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The Japanese Society of Magnetic Applications in Dentistry

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The Journal of the Japanese Society of Magnetic Applications in Dentistry

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Proceedings of the 18th International Conference on Magnetic Applications in Dentistry

The Japanese Society of Magnetic Applications in Dentistry

The 18th International Conference on Magnetic Applications in Dentistry

The 18th International Conference on The Japanese Society of Magnetic Applications in Dentistry organized by JSMAD was held on the Internet as follows;

Meeting Dates:

Monday, February 25 to Friday, March 15, 2019

Location:

JSMAD web site

http://www.jsmad.jp/international/18/

General Chair:

Assoc. Prof. Kazuhiro Nagata, Nippon Dental University at Niigata

Subjects:

Researches and developments related to dentistry and magnetism such as:

- Magnetic attachments for dentures
- Orthodontic appliances using magnets
- Measurement of jaw movement using magnetic sensors
- Biological effects of magnetic fields
- Dental applications of MRI
- Others

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The 19th International Conference on Magnetic Applications in Dentistry General Information

General Information

The Japanese Society of Magnetic Applications in Dentistry (President: Chikahiro Okubo, Tsurumi University) is a scientific association founded in 1991 and is devoted to furthering the application of magnetism in dentistry. The 19th International Conference on Magnetic Applications in Dentistry organized by JSMAD will take place on the Internet as follows.

Meeting Dates:

Friday, February 28 to Tuesday, March 17, 2020

Location:

JSMAD web site:

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General Chair:

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Executive Committee Chair:

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Subjects:

Researches and developments related to dentistry and magnetism such as:

- Magnetic attachments for dentures
- Orthodontic appliances using magnets
- Measurement of jaw movement using magnetic sensors
- Biological effects of magnetic fields
- Dental applications of MRI
- Others

Registration Information

Registration:

Send e-mail titled "registration for 19th international conference" with your Name, University or Institution, Postal address, Phone, Fax and E-mail address to conference secretariat.

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No registration fees. Anyone who is interested in magnetic applications in dentistry can participate in the conference via the Internet.

Publishing Charge for Proceedings:

After the conference, the proceeding will be published. The publishing charge is 10,000 yen per page. (No charge for invited paper.)

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Poster submission: February 14, 2020

Entry:

Send Title and Abstract within 200 words with your Registration.

Paper submission:

Please send papers in Microsoft Word format to the conference secretariat by E-mail. All contents should be written in English. No multi-byte character, such as Japanese Kanji, should be contained. A template file can be obtained from the conference web site. Web presentations for the conference will be produced by the secretariat from the paper. The secretariat will not make any correction of the paper even miss-spelling, grammatical errors etc. Alternative format files are acceptable. Please contact to the secretariat for more detailed information.

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Discussions will be done using a bulletin board on JSMAD Web Site via the Internet. The authors should check the board frequently during the meeting dates. If questions or comments on your presentation are posted, please answer them as soon as possible.

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Freely-given informed consent from the subjects or patients must be obtained. Waivers must be obtained for photographs showing persons.

Note:

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For further information,

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Conference Secretariat

Shogo Tsuda, Kyushu Dental University

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Contents

A case report of a removable denture using magnetic attachments for a successful prognosis of abutment teeth

M. SONE, M. HAMASAKA, F. NARUMI, T. MATSUKAWA, Y. OKAWA, S. SOMEKAWA, D. MATSUMOTO, K. TAKAHASHI, Y. MIYOSHI, M. SUZUKI, T. YOSHIDA, K. OKAMOTO, and S. OHKAWA

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Abstract

This report describes two clinical cases. In both cases, the abutment teeth that acted as retention elements for the dentures were detached due to secondary caries and excessive occlusal force. The patients were dissatisfied with the retention of their denture. However, radiographic examination showed that the crown-to-root ratio of the abutment teeth must be improved for a successful prognosis for the abutment teeth.

