

## Removable Partial Denture on Osseointegrated Implants and Natural Teeth

Li-Ching Chang, DDS, MS; Jen-Chyan Wang<sup>1</sup>, DDS, MS; Chi-Cheng Tasi<sup>2</sup>, DDS, PhD

Implants have been designed to provide edentulous patients with fixed prostheses or overdentures. Recently, implant-supported fixed partial prostheses and single crowns have become successful treatment alternatives to removable and fixed partial dentures. However, few researchers have examined “removable partial dentures on implants and natural teeth”. In this article, we report two patients fitted with “removable partial dentures on implants and natural teeth”. The patients were satisfied with their dentures in terms of function and aesthetics. Regular follow-up visits revealed that the periodontal and peri-implant conditions were stable. There was no evidence of excessive intrusion or mobility of the teeth, nor were any visible changes in the bone levels of the natural teeth or implants noted on radiographs. Since the average duration of observation was about 38 months, further follow-up examinations are necessary to determine whether these dentures remain stable long term. (*Chang Gung Med J 2007;30:274-9*)

**Key words:** implant, removable partial denture

After the use of osseointegrated implants was first reported, numerous basic studies and clinical reports related to implants were published. With regard to partial edentulism, some dentists design fixed prostheses with a combination of implants and natural teeth in addition to implant-supported fixed partial dentures (FPD). However, because of the osseointegration between implants and bone without periodontal ligaments (PDLs) which are present on natural teeth, the movements of implants and natural teeth after loading may be different. Therefore, despite the number of studies in the literature, no conclusions can be made regarding whether this design is proper.<sup>(1-4)</sup>

Implants are expensive and therefore many patients cannot afford them, particularly those with large edentulous areas. For reconstruction among these patients, fixed-type prostheses usually require

more implants for support than removable prostheses. In addition, these patients may require several surgeries to increase bone mass, thus making the entire treatment extraordinarily expensive and complicated. However, if a traditional removable partial denture (RPD) is used, insufficient retention may induce problems.

In order to offer patients affordable prostheses with better retention, we have designed removable partial dentures supported by a combination of implants and natural teeth. Jennings et al. stated that “the principles for the use of both retentive anchors and bar abutments in this situation (removable partial denture) are similar to those for complete overdentures,”<sup>(5)</sup> and Brudivik suggested that implants were the most appropriate for canine and/or molar positions.<sup>(6)</sup> Related clinical reports<sup>(7-11)</sup> are sparse in the literature, however, the majority of presenting cases

---

From the Department of Dentistry, Chang Gung Memorial Hospital, Chiayi, Chang Gung University College of Medicine, Taoyuan, Taiwan; <sup>1</sup>Department of Prosthodontics, <sup>2</sup>Graduate Institute of Dental Sciences, Kaohsiung Medical University College of Dental Medicine, Kaohsiung, Taiwan.

Received: Dec. 2, 2005; Accepted: Oct. 24, 2006

Correspondence to: Dr. Li-Ching Chang, Dental Department of Chang Gung Memorial Hospital, 6, W. Sec., Jiapu Rd., Puzih City, Chiayi County 613, Taiwan (R.O.C.) Tel.: 886-5-3621000 ext. 2277; Fax: 886-5-3621000 ext 2279; E-mail: liching@ms39.hinet.net

of posterior implants for distal extension removable prostheses.<sup>(7,8,11)</sup>

In this report, we present two cases in which removable partial dentures are supported by both implants and natural teeth. Clinical and radiographic changes for implants and natural teeth at least 36 months after functional loading are reported.

## CASE REPORTS

Two patients who suffered from mobile teeth and biting pain were referred from local dental clinics. Case 1 was a 41-year-old, systemically healthy female patient. Case 2 was a 47-year-old male patient with well-controlled Diabetes Mellitus. The initial clinical findings of two patients are listed in Table 1. The oral examinations of the two cases revealed severe periodontitis, multiple missing teeth and ill-fitting bridges.

After the periodontal treatment (including extraction of useless teeth, removal of ill-fitting bridges, interim denture fabrication, and so on), prosthodontic treatment options were presented and discussed with the patients. The final prosthodontic treatment modalities are shown in Tables 1 and 2. A guided bone regeneration (GBR) procedure was performed using an autogenous bone graft and BioMend extend membrane in Case 1. For retention of remov-

able partial dentures, I-bar clasps (Case 2), an embrasure clasp (Case 1), and ball attachments (Cases 1 and 2; O-ring attachment, 3 i Implant Innovations Inc. U.S.A.) were used. The implant system used was 3i Osseotite.

