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Preservation of Hypermobile Teeth by Establishing Posterior Occlusal Support Using Implant Prostheses: A 5-Year Follow-Up

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Abstract

For patients with periodontally compromised, hypermobile teeth, implant-supported fixed dental prostheses (FDPs) or removable dentures are often used after extracting mobile teeth. The loss of native teeth may carry social consequences, depending upon the patient's age, state of health, and degree of social functioning. This report represents successful stabilization and preservation of questionable, hypermobile teeth that have been damaged by traumatic occlusion due to the loss of posterior support with a cross-arch splinted FDP, as well as the implementation of posterior support using implant-supported prostheses.

For patients with periodontally compromised, hypermobile teeth, implant-supported fixed prostheses or overdentures are commonly used after the extraction of mobile teeth; however, loss of teeth, even when they are hypermobile and their prognosis is unpredictable, is undesirable from the patient's perspective. The loss of native teeth may carry social consequences, depending upon the patient's age, state of health, and the degree of the patient's social activity.

Since the invention and development of dental implants, treatment modalities for partially or completely edentulous patients have changed, and increasingly, such patients have been treated with implant-supported fixed restorations or implant-supported removable prostheses rather than conventional dentures. Meanwhile, a trend has developed for the replacement of teeth with questionable viability in lieu of efforts to salvage the native tooth. As Becker et al[1] suggested that one criterion indicating a nonviable tooth is hypermobility, the removal of "hopeless" teeth is a valuable treatment option for teeth involved in advanced periodontitis.

Mobility is an important factor in the determination of periodontal integrity, functional state, and disease. Mobility can be classified as physiologic or pathologic. While physiologic mobility occurs in a healthy periodontium, pathologic mobility is induced by abnormal forces such as occlusal parafunction, that is, occlusal habits that injure the periodontium and the supporting structures, a common manifestation of trauma.[2,3] Secondary occlusal trauma includes forces that can be endured by healthy periodontium but cause traumatic damage, bone loss, and inflammation in the compromised periodontium.[4]

Occlusal force factors, including magnitude, frequency, duration, and velocity, affect the development of tooth mobility.[4] These factors should be identified and addressed to retain the mobile tooth under occlusal trauma as long as possible to provide adequate function within the oral cavity and control of periodontal disease. When considering the mechanical aspect of loaded force on the remaining teeth in partially or fully edentulous patients, the influence of the loss of posterior occlusal support should be accounted for as well. Many studies have reported that the absence of posterior support was related to condyle displacement and mandible position.[5-7] When two posterior molars are lost, significant condylar displacement was found regardless of the level of applied loading force.[7] The level of masticatory ability was associated with reduced occlusal support, and the main occluding area was located more anteriorly in cases in which posterior occlusal support was unstable due to the absence of posterior molars.[6,8,9] Abe

Figure 1 Intraoral photographs from the patient's first visit after scaling.

Table 1 Comparison of tooth mobility (recorded according to the Miller Index[13]).

	Mobility: Maxilla													
	17	16	15	14	13	12	11	21	22	23	24	25	26	27
1st visit			+++	+++	+++	+++		+++	+++	+++	+++	+++		
1 month later (after scaling)			++	+	+	++		++	++	++	+	++		
1 year later (after periodontal surgery)			–	–	–	+		+	+	+	–	+		
	Mobility: Mandible													
	47	46	45	44	43	42	41	31	32	33	34	35	36	37
1st visit	+++	++	++	+	++	+++	+++	+++	+++	+	++	+++	++	+++
1 month later (after scaling)	++	+	–	–	–	++	++	+	+	–	–	+	+	
1 year later (after periodontal surgery)	–	–	–	–	–	–	–	–	–	–	–	–	–	

et al[10] described the occlusal area used during crushing hard food as the main occluding area. When the main occluding area was located more anteriorly, and condylar displacement occurred, the teeth located anteriorly were more susceptible to traumatic load. Therefore, establishing correct posterior occlusal support in both vertical and horizontal aspects should be a prerequisite to any restorative procedure when mobile teeth are to be treated.