After the initial preparation, a removable overlay denture with coping-type magnetic attachments was fabricated as a definitive prostheses, and keepers of the magnetic attachments were fixed to the remaining radicular teeth. As a result, the crown-to-root ratios of the abutment teeth were improved, and patients' complaints of functional dissatisfaction were resolved.

Introduction

Magnetic attachments that have the significant feature of "retention without bracing" protect abutment teeth from excessive occlusal force.[1] Thus, coping-type magnetic attachments can be applied to abutment teeth with decreased crown-to-root ratios.[2] We report the clinical use of coping-type magnetic attachments for successful prognoses of abutment teeth.

Case 1

Clinical History: The patient, a 65-year-old female, complained of aesthetic dissatisfaction and masticatory dysfunction. The patient had a partially edentulous maxilla (Kennedy Class I). At the initial examination, a porcelain-fused-to-metal crown of #7 as an abutment tooth for a removable partial denture was detached, and radiographic examination showed that #6 and #7 has unfavorable crown-to-root ratios (Fig.1). Poor health of the periodontal tissue was not evident.

Treatment Procedure: At first, a porcelain-fused-to-metal crown of #6 was removed, and coping-type magnetic attachments that act as retention elements were applied to #6 and #7 (Fig.2). In this case report, the magnetic attachments used were GIGAUSS C600® (GC, Japan).

Fig.1 Intraoral view and dental radiograph of #6 and 7 at the initial examination

Fig.2 Keepers of magnetic attachments

As a definitive prosthesis, a maxillary removable overlay denture with a horseshoe plate as the major connector was fabricated. As a result, the patient's complaints of aesthetic dissatisfaction and masticatory dysfunction were resolved.

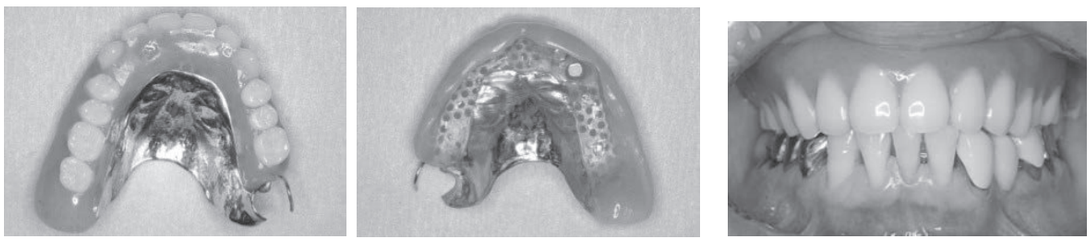

Fig.3 Intraoral view with a definitive prosthesis

Case 2

Clinical History: The patient, a 71-year-old female, complained of masticatory dysfunction. The patient had a mandibular removable partial denture (Kennedy Class II). At the initial examination, a horizontal crown fracture of #29 as an abutment tooth was caused by severe caries (Fig.4). The radiographic examination showed that #29 had an unfavorable crown-to-root ratio (Fig.5). Poor health of the periodontal tissue was not evident.

Treatment Procedure: After endodontic treatment (Fig.5), a coping-type magnetic attachment that acts as a retention element was applied to #29 (Fig.6). In this case report, the magnetic attachment used was GIGAUSS D400® (GC, Japan). Keepers of the magnetic attachment were fixed with adhesive resin cement on a metal coping by the KB method (RelyX™ Unicem 2 Automix, 3M™ ESPE™, USA). The magnetic assembly was then attached to an additional tooth of the denture, which was still used after being repaired (Fig.7). As a result, the patient's complaints of functional dissatisfaction were resolved (Fig.8).

