relative to anatomic area, patient demographics, type of implant system, and any complication encountered were collected. Surgical cohorts were compared using Wilcoxon's rank-sum or chi-square tests, and complication rates were estimated using survival analysis methods. Results indicate no significant difference ($P > .05$) between cohorts with regard to placement of implants in the anatomic locations of the anterior mandible, anterior maxilla, posterior mandible, and posterior maxilla. Patient demographic information was not statistically different, with the exception of mean patient age, where oral and maxillofacial surgeons have seen younger patients ($P < .0001$). Relatively few complications were seen, with no significant difference in complication rates between cohorts ($P > .05$). The type of implant system used showed no significant difference with respect to anatomic location or complication occurrence ($P > .05$). This study indicates that implant surgical referral patterns were similar in this setting between periodontal and oral and maxillofacial surgeons, with the only difference being a tendency to refer younger patients to the oral surgeons.

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The treatment of patients with endosseous dental implant-supported restorations has become a popular restorative option because of predictable implant survival, prosthesis retrievability, and conservation of natural tooth structure.¹⁻⁶ The success of an implant-supported prosthesis depends upon

prudent diagnosis and treatment planning, followed by the performance of technically difficult clinical procedures. This treatment usually involves a team approach in which several clinicians are involved in the surgical and restorative phases of implant treatment.

When considering referrals for the surgical phase of treatment, the restorative dentist must choose an appropriate surgical dentist for the given situation. Standards for graduate training in oral and maxillofacial surgery and periodontics require clinical experience in surgical implant placement.^{7,8} While periodontists and oral and maxillofacial surgeons may be well prepared for a wide variety of implant-related surgical procedures, experience on the part of the restorative dentist may dictate that the patient be seen by one surgical specialist in preference to the other.

Endosseous dental implants have been placed at the Mayo Clinic Department of Dental Specialties,

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Table 1 Percentage of Implants Placed by Area by Each Specialty

Specialty	Area of implant placement			
	Anterior mandible	Anterior maxilla	Posterior mandible	Posterior maxilla
Periodontics	4.6	21.5	47.5	26.4
Oral surgery	7.4	23.0	46.1	23.5

Rochester, MN, since 1983. This treatment was the exclusive domain of oral and maxillofacial surgeons until 1990. Since then, however, periodontists have begun placing implants in this patient group, and currently both surgical specialty groups are involved in the placement of dental implants. It was the purpose of this study to examine referral patterns for the surgical phase of dental implant treatment in partially edentulous patients in this clinical setting.

Materials and Methods

Patient Material. This is a retrospective data analysis of consecutively placed dental implants included in the database at Mayo Clinic. Data from January 1993 through December 1997 were compared. Potential implant patients seen initially by the prosthodontists and then referred for implant placement were assessed. Patients who self-referred to one surgical area and patients who refused to sign an authorization for release of information were excluded from this study. Data regarding the number and location of implants, as well as the outcome of implant placement relative to the 2 surgical cohorts, were recorded. Information regarding the location of each endosseous implant (maxilla or mandible, anterior or posterior), number of implants placed, and patient demographics was recorded. Implant survival, implant complications, and implant manufacturer were recorded.

Anatomic location was divided into 4 categories: anterior mandible, anterior maxilla, posterior mandible, and posterior maxilla. 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).

Statistical Analysis. Surgical cohorts were compared with respect to age, sex, implant location, and implant type using Wilcoxon's rank-sum tests

or chi-square tests. Complication rates were estimated by Kaplan-Meier curves at 3 levels of severity (nonrecoverable, recoverable with intervention, and recoverable without intervention). Significance of effects on complication rates was tested using Cox proportion hazards models. Possible dependence related to having multiple implants per subject was accounted for using the robust standard error method of Wei et al.⁹

Results

Data were gathered from 542 partially edentulous patients who presented for dental implant treatment. A total of 1,313 implants were evaluated in terms of anatomic location, surgical specialty, and occurrence of complications. The most recent 5-year span was studied to determine preferences in surgical specialty referrals relative to anatomic location of the desired implant. Data were collected from the dental implant database of the Mayo Clinic Department of Dental Specialties, restricted to those patients referred and treated by the Section of Prosthodontics.

Periodontists and oral and maxillofacial surgeons had similar experiences during the study period with implant placement when analyzed by anatomic location. The posterior mandible accounted for the greatest percentage of implants placed per group, 47.5% and 46.1%, respectively (Table 1). The anterior mandible accounted for the lowest percentage of implants placed per group. Differences between the 2 surgical groups were not statistically significant ($P > .05$).

