Profiles of 500 Patients Who Did and 486 Patients Who Did Not Respond to a Prosthodontic Treatment Questionnaire

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Purpose: This paper aims to analyze the demographic and prosthodontic treatment differences between patients who did and did not respond to a mailed questionnaire. ***Materials and Methods:*** All living patients who received tooth- and implant-related fixed prosthodontic treatment between January 1984 and June 2005 (n = 986) in one private prosthodontic practice were mailed a questionnaire regarding their prosthodontic treatment. Demographic data (sex, age) and treatment data (survival, type of treatment, time in situ, number of units, number of treatments) for responding and nonresponding patients were collected from patient files and analyzed. Statistical significance was set at $P = .05$. ***Results:*** There were 500 responding patients (50.7%) with 2,702 fixed prosthodontic units (60.02%) and 486 nonresponding patients (49.3%) with 1,800 fixed prosthodontic units (39.98%). Prostheses were in situ from 1 to 20 years, with the average time in situ for respondents of 7.47 ± 5.48 years and 6.5 ± 5.21 years for nonrespondents. Responding and nonresponding patients had similar sex distributions ($P = .61$), Kaplan-Meier 10-year estimated cumulative survivals (92.2 ± 1.72% and 91.5 ± 1.92%; $P = .13$), and received a similar distribution of treatment prostheses (implant versus tooth) ($P = .24$). However, responding patients were significantly older ($P < .001$), had their prostheses in situ for a greater length of time ($P \leq .01$), received more prosthetic units ($P < .001$), and underwent more treatment episodes ($P < .001$) than nonresponding patients. ***Conclusions:*** Patient questionnaires provide valid and unique research information. Prosthesis outcomes for patients who did and did not respond to the questionnaire were the same. Treatment outcomes of patients who attend review appointments and those who are lost to follow-up cannot be assumed to be different. Demographic- and treatment-related characteristics of responding patients indicated that an enhanced provider-patient rapport was a principal motivator for responding to the questionnaire. *Int J Prosthodont 2009;22:459–465.*

Nonattending, nonresponding, lost to follow-up, and unknown patients are commonly identified in the medical literature.[1] Statistical methods exist to mathematically account for these lost data sets in an effort to restrict bias in analyses.[2–4] However, few studies discuss the impact that assumptions built into these methods may have on reported outcomes.

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The effect of lost patient data on the validity and reliability of reported results has rarely been evaluated, with the exception of psychiatry and substance abuse research.[5] A single study in the dental literature sent questionnaires to nonattending temporomandibular disorder (TMD) patients to determine their reasons for dropping out and to evaluate their current disease status.[6] In one study in the orthopedic literature, researchers employed assistants and ultimately a private detective to track 100% of joint arthroplasty patients lost to follow-up to assess demographic- and disease-related indicators.[7]

Authors disagree as to the appropriate time to withdraw lost patient data from a study. The convention of withdrawing lost subjects from analyses at the time of loss has remained unchallenged, primarily because

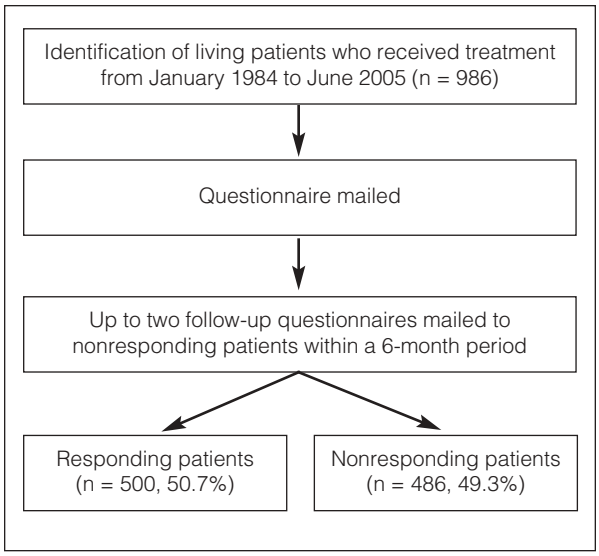

Fig 1 Methodology algorithm.

statisticians lack a better alternative.[8,9] Herrmann et al[10] examined the statistical effect of random versus selected withdrawal of patient data on the reported outcome of dental implants. Randomly withdrawing up to 50% of data from 487 patients did not influence the calculated Kaplan-Meier cumulative survival rate. However, selective withdrawal (such as removal of all the mandibular implants) from the data set resulted in a significant difference.