One valuable method for controlling tooth mobility is a periodontal splint with a meticulous occlusal scheme. Splinting is defined as "the joining of two or more teeth into a rigid unit by means of fixed or removable restorations or devices."[11] Tooth splinting distributes and transmits loaded forces into the root systems of all involved teeth, reducing stress on individual teeth resulting from traumatic forces, even from chewing. The structural stabilization created by a cross-arch splint with affirmative occlusal guidance in the maxilla reorients and redirects all forces along the long axis of the teeth by canceling deteriorating forces.[4,12]

This report describes a 5-year follow-up of the successful stabilization and preservation of questionable, hypermobile teeth damaged by secondary occlusal trauma through the establishment of posterior support with implants and a cross-arch splinted fixed dental prosthesis (FDP) instead of the extraction of all compromised teeth.

Clinical report

A 49-year-old woman with no significant medical conditions visited the Advanced General Dentistry Clinic of Yonsei Dental Hospital (Seoul, Korea) complaining of chewing difficulty and tooth mobility. The patient had visited other clinics concerning

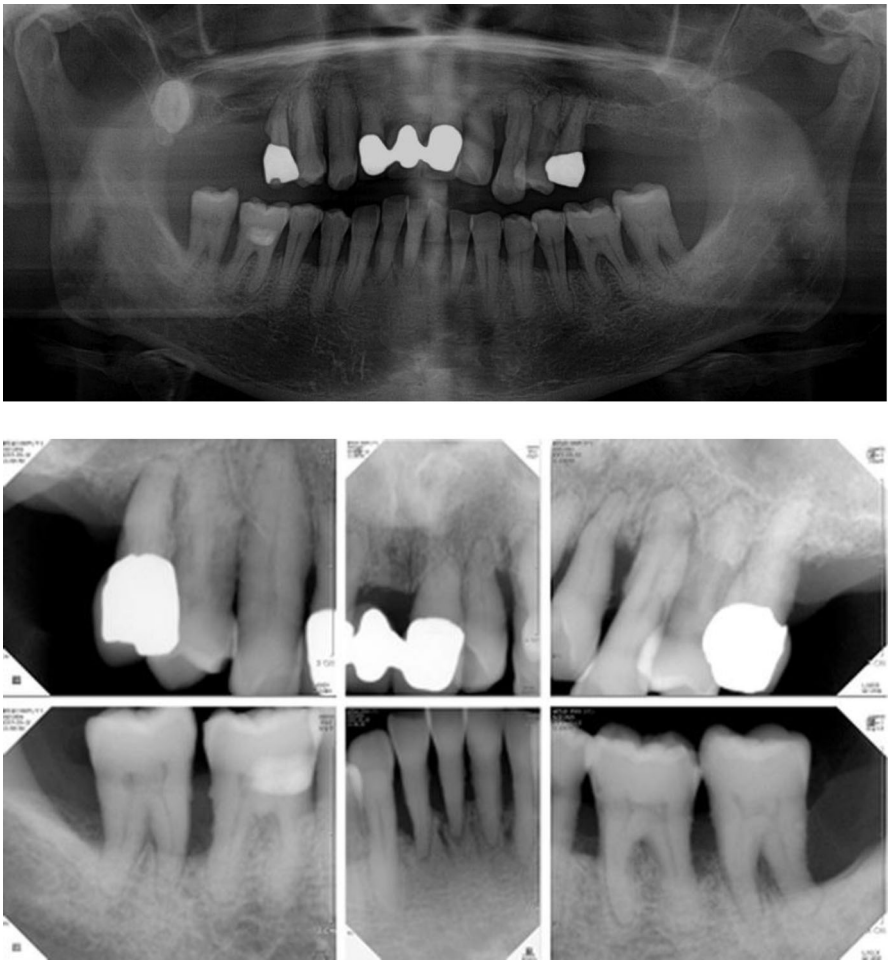

Figure 2 A panoramic radiograph and intraoral radiographs from the patient's first visit revealed generalized chronic advanced periodontitis. The remaining maxillary teeth appeared unsalvageable.

Table 2 Comparison of bone contact ratio of remaining teeth between initial stage and 5-year follow-up.

