Short Communication

Implant Prostheses and Adjacent Tooth Migration: Preliminary Retrospective Survey Using 3-Dimensional Occlusal Analysis

Hua Wei, DDS, PhD[a]/Yoritoki Tomotake, DDS, PhD[b]/Kan Nagao, DDS, PhD[c]/Tetsuo Ichikawa, DDS, PhD[d]

Occlusal force analysis was retrospectively evaluated to clarify the proximal contact loss after fixed implant prosthesis placement. Twenty-eight patients (55 prostheses) with fixed implant prostheses in the posterior region were divided into 2 groups: proximal contact loss and unchanged groups. The occlusal force and its distribution were 3-dimensionally measured using the Dental Prescale system. A high proportion of lingual and anterior component forces and high occlusal force distribution in the intercanine region were observed in the contact loss group. The high occlusal force of the adjacent tooth may enhance the mesial migration. *Int J Prosthodont 2008;21:302–304.*

Proximal contact loss between the adjacent natural tooth and a fixed implant prosthesis can be experienced during treatment, especially in the case of posterior prostheses after implant placement. Since the implant prostheses are fixed in the jawbone, contact loss is most likely caused by mesial migration of the anterior adjacent tooth. It could be considered that there is some reason beyond the natural mesial drift after implant prostheses delivery, since contact loss is not often observed in the natural dental arch.[1,2]

Three-dimensional (3D) occlusal force analysis, periodontal status, and masticatory habits were retrospectively evaluated in volunteers with fixed posterior implant prostheses to evaluate this phenomenon of contact loss.

[a]Visiting Researcher, Peking, China.
[b]Lecturer, Department of Oral & Maxillofacial Prosthodontics and Oral Implantology, University of Tokushima, Institute of Health Biosciences, Tokushima, Japan.
[c]Assistant Professor, Department of Oral & Maxillofacial Prosthodontics and Oral Implantology, University of Tokushima, Institute of Health Biosciences, Tokushima, Japan.
[d]Professor and Chairman, Department of Oral & Maxillofacial Prosthodontics and Oral Implantology, University of Tokushima, Institute of Health Biosciences, Tokushima, Japan.

Correspondence to: *Dr Tetsuo Ichikawa, Department of Oral & Maxillofacial Prosthodontics and Implantology, University of Tokushima, Institute of Health Biosciences, 3-18-15 Kuramoto, Tokushima 770-8504, Japan. E-mail: ichi@dent.tokushima-u.ac.jp*

Materials and Methods

Figure 1 shows the procedure of 3D occlusal force analysis.[3] The occlusal contact areas were recorded with black silicone. The occlusal contact areas on the cast were marked according to the results of occlusal black silicone. The occlusal force value corresponding to the occlusal facet of the cast was acquired from Dental Prescale and Occluzer recording material (GC).[4] The 3D coordinates of occlusal facets of the casts were measured with a desktop digitizing system. After force values were assigned, the anterior, lingual, and downward components of occlusal force and occlusal force distribution were calculated. The reproducibility of this procedure was validated by multiple measurements for 1 subject.

Twenty-eight patients (55 posterior fixed implant prostheses) were serially selected during a fixed period. The following clinical examinations were recorded at every 3-month checkup: implant mobility, gingival condition, tooth mobility, occurrence of bruxism, and the preferred mastication side. When the prosthesis was first delivered, the contact tightness was adjusted so that a 50-μm metal strip could be inserted with appropriate resistance, in the same manner as placing a conventional crown. The patients were categorized into 2 groups for statistical analysis: *(1)* the unchanged group, which showed the same proximal contact tightness as during the delivery, and *(2)* the contact loss group, which showed a loss of primary contact tightness and had an interproximal distance over 50 μm (the metal strip could be inserted easily).