In a study of 1,405 TMD patients, 62.3% of 367 total dropouts were subsequently located.[6] These dropouts gave many reasons for discontinuing the study, including environmental obstacles (family commitments, incapacity, appointment time, access to facility), perceived improvement in symptoms, and dissatisfaction with treatment. Joshi et al,[7] from their study on 100% of patients lost to follow-up in the orthopedic literature, found that patients did not attend further appointments for reasons including: change of residence (country/state), inability to travel (infirmity/aged), dissatisfaction with the results, satisfaction with the results, and financial constraints. Deyo and Inui[1] reviewed factors associated with dropouts and broken appointments, adapting Haynes' classification of dropout determinants into eight categories including features of the patient, medical provider, disease, patient-provider interaction, therapeutic regimen, medical facility, administrative process, and access to the facility.

The literature indicates that patients who are lost to follow-up may be younger,[1,5,11,12] in a minority racial or cultural group,[5,11] have occupations involving mostly manual labor,[1,5] have a history of drug abuse,[5,11] or have a history of psychiatric admission or incarceration[5] compared to patients who are known, attend appointments, or respond to questionnaires.

In an effort to further understand patients lost to follow-up, this study aimed to analyze the demographic and prosthodontic treatment differences between patients who responded to and patients who did not respond to a mailed questionnaire regarding their prosthodontic treatment. The results of the questionnaire will be not be analyzed in this paper.

Materials and Methods

All living patients who received tooth- and implant-related fixed prosthodontic treatment between January 1984 and June 2005 (n = 986) in one private prosthodontic practice were sent a questionnaire regarding satisfaction with their treatment. Patients who did not initially respond were sent up to two follow-up requests within a 6-month period (Fig 1). The prosthodontic practice accepts referred private patients of nonspecific socioeconomic backgrounds. It is not related to any university or hospital facility.

Demographic data (sex, age) and treatment data (survival, type of treatment, time in situ, number of units, number of treatments) for each group were gathered from patient files and analyzed. All parameters were patient-based, not prosthesis-based. The parameters were defined as follows:

- **Sex**
- **Age**–The patient's age when the survey was mailed.
- **Survival (patient-based)**–Each prosthesis received by patients was reviewed and the outcome known within 12 months of the mailed survey. All were allocated an outcome from six fields (successful, surviving, repaired, failed, dead, or lost to follow-up).[13] Prostheses in deceased patients were excluded since patients were unable to respond to the questionnaire. In this study, a single failure, regardless of the presence of other successful prostheses, could affect a patient's willingness to respond to a mailed questionnaire. Hence, any patient who experienced a failure was classified as "failed."
- **Type of treatment**–Patients were classified as having received tooth-only treatments, implant-only treatments, a combination of tooth and implant treatments, and full-arch implant reconstructions.
- **Time in situ**–The amount of time between the issue of their first or only prostheses and the date the questionnaire was sent.
- **Time in situ (groups)**–Patients were further divided into four groups based on the time in situ (those who received their first/only prostheses 1 to 5 years, 6 to 10 years, 11 to 15 years, and 16 to 20 years from the start of the study).

Table 1 Prosthetic Units Received by Responding and Nonresponding Patients

	Responding (n = 500; 50.71%)		Nonresponding (n = 486; 49.30%)		Overall (n = 986)
	No.	%	No.	%	No.
Fixed prosthodontic units	2,702	60.02	1,800	39.98	4,502
Implant-supported single crowns	58	42.96	77	57.04	135
Tooth-supported single crowns	1,384	59.78	931	40.22	2,315
Tooth abutments	930	59.50	633	40.50	1,563
Tooth-related FDPs	386	58.13	278	41.87	664
Implant abutments	330	67.48	159	32.52	489
Implant-related FDPs	80	65.04	43	34.96	123

FDPs = fixed dental prostheses.

- **Number of units**–The number of tooth replacements (crowns, implants, pontics, and abutments) received by the patient during his or her entire treatment history at this specific practice.
- **Number of units (groups)**–Patients were further divided into five groups based on the number of tooth replacements received (those that had received 1 unit, 2 to 5 units, 6 to 10 units, 11 to 15 units, and more than 15 units).
- **Number of treatments**–The number of different treatment episodes patients experienced. Treatment commenced 6 months after the completion of the previous treatment was considered to be a new treatment episode.