The two cases were similar, with missing teeth on the left quarter of the mandibular arch. However, different designs were used because of economic

**Table 2.** Summary of the 2 Cases of Removable Partial Dentures on Osseointegrated Implants and Natural teeth

Case No.	1	2
Site	Mandible	Mandible
Kennedy		
Classification	Class II	Class II→III
Implants	No 22 3i, Osseotite	No 19,23 3i, Osseotite
Retention		
Natural teeth	Embrasure clasp	I-bar
Implants	O-ring	O-ring
Support	Mucosa, Teeth	Mucosa, Teeth, Implant
Occlusion	RPD to RPD	Natural Dentition to RPD
Observation		
Period (months)	39	36

**Abbreviation:** RPD: removable partial denture

**Table 1.** Characteristics of the 2 Cases of Removable Partial Dentures on Osseointegrated Implants and Natural Teeth

Case	Age/gender	Initial clinical findings	Treatment modality	Follow-up
1	41/F	Missing-Nos 1-5,16,17-27,32 Ill-fitted bridge with advanced periodontitis-Nos 11-16 Metal crown-No 14 Lower arch with ID	Implant and GBR-No 22 Ball attachment-No 22 Lower arch- RPOD Upper arch- Nos 11-16 extraction, ID then final RPD	every 3 months
2	47/M	Missing-Nos 1-3,16,17,32 Ill-fitted bridge-Nos 18-31 Advanced periodontitis-Nos 14, 20-23, 26 Angle's Class I	Extraction-Nos 14,20-23,26 Removal of bridge-Nos 27-31 Implant-Nos 19,23 Lower arch- ID then RPOD Ball attachment-Nos 19,23 Survey crown-Nos 27-29 Crown resection- No 31 Upper arch- No further prosthodontic treatment	every 6 months

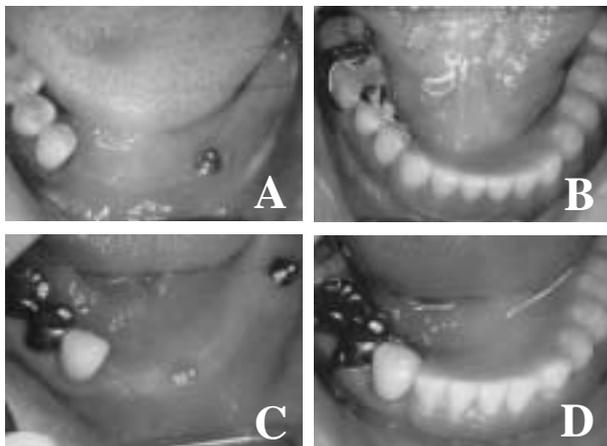
**Abbreviations:** RPOD: Removable partial overdenture; ID: intermediate denture; RPD: removable partial denture.

considerations. After implantation (one implant site: canine position), Case 1 remained in Kennedy Class II (Figs. 1A and 1B), whereas Case 2 (2 implant sites: Lateral incisor and first molar) moved from Kennedy Class II to Kennedy Class III (Figs. 1C and 1D). For these two cases, the opposing occlusion was natural teeth, and the bone loss of the implants was negligible (Fig. 2 and Fig. 3).

Both patients were satisfied with their dentures in terms of function and aesthetics. Regular 3-month follow-up visits revealed that the periodontal and peri-implant conditions were stable. There was no excessive intrusion or mobility of the teeth, nor were any visible changes in the bone levels of the natural teeth or implants noted on radiographs.