Fig.4 Intraoral view at the initial examination

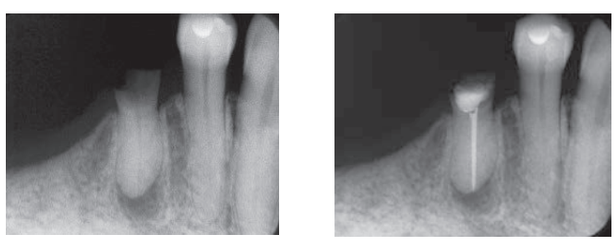

Fig.5 Dental radiograph (before and after endodontic treatment)

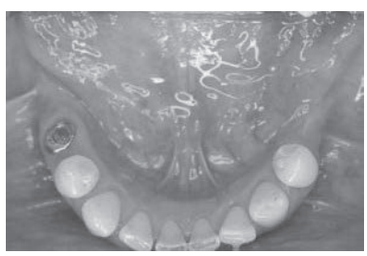

Fig.6 Keeper of a magnetic attachment

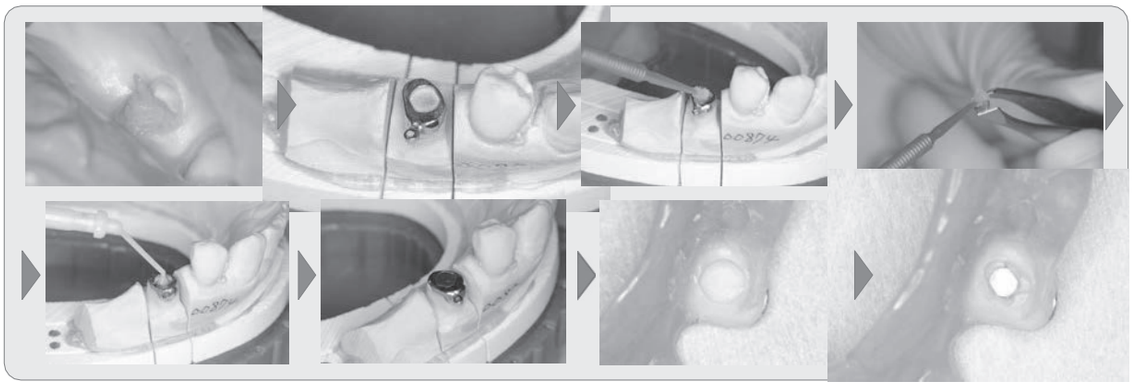

Fig.7 Magnetic attachment treatment procedure

Fig.8 Intraoral view after prosthetic treatment

Conclusion

In the one year since final prosthetic treatment, no complications with dentures or abutment teeth have occurred. These results suggest that coping-type magnetic attachment could provide patients with comfortable retention earlier and improve crown-to-root ratios of abutment teeth of successful prognoses.

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2. M. Sone: A case report of a removable denture using magnetic attachments for a missing mandibular molar with a decreased occlusal vertical dimension followed up for 3 years, JJ Mag Dent, 24(2), 10–14, 2015.

A case of a lower removable partial denture with a dental magnetic attachment

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Abstract

The patient was a 67-year-old female who had visited our clinic. She complained about her lower removable partial denture. She was provided with a non-metal clasp lower partial denture from a certain dental clinic. However, she could not wear it because the gingival inflammation caused by the non-metal clasps of the denture cutting into her gingiva. She hoped for another type of esthetic partial denture without clasps. Number 45 was designed as a root cap with a stud attachment, and No. 37 was designed as a magnotelescopic crown. As the direct abutment tooth, No. 33, was vital, a resin-facing crown with an extracoronal dental magnetic attachment was designed for it. To educate the patient regarding wearing the denture, in addition to explaining cautionary circumstances concerning the dental magnetic attachment, we instructed her how to clean the extracorporeal attachment region of No. 33 in particular.

Because the new denture was esthetically pleasing as well as easy to put on, remove, and clean, the patient was satisfied. Evaluation of various functions before and after treatment showed improvement.

Introduction

Dental magnetic attachments are very useful for the retention of removable partial dentures. At this time, we report on a clinical case of a lower removable partial denture with a stud as well as intracoronal and extracoronal dental magnetic attachments.