Statistical Analysis

Data from responding and nonresponding patients were analyzed using the Student *t* test and Mann-Whitney test for differences in the defined parameters. Statistical significance for all data analyses was set at $P = .05$. The Kaplan-Meier method and Greenwood formula were used to estimate the cumulative survival and standard error of groups. Outcomes were analyzed per patient, not per prostheses, with a terminal event defined by the presence of a failure. Differences in estimated cumulative survival were analyzed with the log-rank test. Other values are expressed as mean ± standard deviation where appropriate. The SPSS statistical package was used for the analyses.

Results

There were 500 responding patients (50.7%) with 2,702 fixed prosthodontic units (60.02%) and 486 nonresponding patients (49.3%) with 1,800 fixed prosthodontic units (39.98%) (Table 1).

Demographic Data

A summary of the demographic data analysis can be found in Table 2. There were no significant differences in the sex distributions of responding and nonresponding patients ($Z = -0.51$, $P = .61$). Of the 500 responding patients, 309 were female (61.80%) and 191 were male (38.20%). Of the 486 nonresponding patients, 308 were female (63.37%) and 178 were male (36.63%). The age of patients at the time the questionnaire was sent ranged from 19 to 96. Responding patients were significantly older than nonresponding patients ($\mu = 59.10 \pm 13.58$; $\mu = 55.61 \pm 14.81$; $Z = -4.04$, $P < .001$).

Treatment Data

A summary of the treatment data analysis can be found in Table 2. There was no significant difference in the survival of prostheses provided for responding and nonresponding patients over the treatment period (chi-square = 2.29, $P = .13$), with a 10-year Kaplan-Meier estimated cumulative survival for responders of 92.2 ± 1.72% and nonresponders of 91.5 ± 1.92% (Fig 2).

There was no significant difference in the type of treatment received (tooth-only, implant-only, combined treatments, full-arch implant prostheses) by patients who responded to and patients who did not respond to the questionnaire ($Z = -1.18$, $P = .24$) (Fig 3).

Analysis for differences in the average time in situ of prostheses showed that responding patients had prostheses in situ for a significantly longer period of time than nonresponding patients ($\mu = 7.47 \pm 5.48$ years; $\mu = 6.50 \pm 5.21$ years; $P = .004$). Reanalysis of the data grouped into four time periods (1 to 5, 6 to 10, 11 to 15, and 16 to 20 years) also showed a significant difference between groups ($Z = -2.5$, $P = .01$) (Fig 4).

Table 2 Summary of the Statistical Analysis

	P	Significant difference	
Demographic data			
Sex	.61	No	
Age	< .001	Yes	Responding patients are significantly older than nonresponding patients
Treatment data			
Time in situ (mean)	< .001	Yes	Responding patients have had their treatment in situ for a significantly longer time than nonresponding patients
Time in situ (groups)	.01	Yes	Responding patients have had their treatment in situ for a significantly longer time than nonresponding patients
Number of units (mean)	< .001	Yes	Responding patients have had significantly more treatment units than nonresponding patients
Number of units (groups)	< .001	Yes	Responding patients have had significantly more treatment units than nonresponding patients
Number of treatments (mean)	< .001	Yes	Responding patients have had significantly more treatment episodes than nonresponding patients
Type of treatment	.21	No	
Survival (Kaplan-Meier)	.13	No	

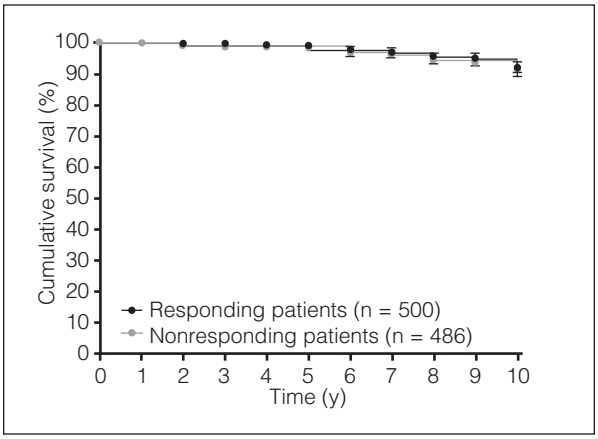

Fig 2 Kaplan-Meier estimated cumulative survival of responding (92.2 ± 1.72%) versus nonresponding (91.5 ± 1.92%) patients. Error bars represent the standard error. There was no significant difference between groups (*P* = .13).