## DISCUSSION

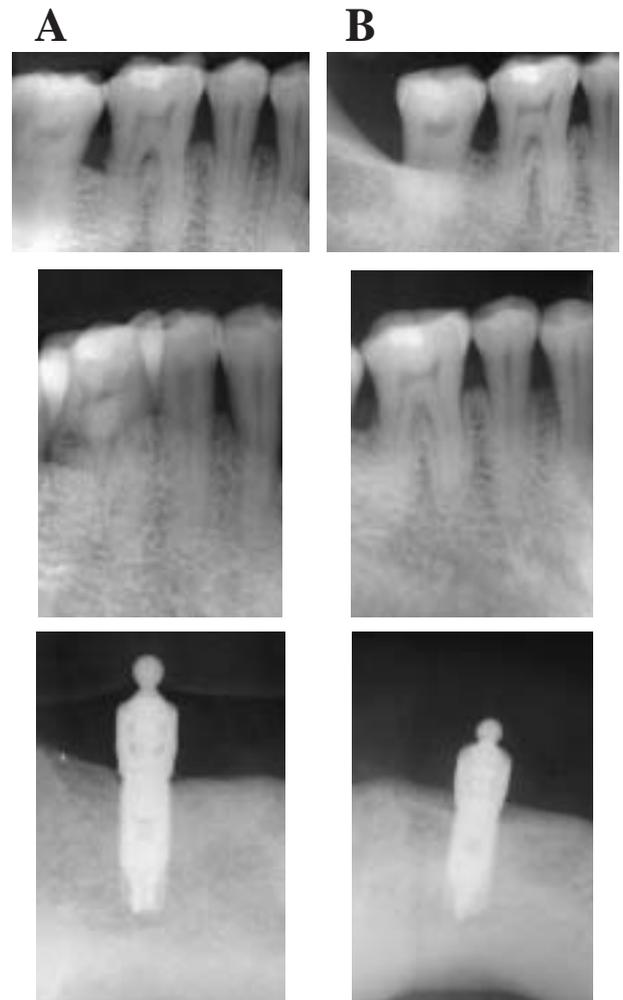
When combining implants and natural teeth in the design of fixed partial dentures, the greatest concerns are implant overload and natural tooth intrusion. Therefore, this design should be avoided. If this design must be used, a natural tooth with little mobility should be chosen for the combination.<sup>(1-4)</sup> However, to date, few cases of removable partial denture with implants and natural teeth have been reported. Moreover, Mitrani et al. (2003) reported that the mean bone loss of the posterior implants for distal extension removable prostheses is less than 1 mm after functional loading, but the mean bone loss



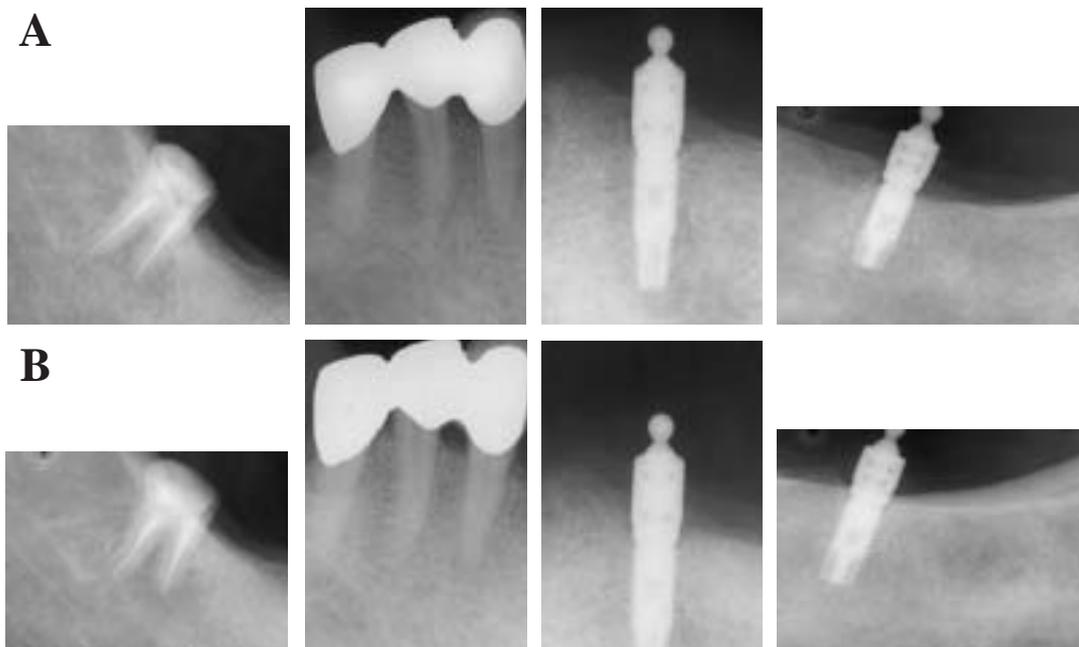
**Fig. 1** The clinical results after prosthetic treatments: (A) without RPD insertion in case 1 patient; (B) with RPD insertion in case 1 patient; (C) without RPD insertion in case 2 patient; (D) with RPD insertion in case 2 patient.

of implants used solely as a vertical stop is less than that of implants using resilient attachments.<sup>(11)</sup>

Brudvik noted that the appropriate position for the implants was on the molar (to prevent the distal free end) and canine positions (to provide vertical support and retention when the lateral incisor is the only choice for terminal abutment).<sup>(6)</sup> When the dental condition is classified as Kennedy Class III or IV, the implants can be used as overdenture abutments, combined with some attachments to provide retention.<sup>(6)</sup> When the implants are connected with other attachments (such as conventional clasping on other teeth or precision milled crowns), the lateral stability and retention can be enhanced. When a single



**Fig. 2** The radiographic follow-up after prosthetic treatment in Case 1: (A) post-loading one month; (B) post-loading 24 months.



