
Natural Tooth Intrusion Phenomenon With Implants: A Survey

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A common assumption when planning for treatment for a fixed partial denture potentially involving an osseointegrated implant is to avoid connection between the implant and natural tooth abutment because of the differences in mobility and potential long-term effects. A large population was surveyed to measure the incidence of natural tooth intrusion in implant-assisted fixed partial dentures (IAFPD) and to try to identify a correlation between type of implant and/or type of connector. Natural tooth intrusion occurred in 3.5% of the patient population specifically treated with IAFPD. No correlation could be made between incidence of intrusion and the type of implant or type of connector used.

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Implant therapy using osseointegrated implants has provided clinicians with a predictable treatment alternative for edentulous and partially edentulous patients. Early prosthodontic designs for the partially edentulous patient¹ used freestanding prostheses without incorporating a natural tooth abutment. The use of osseointegrated implants in partially edentulous patients led to a clinical dilemma: whether or not to incorporate a natural tooth as an abutment for an implant-assisted fixed partial denture. Early literature supported the use of a nonrigid connector until clinical studies could support the use of a rigid connection between the natural tooth and the implant.² The nonrigid connector was used to allow for normal tooth movement and loading in function.³ Techniques for using a nonrigid connector have been dis-

cussed in detail for different clinical implant scenarios with the disclaimer that, whenever possible, multiple implants should be placed to support a freestanding fixed implant partial denture.⁴

A published clinical report by Cho and Chee⁵ discussed restoration of complete arches using natural teeth and implants in an implant-assisted fixed partial denture. The prosthodontic design included the use of a semiprecision slot-type attachment and telescopic copings. The earliest detection of any problems occurred at the 5-month follow-up appointment, where a marginal discrepancy was noted between the coping and the suprastructure. The actual cause was unknown, but the authors believed the cause was intrusion of the natural tooth abutment.

Rieder and Parel^{6,7} reported results of a survey of natural tooth intrusion and attempted to develop possible hypotheses for the intrusion phenomenon. The four hypotheses described included disuse atrophy, debris impaction, impaired rebound memory, and mechanical binding. They provided probable causative reasons for the occurrence of apical migration of a natural tooth when connected to an ankylosed implant.

Sheets and Earthman⁸ reported the phenomenon and developed a mechanism for reversal of the natural tooth intrusion. This was based on a prosthodontic design using milled telescopic copings with a suprastructure. They noted the earliest evidence of intrusion on a patient at the 8-month follow-up. Their hypothesis was based on biomechanical principles described as a combination of sudden impact

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forces, inelastic deformation, and stress wave propagation from the implant suprastructure. They demonstrated recovery of the natural tooth to its original position, verified by return of the abutment reseated into the suprastructure from a gingival direction. Based on their analyses, they recommended a conservative approach to prosthodontic treatment, maintaining a freestanding implant prosthesis whenever possible; this directly affects treatment planning for implant surgery and subsequent prosthodontic care. Their recommendation for further studies prompted the survey reported in this article.

One previous survey (Rieder and Parel⁶) was limited in scope; only 110 selected practitioners, including both specialists and generalists, were questioned. The response rate was high (45 of 110), but the sample size was small. The authors attempted to identify the occurrence of intrusion phenomenon relative to prosthetic experience and types of attachment mechanisms used. Their overall results showed that occurrences of natural tooth intrusion fell in a range from 3 to 37% and occurred with all five of the different types of attachment mechanisms identified.

The purpose of this study was to identify the prevalence of the natural tooth intrusion phenomenon in patients of dental practitioners involved in dental implant rehabilitation. A high prevalence rate combined with other attachment type information would justify further *in vitro* and *in vivo* studies.

Materials and Methods

The survey instrument was designed as a retrospective study with a total of seven simple questions. Sample surveys were reviewed by faculty members at the University of Colorado Health Sciences Center, School of Dentistry, to clarify questions and review format. A statistician reviewed the format to ensure that the findings would be statistically valid. An introductory letter was included with the survey to define the phenomenon and the current specific implant prosthesis terminology used (implant-assisted fixed partial denture), as well as to solicit a response.

The survey targeted the broad-based membership of the Academy of Osseointegration, a membership that reflects different dental education backgrounds and interest in osseointegrated implants. The membership rosters and appropriate releases were obtained through the Academy of Osseointegration administrative services.

In June 1995, the introductory letter and survey were mailed to the 2,384 U.S. members of the Academy of Osseointegration. Two months after the initial mailing, a second mailing of 1,000 was made to members who had not responded to the first mailing. The

survey was a pilot study to determine if the members had seen the natural tooth intrusion phenomenon with implant-assisted fixed partial dentures. Additional questions asked for the type of attachment and the implant system used on the patients demonstrating the intrusion phenomenon. Another question attempted to identify how the dentist-determined intrusion had occurred.