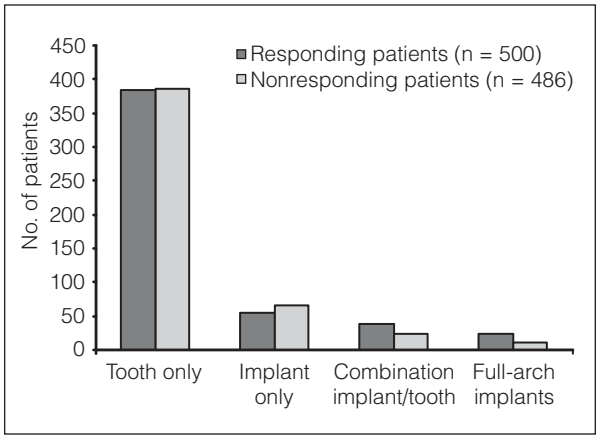

Fig 3 Type of treatment received by responding and nonresponding patients. There was no significant difference between groups (*P* = .21).

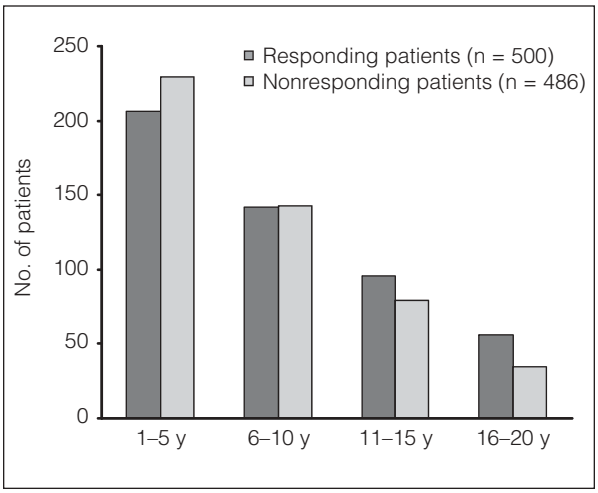

Fig 4 Number of responding and nonresponding patients who have had prostheses in situ for given time periods. Responding patients had their prostheses in situ for a significantly longer time than nonresponding patients (*P* = .01).

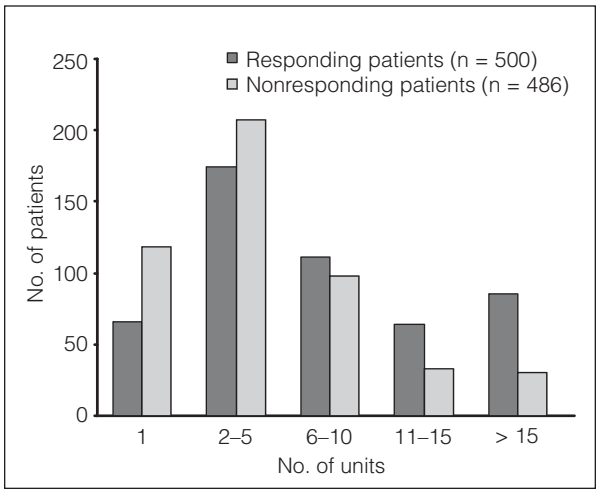

Fig 5 Number of prosthetic units received by responding and nonresponding patients. Responding patients received significantly more prosthetic units than nonresponding patients (*P* < .001).

Analysis of equality of means showed that responding patients received significantly more prosthetic units than nonresponding patients ($\mu = 8.12 \pm 7.24$; $\mu = 5.22 \pm 5.19$; $P < .001$). Reanalysis of subgroups where patients received 1 unit, 2 to 5 units, 6 to 10 units, 11 to 15 units, and > 15 units also showed that responding patients received significantly more prosthetic units than nonresponding patients ($Z = -7.12$, $P < .001$) (Fig 5). Further analysis showed that responding patients underwent significantly more treatment episodes than nonresponding patients ($\mu = 1.72 \pm 1.15$; $\mu = 1.34 \pm 0.84$; $P < .001$).

Discussion

Ideal prosthodontic treatment planning is evidence-based and reliant on accurate outcome data. Meaningful outcome data require clear definitions of survival, considered methodology, a reasonable number of patients, and a follow-up of greater than 5 years.[14] The length of the study, design of methodologic variables, and the initial inclusion of sufficient patient numbers are factors under the direction of researchers. However, the re-presentation of patients for subsequent reviews is beyond their control, with researchers reporting up to 75% loss to follow-up.[15–18] A greater understanding of the "unknown" patient would be valuable.