	Bone contact ratio (%): Maxilla													
	17	16	15	14	13	12	11	21	22	23	24	25	26	27
1st visit			34.871	43.264	54.140			47.239	44.940	30.949		57.910		
5-year follow-up			69.415	84.493	85.978			78.976	68.790	83.597		75.030		
	Bone contact ratio (%): Mandible													
	47	46	45	44	43	42	41	31	32	33	34	35	36	37
1st visit	51.028	71.811			59.762	36.173	26.239	39.123					45.552	
5-year follow-up	64.543	80.928			66.533	39.207	31.369	43.582	56.350				79.992	

(Teeth with no value listed were missing or could not be compared because of radiographic inaccuracy).

her oral discomfort and obtained recommendations for a maxillary complete denture or FDPs supported by multiple implants after the extraction of all remaining maxillary teeth; however, she was reluctant to undergo the extraction of all of her teeth.

Clinical examination showed generalized gingival swelling and redness and absence of all maxillary first and second molars (Fig 1). A 3-unit FDP was on the maxillary incisors to replace the missing right central incisor. The gingiva around the remaining teeth bled easily on probing, and the pocket depths were within 6 to 9 mm. All of the remaining teeth on the maxilla showed grade 3 mobility without vertical movement according to the Miller Index,[13] whereas the remaining mandibular teeth

Figure 3 Intraoral photographs at the 5-year follow-up. Lateral view of the eccentric movement shows the partial group function occlusal scheme.

showed grades 1 to 3 mobility (Table 1). The patient had an old, maxillary removable partial denture (RPD) with poor stability and no stable posterior centric stops due to the attrition of artificial teeth. During mandibular movement, no consistent anterior guidance was identified, and sequential tooth mobility or fremitus was observed in all maxillary teeth. The occlusal vertical dimension (OVD) was considered not to be disrupted or reduced because occlusal centric stops existed on both sides of the premolars.

Radiographic evaluation showed generalized advanced alveolar bone resorption and unfavorable crown:root ratios with regard to prosthetic considerations (Fig 2). The clinical diagnosis was generalized chronic advanced periodontitis combined with secondary traumatic occlusion related to the loss of posterior occlusal support.

Treatment objectives and procedures

The treatment goals were to control the periodontal inflammation, prevent traumatic forces, stabilize the remaining maxillary teeth by establishing correct posterior occlusal support via prosthetic intervention with centric relation (CR) verification, and ultimately to enhance the patient's esthetic appearance, psychological well-being, and social confidence. First, periodontal treatments including scaling and subgingival curettage were performed on both maxillary and mandibular arches followed by periodontal surgery on the left maxillary teeth. The left mandibular second molar was extracted. Simultaneously, an interim partial denture fabricated under verified CR position that maintained the original OVD was delivered to establish posterior centric stops and supports, and meticulous occlusal adjustments were performed to remove risk factors for traumatic occlusion. A provisional cross-arch periodontal splint was not inserted on the remaining maxillary teeth because the periodontal healing of each tooth needed to be monitored. Bilateral sinus lifts were performed via lateral window approach; periodic periodontal examinations demonstrated reduced mobility of the remaining individual teeth to grades 1 or 2 and pocket depth within normal range without bleeding on probing.

After a 2.5-month period with interim prostheses, a cross-arch splinted porcelain FDP from the right second premolar to the left second premolar on the maxillary teeth and a new interim prosthesis were inserted to maintain stable posterior support and CR position with partial group function from the canine to the second premolar. A soft diet was recommended to minimize lateral forces generated when eating tough food until the posterior implant prostheses were delivered for posterior support.

Meanwhile, two-stage surgery to place three 4.8 × 10 mm (on the right second molar and left two molars) and 4.1 × 10 mm (on the right first molar) ITI implants (Straumann AG, Basel, Switzerland) was performed. Cement-retained, implant-supported splinted FDPs on milled titanium abutments were delivered on each side, and a resin-bonded wire splint was attached on the mandibular anterior teeth (Fig 3). In this case, a primary goal of the occlusal scheme was to distribute the occlusal load to the entire dentition under a heavy load but to protect implant prostheses by ensuring that they barely make contact under a light bite force.