**Fig. 3** The radiographic follow-up after prosthetic treatment in Case 2: (A) post-loading 6 months ; (B) post-loading 24 months.

implant abutment is used on a removable partial denture, the use of extracoronary attachments (such as an O-ring) is indicated. On the other hand, stress relief should be considered in the application of intracoronary attachments (such as resilient wire).<sup>(6)</sup>

Cases 1 and 2 were similar in that both of them had missing teeth on the left quarter of the mandibular arch. Different designs were used owing to economic considerations. After implantation (one implant in the left mandibular canine position), Case 1 remained in Kennedy Class II, whereas Case 2 (2 implants in left mandibular lateral incisor and first molar positions) changed from Kennedy Class II to Kennedy Class III. For these two cases, the opposing occlusion was natural teeth, but the bone loss around the implants was negligible after 3 years of functional loading. The significant amounts of time and money needed to resolve selected cases with prosthetic complications, as is done for implant-retained mandibular overdentures, are not required.<sup>(12,13)</sup> These two cases required realignment and O-ring replacement only twice.

These two implants (3i, Osseotite) on the left mandible were attached with ball attachments instead of bar attachments, which were originally proposed for Case 2. The main reason for this change was that

both attachments had similar stability, but the former was easier to manipulate.<sup>(14,15)</sup> In addition, ball attachments can share loads across broader areas of mucosa and decrease the stress on the peri-implant bone.<sup>(16,17)</sup> Although, in some reports, no differences were found between these two types of attachment in surrounding bone loss and mucosal health, bar attachments may require more repairs.<sup>(18-20)</sup> When vertical space is limited, the Locator can be used as a new alternative (3 i Implant Innovations Inc. U.S.A.).

The two patients were satisfied with their dentures in terms of function and aesthetics. Regular follow-up visits revealed that the periodontal and peri-implant conditions were stable; there were no excessive intrusions or mobility problems of the teeth; and no visible changes in the bone levels of the natural teeth and implants were noted on radiographs. Since the duration of the observation was only about 38 months, further follow-up visits are necessary to determine whether these dentures remain stable over the long term.

Because the structures of implants and natural teeth are different, their mobility also differs. If it is possible, attempts to include both implants and natural teeth in prostheses should not be made. If the

combination of implants and natural teeth is necessary, overloading of implants and intrusion of natural teeth should be monitored carefully. In the cases presented above, most supportive forces were born by the teeth and mucosa, whereas the implants provided mainly retention, so that overloading was less likely. In addition, the natural teeth, which were used as the supportive component, were quite stable (mobility grade 0 or 1). Consequently, there was little chance for intrusion to occur. This case report was presented because discussion of applying implants on removable partial dentures is limited in the literature. However, our follow-up duration was short (36-39 months), so further follow-up observations are required to determine the long-term effects of this design.