Reporting the profiles of this patient cohort is unique. It is limited by a narrow patient population source (one private prosthodontic practice), but it is this population source that has allowed the demographic, treatment, and survival data for both responding and nonresponding patients to be collated. Results from this study should be directly applicable to other private prosthodontic practices.

The response rate of 50.7% for this study is comparable to that reported in the literature for patient questionnaires. Stanford et al[19] reported a 43% response rate, with a 36% useable response rate, for a survey of implant therapy in an ectodermal dysplasia population. Johansson et al[12] reported a 57% response rate from Swedish adult patients when sent a questionnaire about their demographics, health, and quality of life. Yatani et al[6] reported a response rate of 62.3% in a survey of nonattending TMD patients. A single study on knee arthroplasty obtained a 100% response rate, but required the services of a private investigator to locate all patients.[7]

Researchers may hypothesize that patients responding to a mailed questionnaire are more likely to be both long-term patients and those who have received a greater amount of treatment over an extended number of years. The analysis of the responding and nonresponding groups in this study confirms these hypotheses. Statistically, patients who responded had their prosthesis in situ for a greater length of time, received more prosthetic units, and underwent more treatment episodes than nonresponding patients. The responders were also significantly older. These findings are codependent. By definition, older prostheses will be in older patients, and more treatment episodes will result in more prosthetic units. Any patient who displays one of these parameters is likely to also display another.

Multiple studies have reported that patients who do not attend follow-up appointments and those who do not respond to surveys are younger than those who do.[1,5,11] A literature review from Deyo and Inui[1] concluded that younger age correlates with higher rates of patients lost to follow-up in a variety of research settings. In this study, age as well as specific prosthodontic parameters indicated that responding patients had known the treating clinician longer than nonresponding patients. Therefore, an enhanced patient-provider rapport, rather than discrete treatment or demographic parameters, may in fact be the principal motivator for response.

Response was not related to the type of treatment. Responding and nonresponding patients were divided into subgroups of tooth-only treatments, implant-only treatments, both tooth and implant treatments, and full-arch implant reconstructions. There were no statistically significant differences in the type of treatment received by the responding and nonresponding groups. If responding was related only to variables of expense, investment of time (and multiple treatment steps), and marked improvements in function, one would expect a skewed response rate from implant patients, especially those who received full-arch fixed prostheses. However, this did not occur.

Response rate was also not related to sex. Both responding and nonresponding patients exhibited a 2/3:1/3 ratio of females to males.

Response rate was unrelated to survival, with a Kaplan-Meier 10-year cumulative estimated survival of 92.2 ± 1.72% for responding patients and 91.5 ± 1.92% for nonresponding patients. The Kaplan-Meier method uses a mathematic model to account for failed and lost to follow-up events over a defined period of time, allowing the estimated cumulative survival to be calculated. The effect of failure on patient response and attendance for follow-up review is controversial. Conclusions from the same studies are even contradictory, with some patients stating they have not attended because they were dissatisfied with their results/treatment, and others stating that they did not attend because they were very satisfied with their results/treatment and felt that further review was unnecessary.[6,7] Bias arises when one of these groups outweighs the other.[9]

Although 49.3% of the 986 patients did not respond to the mailed questionnaire at that given point in time, many had attended the prosthodontic practice for continuing treatment and maintenance reviews over the preceding years. Thus, the six-field outcome[13] of prosthetic units received by the responding and nonresponding questionnaire patients was known to within 12 months of mailing it out, and a Kaplan-Meier analysis of treatment outcomes could be completed. Statistical comparison of their estimated cumulative survivals clearly shows no significant difference. Therefore, assuming a higher failure rate in nonresponding patients is unrealistic and misleading.

Furthermore, extrapolating these findings may provide additional insight into the characteristics of patients who present for review appointments and those who become lost to follow-up during outcome research studies.

The Greenwood formula also accounts for failed and lost to follow-up events in calculating the standard error of the sample and providing information about the variance and accuracy of the reported estimated survival. An increase in number of failures and an increase in the number lost to follow-up results in a decrease in the calculated survival and an increase in the magnitude of the standard error.