Clinical history

The patient was a 67-year-old female who visited our clinic on April 17, 2014. She complained about her lower removable partial denture. In 2013, she was provided with a non-metal clasp lower partial denture for the edentulous region of Nos. 34, 35, 36, 46, and 47 from a certain dental clinic. However, she could not wear it because of the gingival inflammation caused by the non-metal clasps (Nos. 33, 37, 44, and 45) of the denture cutting into her gingiva. Her complaint was the gingival inflammation caused by the clasp

regions of the non-metal clasp lower partial denture. She hoped for another type of esthetic partial denture without clasps (Fig.1).

Fig.1 Intraoral findings without the lower partial denture (May 15, 2014)

Treatment procedure

As Nos. 45 and 37 were non-vital direct abutment teeth, a magnotelescopic crown was designed for No. 37 (Figs.2,3). As No. 33 was a vital direct abutment tooth, a resin-facing crown with an extracoronal dental magnetic attachment was designed for this tooth (Fig.4). Dental magnetic attachments (GIGAUS C600®; GC Corporation, Tokyo, Japan) were used as retainers in all three abutments. After fixing the inner crowns of No. 37 and No. 45 with adhesive resin cement, a removable partial denture was fabricated by the conventional method (Figs.5,6).

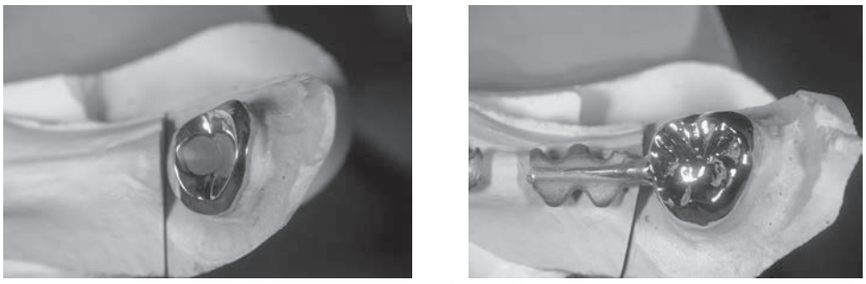

Fig.2 A magnotelescopic inner crown and a full metal outer crown on No. 37

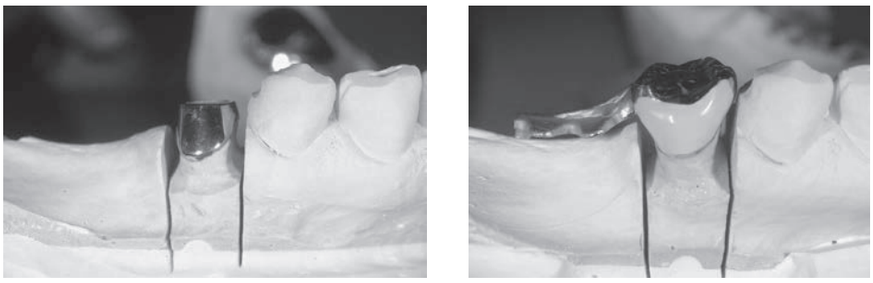

Fig.3 A magnotelescopic inner crown and a resin-facing outer crown on No. 45

Fig.4 A resin-facing crown with an extracoronal dental magnetic attachment on No. 33

Fig.5 Finished crowns

Fig.6 Wax denture

At the try-in of these crowns and a wax denture, the patient complained about the outer crown of No. 45. She did not want to see the metal color of the occlusal surface.

Therefore, we decided to use the inner crown of No. 45 as the root cap of an overdenture (Fig.7).

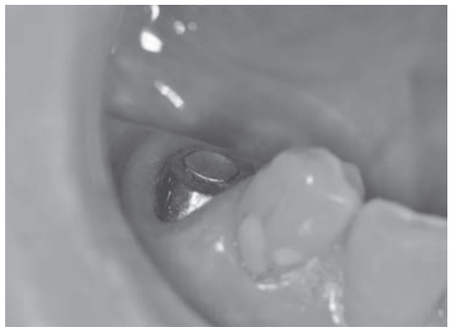

Fig.7 Root cap with a keeper on No. 45

The finished partial denture was set on March 10, 2015 (Figs.8–10). To educate the patient regarding wearing the denture, in addition to explaining cautionary circumstances concerning the dental magnetic attachment, we instructed her how to clean the extracorporeal attachment region of No. 33 in particular.