Outcome

Before the final cementation of maxillary FDPs, the reduced mobility of each tooth was maintained at grade 1 (Table 1). After the final cementation of the FDPs, the alveolar bone

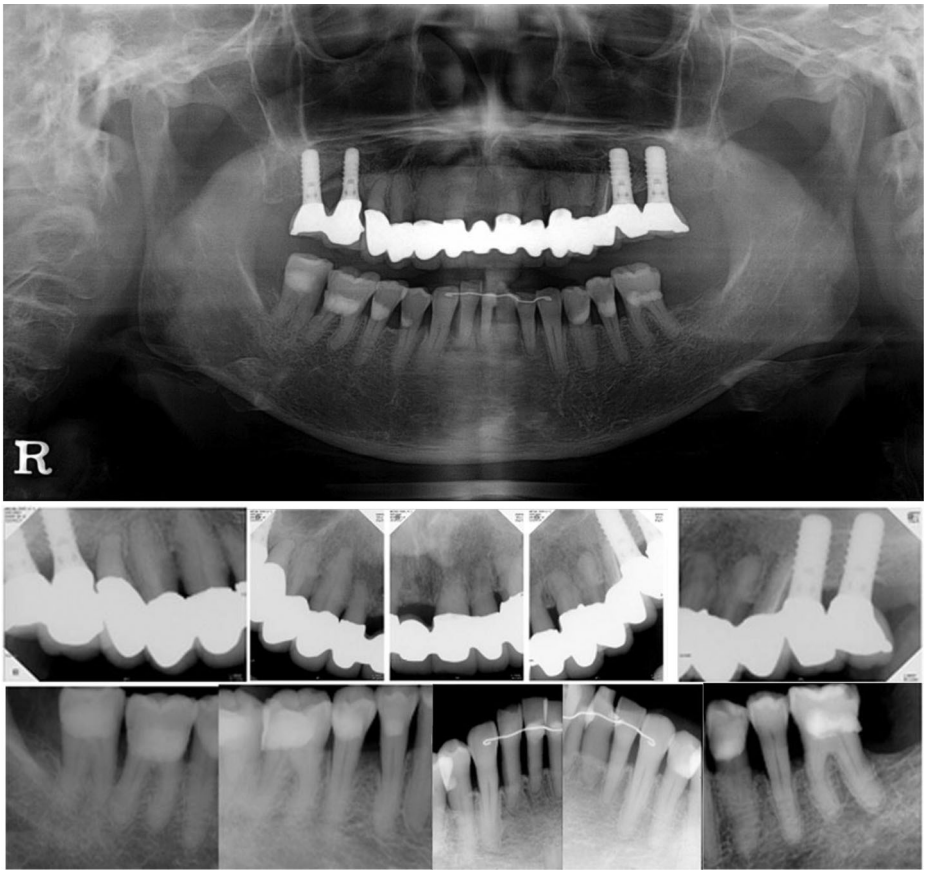

Figure 4 A panoramic radiograph and intraoral radiographs at the 5-year follow-up.

levels were assessed by periapical radiograph at every 6-month regular check-up. The implant-supported FDPs in the maxillary posterior segments provided additional posterior contacts for posterior occlusal support and a reduction in the occlusal forces transferred to the premolars, which had previously been used as the main occluding area. The patient was satisfied with speech, chewing, and esthetics except for the oral hygiene procedures required for the splinted FDPs. Periodic maintenance programs and a variety of oral hygiene equipment including chemical and mechanical methods were presented to the patient, making her recognize the guarded prognosis and encouraging her to practice effective oral hygiene.

The 5-year follow-up radiographs showed stable alveolar bone conditions with some bone deposition depending on the location (Fig 4). Generalized periodontal pockets of less than 3 mm, as well as firm and healthy gingival conditions, were maintained.