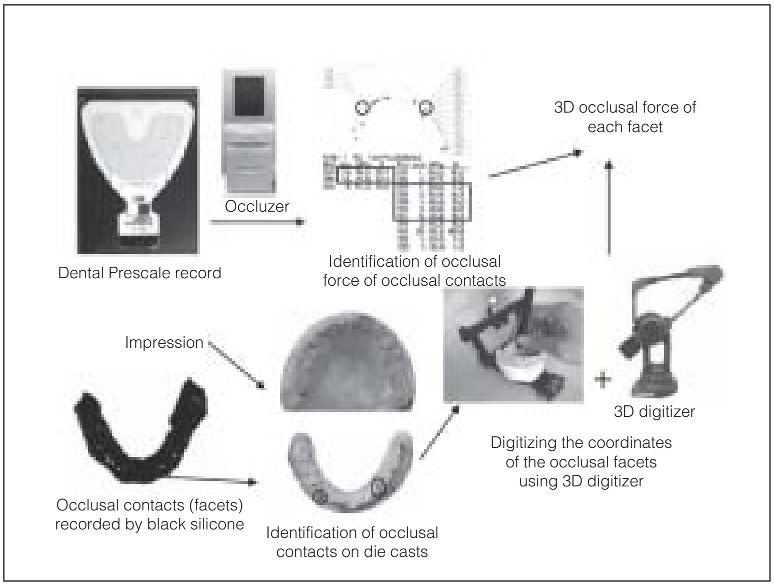

Fig 1 Experiment setup for 3D evaluation of the occlusal force.

Table 1 Distribution of Prostheses and Incidence of Proximal Contact Loss*

Prosthesis span	Maxilla	Mandible	Total
Within molar (posterior to second premolar)	8 (4)	17 (9)	25 (13)
Posterior (first premolar to molar)	7 (6)	19 (11)	26 (17)
Anterior to molar (beyond canine)	3 (2)	1 (0)	4 (2)
Total	18 (12)	37 (20)	55 (32)

*Number in parentheses represents the prostheses showing proximal contact loss.

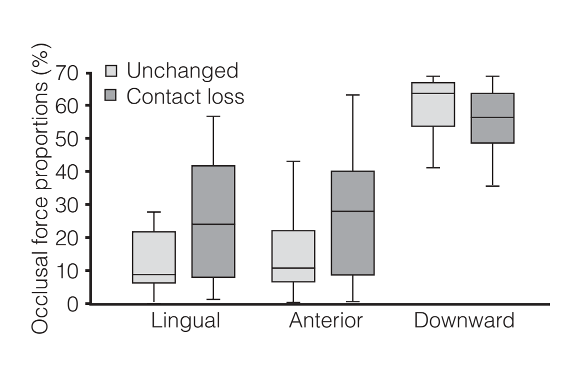

Fig 2 Three-dimensional vector components of occlusal force proportions on the tooth adjacent to the implant prosthesis.

Table 2 Factors Affecting Proximal Contact Loss

Group	Age (y)	Postdelivery period (y)*	Occlusal force (N)	Intercanine region: Occlusal contact area (mm^2)	Intercanine region: Occlusal average pressure (MPa)*	Intercanine region: Occlusal force (N)*	Intercanine region relative to dental arch: % of contact area*	Intercanine region relative to dental arch: % of occlusal force*
Unchanged	56.7 ± 4.5	1.28 ± 0.9	737.4 ± 325.9	2.21 ± 2.04	22.60 ± 15.06	54.09 ± 49.79	10.0 ± 0.9	8.2 ± 7.0
Contact loss	58.6 ± 6.5	2.2 ± 1.1	770.1 ± 321.7	3.82 ± 3.19	34.74 ± 7.37	118.19 ± 86.58	18.4 ± 10.9	17.7 ± 10.2

*Statistically significant difference between groups ($P < .05$).

Results

The chi-square test indicated no significant differences between the loss of proximal contact and the location of the prosthesis (Table 1). Implant, periodontal, and masticatory conditions of all participants were well controlled. The proximal contact loss was not statistically affected by age and occlusal force; however, the proximal contact loss worsened significantly over time (Table 2).

Within the implant prostheses located posterior to the canine, the contact loss group showed significantly higher occlusal force in the intercanine region than the unchanged group. Although there were no significant differences found between the 2 groups, higher proportions of lingual and anterior component forces were observed in the contact loss group (Fig 2).

Discussion

Proximal contact loss was observed in more than 50% of the sampled cases. The earliest occurrence was found 3 months after prosthesis delivery. Generally, Asian people have poor jawbone morphology for implant placement. The present study was conducted with the assumption that the proximal contact loss is caused by occlusal force.

No significant differences were found between the 2 groups, except regarding occlusal components. It is thought that the results of 3D occlusal analysis—trends toward a higher proportion of lingual and anterior component forces with contact loosening and high occlusal force distribution in the intercanine region—result in higher mesial force vector; therefore, this is considered to drive the anterior teeth forward and to result in the spacing anterior to the implant prosthesis.[5] Application of unfavorable loading forces results in early failure of implants.[1] According to the overall results, it is necessary to evaluate the occlusal force distributed to the remaining teeth and to the implant prosthesis during delivery.[2]

Conclusion

Proximal contact loss may be caused by inevitable occlusal contact with overstressing residual teeth.