Demographic data revealed no difference between groups with regard to sex ($P > .05$), with 44.9% males and 55.1% females. The mean age of the patients treated was different between periodontics (54.96 years, range 14 to 82) and oral surgery (47.46 years, range 14 to 84). These differences were significant ($P < .0001$). Two implant systems were used within the study period: Brånemark (Nobel Biocare, Westmont, IL) and ITI (Straumann, Waltham, MA). The majority of

Fig 1 Cumulative survival by specialty. Differences were not significant ($P > .05$).

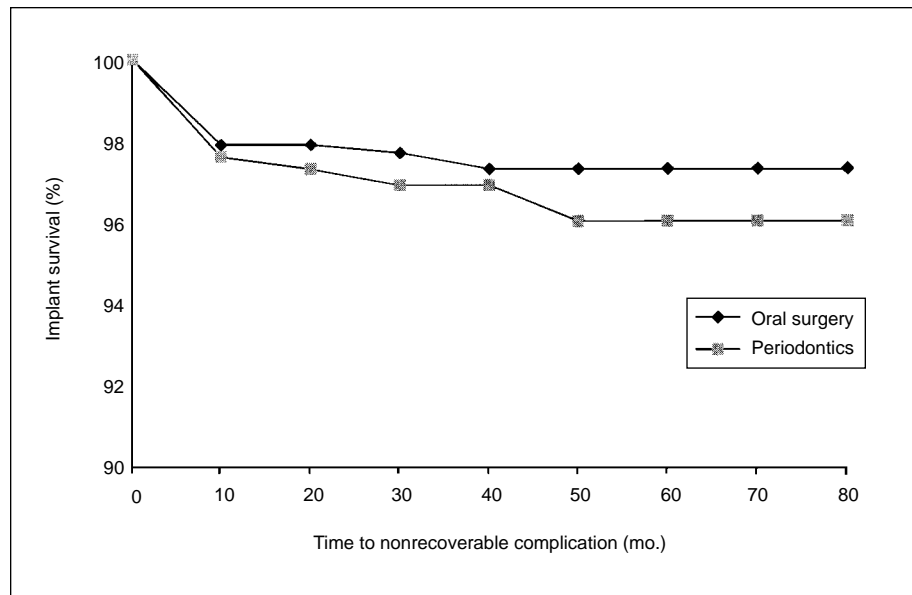
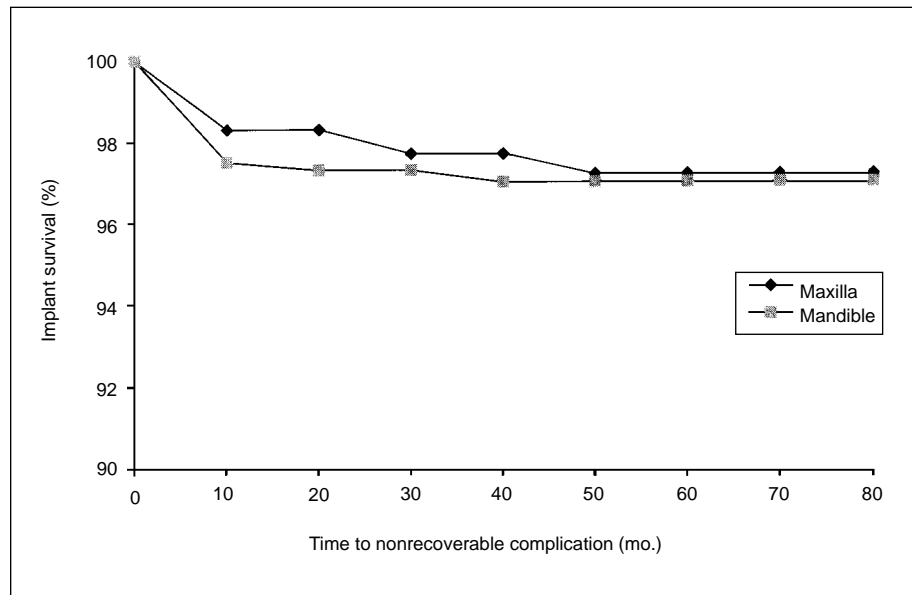


Fig 2 Cumulative survival over time, maxilla versus mandible. Differences were not significant ($P > .05$).



implants placed were Brånemark (80.9%), with the remaining 19.1% being ITI. With respect to specialty, 71.5% of implant surgeries were performed by oral surgeons and 28.5% were performed by periodontists. No differences between the 2 systems were found with regard to anatomic location, type of surgeon, or complication rate ($P > .05$).