Results

Of the 2,384 members of the Academy of Osseointegration to whom introductory letters and surveys were mailed, 775 members responded, for a response rate of 32.5%. The response rate varied from question to question, since all respondents did not answer all the questions. The raw data for each question are presented in Table 1.

Question 1: Have you provided or do you have patients with implant-assisted fixed partial dentures (IAFPD)? The response was either yes or no, along with the number of IAFPDs restored. There were 774 responses to this question: 644 (83%) said they had patients with IAFPD, while 130 (17%) said they did not.

Question 2: Have you seen the natural tooth intrusion phenomenon on any implant patients? The response to this question was either yes or no. There were 722 responses: 344 (44%) said they had seen natural tooth intrusion, while 380 (49%) said they had not. One respondent commented additionally that this had occurred in 25% of IAFPDs performed, and another that it occurred in 33% of IAFPDs performed.

When asked how many patients were affected by this occurrence, there was a wide range of responses, ranging from 1 patient to 333 patients. The total number of patients in which the phenomenon was observed was 2,786. Since some of the responses were vague, the total number could have been interpreted as being much higher; however, the most conservative interpretation was used. Although nearly half of the respondents had seen the phenomenon, it was seen in a relatively small number (2,786) of the total patients (79,806) on which IAFPDs had been restored. The overall occurrence rate was relatively low (3.5%).

Question 3: What type of attachment was used in the implant-assisted fixed partial denture? The choices for response included rigid connector, nonrigid connector, screw-type nonrigid connector, or other. There was a total of 865 responses to the above choices. The majority of those responding (377, or 44%) used nonrigid connectors. Those who used rigid connectors comprised 303 (35%) of the respondents, with only 90 (10%) of those using

Table 1 Questions and Responses to Survey of the Incidence of Natural Tooth Intrusion Phenomenon With Implants*

Question	Total no. of responses	"Yes"	Percentage
1. Have you provided or do you have patients with implant-assisted fixed partial dentures (IAFPD)? How many?	775	645	83
2. Have you seen the natural tooth intrusion phenomenon on any implant patients? How many?	723	343	44
3. What type of attachment was used in the implant-assisted fixed partial denture?	877		
Rigid connector		304	35
Nonrigid connector		388	44
Screw-type nonrigid connector		90	10
Other		95	11
4. On which implant system did you see the intrusion phenomenon?	564		
Brånemark		279	49
Calcitek		65	11
Dentsply		46	8
IMZ (with IME/IMC)		52	9
IMZ (without IME/IMC)		41	7
ITI		13	2
SteriOss		39	7
Sustain		1	0.2
Other		29	5
5. How did you realize that you may have natural tooth intrusion on this patient?	560		
Matrix/patrix (key/keyway) connector area didn't fit flush		214	38
Change in occlusal plane		127	22
Break of cementation seal		177	27
Other		43	13
6. Would you be willing to provide copies of radiographs and/or photos?	371	244	66
7. If you wish to provide additional comments, please use the back of this form.	94		

*The respondents surveyed may represent a population with preferences for particular implant systems. Attempts to correlate the data with percentage market share of all implant systems were unsuccessful, so data related to specific implant systems and the intrusion phenomenon do not render conclusive results.

screw-type nonrigid connectors. The "other" response was selected by 95 (11%) of the respondents. Those responding to the "other" category primarily used copings with telescopic crowns.

Question 4: On which implant system did you see the intrusion phenomenon? The choices for response included Brånemark (Nobel Biocare, Göteborg, Sweden), Dentsply (Dentsply, Encino, CA), ITI (Straumann, Cambridge, MA), SteriOss (Steri-Oss, Yorba Linda, CA), Calcitek (Calcitek, Sulzer Medica, Carlsbad, CA), IMZ with IME/IMC, IMZ without IME/IMC (Interpore International, Irvine, CA), Sustain (Lifecore Biomedical, Chaska, MN), or other system. There was a total of 564 responses to this question.

Of the responses, nearly half (279, or 49%) indicated that they saw the intrusion phenomenon with the Brånemark implant system. The next highest incidence was with the Calcitek system (64, or 11%),

followed by the IMZ system with IME/IMC (52, or 9%), Dentsply system (46, or 8%), IMZ without IME/IMC (41, or 7%), SteriOss system (39, or 7%), ITI system (13, or 2%), and finally the Sustain system (1, or 0.2%). Twenty-nine responses (5%) were recorded in the "other" response area and included blade-type implants, Implamed system, CoreVent, and several unidentified types.