The Kaplan-Meier estimate[20] and the Greenwood formula[4] are considered consistent when data are mutually independent. For outcome data, reporting the survival of individual independent prosthetic units is the main objective. However, multiple failures or successes within one patient may not be independent occurrences.[10,21,22] If dependency is likely, implant literature recommends randomly selecting a single prosthesis within a patient and following its independent outcome.[21] In this study, a single failure, regardless of the presence of other successful prostheses, could affect a patient's willingness to respond to a mailed questionnaire. For this reason the patient's outcome was not determined by one randomly selected prosthesis, but by the presence of even one single failure. Therefore, any patient experiencing a failed prosthesis was considered to be a failure for statistical analysis. This is a strict classification of failure.

Questionnaires are often the most appropriate media to assess aspects of dental treatments such as patient satisfaction. The low reported response rates for questionnaire-based survey studies in the literature have equated this study method with an apparent lack of accuracy. It has undermined the acceptance of the methodology, with questionnaire-based studies ranking low in the hierarchy of evidence.[23] Notwithstanding these criticisms, results from this study quantify some similarities and differences between patients who responded to and those that did not respond to the questionnaire, thus strengthening the veracity and validity of the unique information gained from such studies.

Conclusions

- Patient questionnaires provide valid and unique research information.
- Outcomes of prostheses in patients who did and did not respond to the questionnaire were the same.
- Treatment outcomes of patients who attend review appointments and those who are lost to follow-up cannot be assumed to be different.
- Demographic- and treatment-related characteristics of responding patients indicated that an enhanced provider-patient rapport was a principal motivator for response to the questionnaire.

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Literature Abstract

Comparison of different methods of assessing alveolar ridge dimensions prior to dental implant placement

The aim of this clinical case series study was to compare measurements before surgical flap reflection and measurements using computer cone beam computed tomography (CBCT) images with direct caliper measurements after surgical exposure of bone for dental implant placement. Sixteen patients (seven males and nine females; age range of 36 to 69 years old) with 25 sites for planned implant placement were recruited. Inclusion criteria applied were: presence of a partially edentulous ridge in the left to right second premolar regions, presence of at least one periodontally healthy and stable tooth adjacent to the edentulous ridge, a healing period of at least 3 months postextraction at site of planned implant, and a treatment plan including implant placement or ridge augmentation prior to implant placement. A clear acrylic surgical stent was fabricated from diagnostic casts. Three pairs of buccolingual measurement points, located at 4, 7, and 10 mm from the summit of the alveolar soft tissue, were marked on the casts. These reference points were transferred to the stent via guide holes that were filled with gutta percha. CBCT was performed on all subjects and images were obtained from 2-mm CT axial sections, which were then further reconstructed with the manufacturer's software. Following local anaesthesia, the stent was placed intraorally and the tips of a ridge mapping instrument were inserted into the guide holes, penetrating through soft tissues until bone contact was achieved. The width of the alveolar ridge at the various reference points was recorded to the nearest millimeter. These measurements were repeated directly on the exposed bone following surgical flap reflection. Two examiners performed the measurements. Frequency distributions of differences between pairs of measurements and the mean ± SD of these differences were calculated using individual measurement locations as the unit for calculation. Eleven out of the proposed 75 measurement positions were excluded due to interference with a shallow vestibule. When comparing ridge-mapping and direct caliper measurements, deviations within ± 1 mm occurred for 94% and 89% of the comparisons for examiner 1 and 2, respectively. When correspondingly comparing ridge width utilizing CBCT with direct caliper measurements, deviations within ± 1 mm showed 70% and 55% of comparisons for examiner 1 and 2, respectively. Deviations of ≥ 3 mm occurred in eight sites for examiner 1 and 16 sites for examiner 2. Positive value deviations for CBCT images with that of direct caliper measurements occurred more frequently than negative value deviations. The authors conclude that CBCT measurements demonstrated less favorable and consistent agreement compared to those between ridge-mapping and direct caliper measurements. However, the authors rightly suggested that clinical experience of clinicians as well as calibration between examiners could have contributed to the outcomes of the study.

Chen LC, Lundgren T, Hallstrom H, Cherel F. *J Periodontol* 2008;79:401–405. **References:** 11. **Reprints:** Dr Tord Lundgren, Department of Periodontology, College of Dentistry, University of Florida, PO Box 10034, Gainsville FL 32610. Email: tlundgren@dental.ufl.edu—*Elvin W.J. Leong, Singapore*