The complication rates were small for the categories of nonrecoverable implants (2.5%), recoverable with intervention (0.6%), and recoverable without intervention (0.2%). Statistical differences

were not shown between surgical groups with respect to any of these complications ($P > .05$). Time to complication revealed a significant result following the median date of placement (August 1, 1995), with a decreased incidence of complications following this date ($P = .011$). Nonrecoverable complications are shown in Figs 1 to 4. Since differences were not significant between surgical cohorts, these data were combined to demonstrate cumulative implant survival for the anterior and posterior mandible and maxilla.

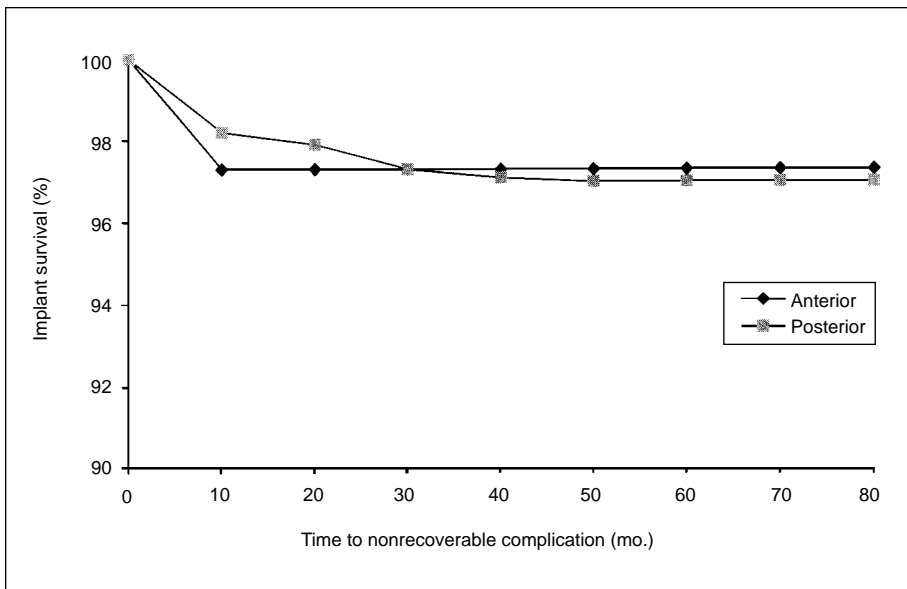


Fig 3 Cumulative survival over time, anterior versus posterior maxilla or mandible. Differences were not significant ($P > .05$).

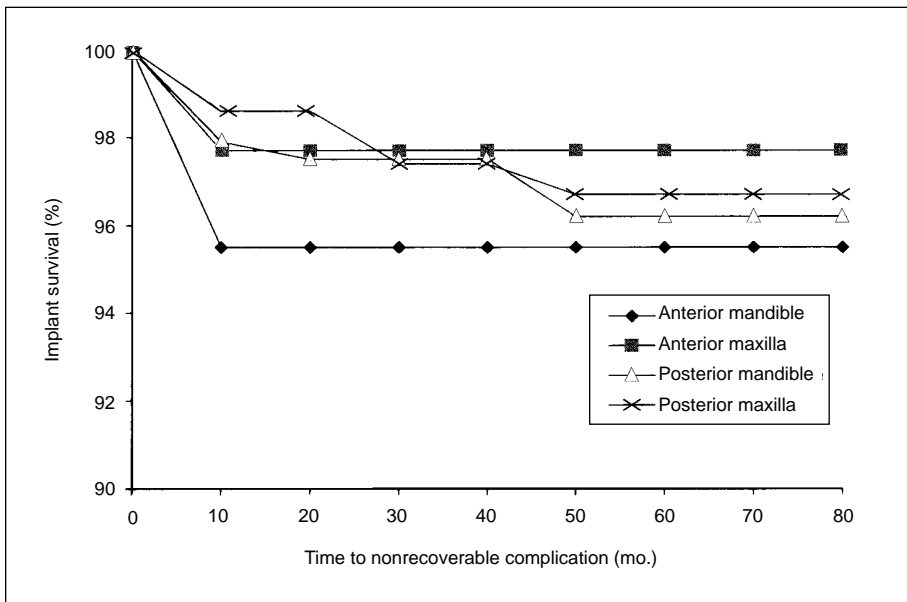


Fig 4 Cumulative survival over time, multivariate effects. Differences were not significant ($P > .05$).