Question 5: How did you realize that you may have natural tooth intrusion on this patient? The choices for response included matrix/patrix (key/keyway) connector area did not fit flush, change in occlusal plane, break of cement seal, and other. Of the 560 responses to this question, the majority of natural tooth intrusion phenomenon was recognized by the matrix/patrix not fitting flush (213, or 38%). The next most common occurrence was breakage of the cement seal (149, or 27%), followed by changes in the occlusal plane (126, or 22%). Some

respondents marked the "other" category (72, or 13%). However, after careful examination of the comments in this section, 28 of the responses should have been in the "break of cementation seal" category and 1 in the "matrix/patrix (key/keyway) connector area didn't fit" category. Moving these responses to the appropriate categories increased the number of responses in the "break of the cementation seal" category to 177 (32%), reducing the "other" responses to only 43 (8%). The remaining responses in the "other" category predominately identified intrusion using radiographs (32, or 6%), with the remaining responses divided among visual observation, tooth or implant fracture, and tooth mobility.

Question 6: Would you be willing to provide copies of radiographs and/or photos? This was a yes-or-no response, with 244 (66%) responding yes and 127 (34%) responding no.

Question 7: If you wish to provide additional comments, please use the back of this form. Some of the comments were not applicable to the study subject. Of the 94 applicable responses, 27% stated they did not use implant-assisted fixed partial dentures because they saw intrusion occurring in early cases and now avoid this type of implant prosthodontic treatment.

Discussion

The response rate of 32.5% for this survey can be considered statistically valid when determining significance of data for each question. In general, other types of surveys conducted had response rates ranging from 25% to 90%, with the American Dental Association achieving a response rate of 25% for mass mailing to members.⁹ One review of multiple articles specifically trying to identify nonresponse rates to surveys reported a range of response rates falling between 33% and 92%.¹⁰ Hence, the response rate was within the average for large dental mailings.

The survey was designed to identify the prevalence of the natural tooth intrusion phenomenon. The results showed an occurrence rate of 3.5%. The survey conducted by Rieder and Parel⁶ found a large variation in occurrence rates, ranging from 3% to 27%, directly related to the experience level of the practitioners. At only 45, the population that responded in the Rieder and Parel survey was small. By identifying the practitioners for their survey, they attempted to avoid duplicating patient data. The population used for the present survey did *not* account for possible duplication of responses by the respondents, but did sample a very large group. The members of the Academy of Osseointegration include academicians, clinicians, prosthodontists, general

practitioners, oral and maxillofacial surgeons, and periodontists. Most respondents not involved directly with restoration did not respond or returned the survey stating that they did not do the restorative portion of implant treatment, or forwarded their copy of the survey to their restorative dentist.

In quantifying the number of implant-assisted fixed partial dentures done, an additional question was included as a follow-up to question 1. When asked how many IAFPDs had been done, most respondents were fairly precise, while others gave a more general response. If a number could be assigned to the response, it was included in the total. If the response was too general to assign a number, the response to this part of the question was dropped from the study. A conservative estimate of the number of units involving IAFPD reported by the respondents, using the above criteria, was 79,807. Although this represents an average of 124 per respondent, the number reported varied from as low as 1 to as high as 7,500 for two respondents, demonstrating a very wide range of experiences. This interpretation was difficult because of the limited confusion as to whether the number reported referred to individual patients, actual number of implants placed, or the number of IAFPDs placed.

When the respondents identified the number of patients that experienced the natural tooth intrusion phenomenon, the responses were interpreted conservatively at 2,786, although the actual number of patients would be higher if vague responses were not disqualified, marginally increasing the occurrence rate.

It was not possible to directly correlate a specific implant type with the natural tooth intrusion phenomenon. Although the Brånemark implant system showed the largest number of intrusions (49%), followed by the IMZ implant system (16%), this result is probably more reflective of the relative popularity of the systems used rather than a system problem. Additional data regarding market share would have been helpful in interpreting system prevalence, but such information is proprietary and thus not available. Also, the practitioners surveyed may reflect a population that favors the use of a specific implant system.

The majority of respondents (38%) determined intrusion of the natural tooth abutment by the fit, or rather lack of precise fit, of the nonrigid connector, with 32% noting the phenomenon by breakage of the cement seal on the natural tooth abutment. Visual inspection and evaluation during clinical examination must be an important aspect of the implant maintenance protocol, since radiographic evidence (6%) was limited.

When asked for additional comments, many respondents offered invaluable information that could not be quantified but will be useful for future research. One practitioner provided evidence of natural tooth intrusion of the natural teeth opposing an implant-supported partial denture. Another practitioner associated the natural tooth intrusion phenomenon with telescopic-type prostheses, not with the implant itself. Multiple responses stated the need to avoid attaching implants to natural teeth.

The results of this survey and the strength of written comments create further questions for development of research projects to test possible theories.

Conclusion

This survey found a 3.5% occurrence rate of the natural tooth intrusion phenomenon in implant-assisted fixed partial dentures. The results demonstrated that the intrusion phenomenon is as likely to occur with nonrigid as with rigid connectors. The occurrence rates for screw-type nonrigid connectors and "other"—specifically, telescopic coping design—were less than the other categories, but occurred nonetheless. There was insufficient evidence to correlate the intrusion phenomenon with a specific implant system.

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