## REFERENCES

1. Weingerg LA, Kruger B. Biomechanical considerations when combining tooth-supported and implanted prostheses. *Oral Surg Oral Med Oral Pathol* 1994;78:22-7.
2. Schlumberger TL, Bowley JF, Maze GI. Instruction phenomenon in combination tooth-implant restorations: a review of the literature. *J Prosthet Dent* 1998;80:199-203.
3. Ochiai KT, Ozawa S, Caputo AA, Nishimura RD. Photoelastic stress analysis of implant-tooth connected prostheses with segmented and nonsegmented abutments. *J Prosthet Dent* 2003;89:495-502.
4. Lin CL, Wang JC. Nonlinear finite element analysis of a splinted implant with various connectors and occlusal forces. *Int J Oral Maxillofac Implants* 2003;18:331-40.
5. Jennings KJ, Critchlow HA, Lilly P, Broad MT. The clinical use of ITI transmucosal implants. *British Dent J* 1992;25:67-71.
6. Brudvik JS. Advanced removable partial denture. 1st ed. Illinois: Quintessence, 1999:153-9.
7. Keltjens H, Kayser A, Hertel R, Battistuzzi P. Distal extension removable partial dentures supported by implants and residual teeth: Considerations and case reports. *Int J Oral Maxillofac Implants* 1993;8:208-13.
8. Giffin KM. Solving the distal extension removable partial denture base movement dilemma: A clinical report. *J Prosthet Dent* 1996;76:347-9.
9. Starr NL. The distal extension case: an alternative restorative design for implant prosthetics. *Int J Periodontics Restorative Dent* 2001;21:61-7.
10. Chang LC, Tsai CC. Removable partial denture on osseointegrated implants and natural teeth: two cases report. *Chin J Periodontol* 2002;7:127-38.
11. Mitrani R, Brudvik JS, Phillips KM. Posterior implants for distal extension removable prostheses: A retrospective study. *Int J Periodontics Restorative Dent* 2003;23:353-9.
12. Goodacre CJ, Bernal G, Rungcharassaeng K, Kan JYK. Clinical complications with implants and implant prostheses. *J Prosthet Dent* 2003;90:121-32.
13. Chaffee NR, Felton DA, Cooper LF, Palmqvist U, Smith R. Prosthetic complications in an implant-retained mandibular overdenture population: initial analysis of a prosthetic study. *J Prosthet Dent* 2002;87:40-4.
14. Setz JM, Wright PS, Ferman AM. Effects of attachment type on the mobility of implant-stabilized overdentures - an in vitro study. *Int J Prosthodont* 2000;13:494-9.
15. Palmer RM, Smith BJ, Howe LC, Palmer PJ. Implant denture prosthodontics. In Palmer RM, Smith BJ, Howe LC, Palmer PJ, eds. *Implants in clinical dentistry*. 1st ed. London: Martin Dunitz Ltd, 2002:215-34.
16. Menicucci G, Lorenzetti M, Pera P, Preti G. Mandibular implant-retained overdenture: finite element analysis of two anchorage systems. *Int J Oral Maxillofac Implants* 1998;13:369-76.
17. Kenney R, Richards MW. Photoelastic stress patterns produced by implant-retained overdentures. *J Prosthet Dent* 1998;80:559-64.
18. Gotfredsen K, Holm B. Implant-supported mandibular overdentures retained with ball or bar attachments: a randomized prospective 5-year study. *Int J Prosthodont* 2000;3:125-30.
19. Oetterli M, Kiener P, Mericske-Stern R. A longitudinal study on mandibular implants supporting an overdenture: the influence of retention mechanism and anatomic-prosthetic variables on periimplant parameters. *Int J Prosthodont* 2001;14:536-42.
20. Payne AG, Solomons YF. The prosthodontic maintenance requirements of mandibular mucosa- and implant-supported overdentures: a review of the literature. *Int J Prosthodont* 2000;13:238-45.

## 牙科植體應用於部分活動義齒設計之病例報告

張儷卿 王震乾<sup>1</sup> 蔡吉政<sup>2</sup>

自從 Branemark 將人工牙根開始應用於全口無牙之病患後，有關人工牙根的各式各樣研究與病例報告便多得不勝枚舉；比如：部分缺牙區或單顆缺牙區利用人工牙根來恢復功能與美觀，單顎無牙或全口無牙患者使用人工牙根之固定或活動義齒設計來做全口重建。不過在這麼多的文獻中，對於人工植體 (implant) 與自然齒 (natural tooth) 的合併應用之探討，大多著墨於固定補綴的膺復方式，然而有關部分活動義齒設計，同時應用人工牙根與自然齒的報告，卻是寥寥無幾。本病例報告即提出兩例有關“部分活動義齒 (RPD) 同時應用人工牙根與自然牙”之短期觀察結果；在約三年觀察時間中發現不論是臨床或放射線檢查，人工牙根與自然牙的狀況都十分穩定。至於此設計方式的長期療效如何，則需要進一步的觀察追蹤。(長庚醫誌 2007;30:274-9)

**關鍵詞：**部分活動義齒，人工牙根

---

長庚紀念醫院 嘉義院區 牙科；長庚大學 醫學院；高雄醫學大學 牙醫學院 <sup>1</sup>補綴科，<sup>2</sup>牙醫學研究所

受文日期：民國94年12月2日；接受刊載：民國95年10月24日

通訊作者：張儷卿醫師，長庚紀念醫院 牙科。嘉義縣613朴子市嘉朴路西段6號。Tel.: (05)3621000轉2277; Fax: (05)3621000轉2279; E-mail: liching@ms39.hinet.net