Discussion

Brånemark described a team approach to endosseous implant therapy.¹⁰ Implants were used to address failure with conventional prosthodontic treatment, to provide a restoration that better conserves tooth structure, or to provide a restoration that is more secure and stable for the patient. Implant placement was designed to be accomplished by an experienced surgeon, and the final restoration was to be fabricated by a restorative dentist with similar skills and experience. When

this treatment modality was first introduced in the United States, the surgery was provided only by oral and maxillofacial surgeons, and the definitive prostheses were fabricated by prosthodontists. With time, this rigid protocol was relaxed, with other surgical specialists and restorative dentists becoming involved in the treatment. Today, the surgical phase of treatment is generally performed by oral and maxillofacial surgeons, periodontists, and general practitioners, while the restorative care is provided primarily by prosthodontists and general dentists.

Prosthetic needs primarily determine whether or not dental implants are placed. Patients are typically concerned with existing prostheses or the need for new prostheses, not with a perceived need for an alloplastic implantable material. This explains why patients often present first to the restorative dentist, rather than initially seeking the advice of a surgeon. When this pattern is encountered, it is clear that the restorative dentist initiates the referral to the surgical specialist. The restorative dentist should select team members based upon experience, compatible philosophies, and an ability to communicate well with all team members. When medicolegal risk management is considered, it becomes clear that the assembly of the "right team" is critical to treatment success.

This study examined the referral patterns for surgical implant placement of a small group of prosthodontists in an integrated group practice during the most recent 5-year period. Within the confines of this study, no significant differences were seen in referral patterns for different anatomic location of implants, gender of patient, or number of implants placed in partially edentulous jaws. Prior to performing the data analysis in this study, we anticipated that differences might exist in implant placement in different anatomic areas. Periodontists in this group practice are more likely to employ barrier membrane techniques for residual ridge preparation, whereas oral surgeons in this practice are prone to use autogenous grafts when there is insufficient bone for implant placement.

It is interesting to note that a difference in patient age was seen with oral and maxillofacial surgeons, who treated patients with a younger mean age. This result was unexpected, since age-related health concerns are thought to be associated with greater anesthetic risks that might be better managed by the surgical specialist with more extensive medical training. The apparently contradictory results of this study may reflect desire for general anesthetic on the part of the younger patients, since periodontists in this group practice do not administer general anesthesia, while oral surgeons include this treatment modality. Alternative explanations may relate to overall adequate health of the geriatric patients, which would minimize the need for aggressive medical management of these patients through the oral surgeon, and the recognition that patients presenting for implant placement in partially edentulous jaws may have a long-standing professional relationship with the periodontist.

Regardless of the explanation for the age difference in patients presenting for implant placement,

the study demonstrates an overall appreciation for the surgical skills of both specialties. This illustrates a confidence by the referring dentists in both specialties, especially in challenging areas such as the anterior maxilla or "esthetic zone," or in areas associated with poor-quality bone, such as the posterior maxilla.^{11,12}

With respect to the total number of implants placed in partially edentulous jaws, the percentage of implants placed was roughly $\frac{1}{3}$ by periodontists and $\frac{2}{3}$ by oral surgeons. This reflects the number of dental surgical staff clinicians, in which the periodontists make up $\frac{1}{3}$ of the total surgical staff, and oral and maxillofacial surgeons account for the remaining $\frac{2}{3}$.

The cumulative survival over time considering multivariate effects shows no significant differences in implant survival for different anatomic areas. This is contrary to previous reports.^{1,13} The number of nonrecoverable complications was a small percentage of the total, which could explain the lack of statistical significance. It is interesting to note that the highest percentage of implant failures occurred in the anterior mandible; however, it must be remembered that this finding was not significant. A more interesting observation was the difference (though statistically insignificant) between the anterior and posterior groups: the anterior groups seemed to stabilize in terms of nonrecoverable complications after the first 10 months, but the posterior groups continued having more nonrecoverable complications after the first 10 months and did not seem to stabilize until after 50 months. This observation cannot logically be related to surgical placement and must instead be considered to be related to functional load or prosthodontic treatment.

While the impact of this study might be limited to referral patterns within one dental treatment center, this study does demonstrate that well-trained surgeons, regardless of specialty, can play an integral role in the implant prosthetic treatment team. It may be interesting to determine whether the referral pattern shown in this report reflects a national trend. As the scope of implant dentistry expands, it is prudent for the dental practitioner to be aware that there are expanding resources of qualified dental professionals who can participate as part of the implant treatment team.

Conclusions

This study evaluated the referral patterns of prosthodontists within the Mayo Clinic Department of Dental Specialties and assessed implant

survival relative to anatomic area and specialty training of the surgical specialist. The study found that:

1. Referral patterns showed no preference toward periodontists or oral surgeons when implants were placed in partially edentulous jaws.
2. Implant survival was not affected by the specialty training of the surgeon placing the implant.
3. Implant survival in partially edentulous jaws was statistically the same for all anatomic areas.

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