References

1. Gothberg C, Bergendal T, Magnusson T. Complications after treatment with implant-supported fixed prostheses: A retrospective study. Int J Prosthodont 2003;16:201–207.
2. Kim Y, Oh TJ, Misch CE, Wang HL. Occlusal considerations in implant therapy: Clinical guidelines with biomechanical rationale. Clin Oral Implants Res 2005;16:26–35.
3. Hattori Y. Occlusal diagnosis from biomechanical aspect [in Japanese]. J Jpn Prosthodont Soc 1999;68–71.
4. Matsuyama M, Tsukiyama Y, Tomioka M, et al. Clinical assessment of chewing function of obturator prosthesis wearers by objective measurement of masticatory performance and maximum occlusal force. Int J Prosthodont 2006;19:253–257.
5. Wolpoff MH. Interstitial wear. Am J Phys Anthropol 1971;34: 205–228.

Literature Abstract

Bone level changes at axial- and non-axial positioned implants supporting fixed partial dentures. A 5-year retrospective longitudinal study

This retrospective study analyzed the influence of implant inclination on marginal bone loss at freestanding, implant-supported fixed partial dentures (FPDs) over a 5-year period of functional loading. Thirty-eight partially dentate, periodontally compromised patients with 42 freestanding FPDs supported by 111 Astra implants were included. Twenty-four implants (57%) were placed in the maxilla. Fifteen FPDs were supported by 2 implants, and 27 FPDs were placed on 3 implants. Twenty-two (52%) FPDs were designed with a cantilever extension. All implants had a diameter of 3.5 mm, while the length varied between 8 and 19 mm. Standardized photographs were taken for implant inclination measurements. The first was taken at the implant sites of the occluded original master casts, the second was taken with guide pins abutment pick-up in place, and the third was obtained when the second image was superimposed with precision on the first image. The third photograph showed the image of the 2 casts in occlusion with the guide pins revealing the inclination of the implants in relation to the occlusal plane. The inclination in the mesiodistal direction of each individual implant, in relation to a vertical axis perpendicular to the occlusal plane, was measured. For cases with an FPD supported by 2 implants, an additional photograph of the cast with the guide pins in place was taken in a transversal direction. Assessments of the interimplant inclination in both mesiodistal and buccolingual directions were performed. The methodologic error of the whole recording procedure and the interexaminer reproducibility for inclination assessments were determined. The marginal bone level in relation to the marginal edge of the implant was assessed using standardized radiographs. It was shown that the axial-positioned implants had a mean angulation of 2.4 degrees, while the mean value for non-axial-positioned implants was 17.1 degrees. The mean bone loss during the 5 years in function was 0.4 mm (SD: 0.97) and 0.5 mm (SD: 0.95) for the axial- and non-axial-positioned implants, respectively. Thirty-nine percent of the axial-positioned implants demonstrated no bone loss after 5 years in function, compared with 37% of the axial-positioned implants. Thirty percent of the axial-positioned and 33% of the non-axial-positioned implants showed more than 1 mm peri-implant bone loss. No statistically significant differences in marginal bone change were found between axial- and non-axial-positioned implants. The interimplant inclination for FPDs supported by 2 implants varied between 1 and 36 degrees (mean: 7.4 degrees, SD: 8.8) in mesiodistal direction and between 0 and 24 degrees (mean: 6.9 degrees, SD: 7.3) in buccolingual direction. No significant correlations were found between interimplant inclination and 5-year bone level changes. The findings of the study with moderately tilted implants (≤ 30 degrees) indicated that a tilted position did not increase the risk for bone loss during functional loading. However, the results may not be extrapolated to single implant replacements because of different loading conditions.

Koutouzis T, Wennstrom JL. *Clin Oral Implants Res* 2007;18:585–590. **References:** 36. **Reprints:** Dr Jan L. Wennstrom. Department of Periodontology, Institute of Odontology, The Sahlgrenska Academy at Goteborg University, Box 450, SE 405 30 Goteborg, Sweden. E-mail: wennstrom@odontologi.gu.se—*Huong Nguyen, Singapore*