For a quantitative comparison of alveolar bone deposition, bone contact ratios of the remaining teeth and the teeth at the initial stage of the treatment were calculated using IMT i-solution lite v.8.1 (IMT i-solution Inc., Vancouver, Canada; Fig 5; Table 2). Although making an exact comparison was difficult due to the different angulation of the radiographs, a favorable bone deposition trend and prospective prognosis of the periodontium could be observed from the data.

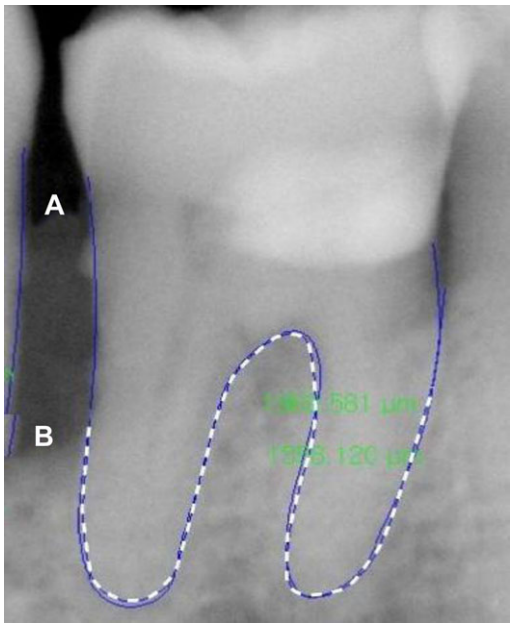

Figure 5 Bone contact ratio assessment using IMT i-solution lite ver 8.1(b/a). A: root surface area of the anatomical root surface; B: root surface area in the alveolar bone.

Discussion

Patients with unstable posterior occlusal support are typically treated with either implant prostheses or RPDs. One study reported that for subjects with RPDs, the main occluding areas were located more anteriorly than those in the group treated with implant prostheses.[9] Others reported that loss of posterior occlusal support was related to condylar displacement and that the food platform area changed accordingly to enable mastication using the remaining natural teeth, so when the chewing region was changed from the first molar to the first premolar, the mandible would be forced to deviate to chew.[5-8,14] The abovementioned studies suggested that reduction or loss of posterior occlusal support caused traumatic overloads on the anterior teeth.

In the present case, the patient was initially class IV according to the American College of Prosthodontists Prosthodontic Diagnostic Index (ACP PDI) for partial edentulism,[15] in which abutments in four or more sextants require extensive localized adjunctive therapy and have a guarded prognosis; however, after periodontal treatment and establishment of occlusal position, the condition of the abutments was improved to being moderately compromised, and the classification could be changed to ACP PDI class III. Considering the main occluding area, the edentulous state had two occlusal supporting zones.[10] The initial hypermobility of the remaining teeth was not considered to be a result of periodontal disease alone.

In recording the CR using bilateral manipulation and CR verification by loading test,[16] a discrepancy between the CR and the CO, as well as mandibular displacement caused by condylar displacement, was observed. Thus, the change of the main occluding area was suspected of causing traumatic overloads on the teeth anterior to the molars.[8,16] In this report, the posterior centric contacts for posterior support were restored using implant-supported prostheses, which have been reported to provide a more effective substitution of posterior support than RPDs.[9]

FDPs supported by periodontally compromised teeth have become controversial, and dentists are reluctant to use hypermobile teeth as abutment teeth for FDPs because reported cases were empirically based, and no reasonable basis was provided for the rationale for using compromised teeth as abutments for FDPs. A few studies revealed that mobile, periodontally compromised abutment teeth exhibited stable periodontal parameters and continued to function without discomfort to the patients and furthermore, that perceptive splinting is beneficial and enhances the longevity of the restoration.[17,18] When teeth are in the final stages of periodontal disease, and the remaining periodontal tissues can no longer withstand the masticatory load, the only way to preserve such teeth is to use a fixed splint of cross-arch design to render the mobility of the entire FDP either "normal" or "nonprogressive." Additionally, the functional forces exerted on a cross-arch splint should be evenly distributed over the entire extent of the splint, and the lever effect of the forces should be reduced.[12,19] Many studies concerning tooth stabilization and splinting with FDPs have emphasized the importance of maintaining suitable oral hygiene of the undersurface of the splint, which was the main cause of biological complications. Periodontally compromised teeth can be considered to support FDPs under the following conditions: a fastidious plaque control program, periodic examination, and awareness of the guarded prognosis related to the biological vulnerability and mechanical difficulties associated with the management of poorly supported mobile abutment teeth.[17]

Based on the studies described above, using a cross-arch splinted FDP, partial group function from the canines to the premolars was designed by meticulous occlusal adjustments after a provisional period. An interim prosthesis could provide an opportunity to evaluate the response of periodontally weakened teeth or impaired dentition prior to delivering the final restoration. Splinting with FDPs should not be performed if occlusal stability cannot be obtained using interim prostheses.[12] This approach would successfully preserve the dentition by controlling the magnitude, velocity, and direction of the loading force, and ultimately, the physical, emotional, and social stigma of tooth loss could be prevented.

Conclusion

In the prosthetic rehabilitation of patients with hypermobile teeth due to reduced periodontal support and the loss of posterior occlusal support, redefining the centric contact position and load direction through the establishment of posterior occlusal support based on the proper CR position is mandatory for maintaining optimum dental health.

References

1. Becker W, Berg L, Becker BE: The long term evaluation of periodontal treatment and maintenance in 95 patients. Int J Periodontics Restorative Dent 1984;4:54-71
2. Muhlemann HR: Tooth mobility: a review of clinical aspects and research findings. J Periodontol 1967;38:Suppl:686-713
3. Serio FG: Clinical rationale for tooth stabilization and splinting. Dent Clin North Am 1999;43:1-6
4. Bernal G, Carvajal JC, Munoz-Viveros CA: A review of the clinical management of mobile teeth. J Contemp Dent Pract 2002;3:10-22
5. Igarashi Y, Yamashita S, Kuroiwa A: Changes in interarch distance and condylar position related to loss of occlusal support for partially edentulous patients. A pilot study. Eur J Prosthodont Restor Dent 1999;7:107-111
6. Kozawa T, Igarashi Y, Yamashita S: Posterior occlusal support and bite force influence on the mandibular position. Eur J Prosthodont Restor Dent 2003;11:33-40
7. Seedorf H, Seetzen F, Scholz A, et al: Impact of posterior occlusal support on the condylar position. J Oral Rehabil 2004;31:759-763
8. Nakatsuka Y, Yamashita S, Nimura H, et al: Location of main occluding areas and masticatory ability in patients with reduced occlusal support. Aust Dent J 2010;55:45-50
9. Tanigawa Y, Kasahara T, Yamashita S: Location of main occluding areas and masticatory ability in patients with implant-supported prostheses. Aust Dent J 2012;57:171-177
10. Abe H, Miura H, Okada D, et al: The main occluding area in patients with fixed partial dentures. J Med Dent Sci 2011;58:41-48
11. The glossary of prosthodontic terms. J Prosthet Dent 2005;94:10-92

12. Siegel SC, Driscoll CF, Feldman S: Tooth stabilization and splinting before and after periodontal therapy with fixed partial dentures. Dent Clin North Am 1999;43:45-76
13. Miller SC: Textbook of Periodontia (ed 2). Philadelphia, Blakiston, 1943
14. Hashii K, Tomida M, Yamashita S: Influence of changing the chewing region on mandibular movement. Aust Dent J 2009;54:38-44
15. McGarry TJ, Nimmo A, Skiba JF, et al: Classification system for partial edentulism. J Prosthodont 2002;11:181-193
16. Dawson PE: Functional Occlusion: From TMJ to Smile Design. St. Louis, Mosby, 2007, pp. 501-511
17. Freilich MA, Breeding LC, Keagle JG, et al: Fixed partial dentures supported by periodontally compromised teeth. J Prosthet Dent 1991;65:607-611
18. Hochman N, Yaffe A, Ehrlich J: Splinting: a retrospective 17-year follow-up study. J Prosthet Dent 1992;67:600-602
19. Nyman SR, Lang NP: Tooth mobility and the biological rationale for splinting teeth. Periodontol 2000 1994;4:15-22