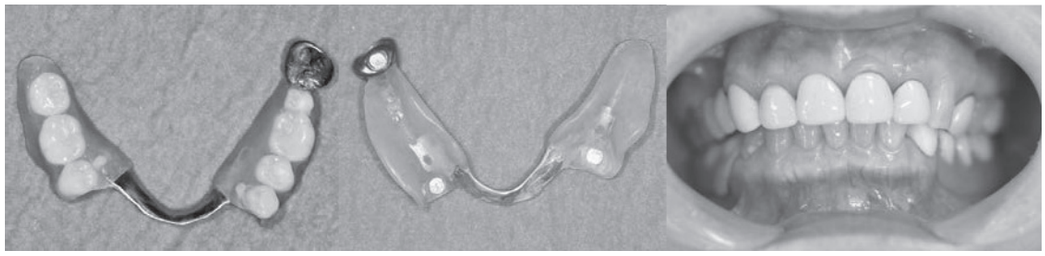

Fig.8 Finished denture (August 12, 2014)

Function evaluation

Table 1 shows the results of the evaluation of various functions before and after treatment. Maximum occlusal force using the Dental Prescale® System was 221.5 N before and 424.2 N after Tx. Mastication scores for chewing ability by the amount of glucose elution using Gumi-jelly® were 47 mg/dl before and 228 mg/dl after Tx. The mastication scores were 39.7 before and 49.7 after Tx. In oral QOL evaluations, OHIP-J14 scores were 30 before and 18 after Tx, and GOHAI scores were 29 before and 51 after Tx. The results showed that all items of the functional evaluation tended to improve.

Evaluation items	Before Tx	After Tx
Occlusal force （Dental prescale：N）	221.5	424.2
Chewing ability （Elution volume of glucose mg/dL）	147	228
Mastication score	39.7	49.7
OHIP14	30	18
GOHAI	29	51

Table 1 Evaluation of various functions

Prognostic process

At a basic periodontal examination and tooth mobility test conducted on November 7, 2017, it was almost possible to clean the patient herself because the scores of all residual teeth were unchanged from before treatment. In addition, problems were not observed in the denture base fitness test and occlusal examination, and it seemed that this lower removable partial denture functioned well.

Conclusion

Because the new denture was esthetically pleasing as well as easy to put on, remove, and clean, the patient was satisfied. Evaluation of various functions before and after treatment showed improvement. The post treatment evaluation confirmed improved oral QOL.

All authors report that they have no conflict of interest regarding this report.

Denture repair with the application of a magnetic attachment to the inner crown of a telescopic crown: Athree-year follow-up case

A. Izumida

Department of Comprehensive Dentistry, Tohoku University Hospital

Abstract

This case report describes a three-year follow-up case after denture repair with the application of a magnetic attachment to the inner telescopic crown. The patient was a 74-year-old woman. In December 2000, inner conical telescopic crowns on the maxillary right central incisor, left first premolar, and left second premolar were produced for three tooth defects of the central incisor, lateral incisor, and cuspid on the maxillary left side, respectively. Then a removable denture equipped with outer crowns conforming to those inner crowns was set. In November 2014, acute apical periodontitis occurred on the maxillary right central incisor that was one of the abutment teeth. After the inner crown of the tooth was removed, root canal treatment was performed. Following prosthetic treatment, a magnotelescopic crown was fabricated for the maxillary right central incisor and adapted to the corresponding outer crown. In this case, prosthetic treatment by making maximum use of the existing denture was considered. The patient was highly satisfied with using the repaired denture, and the periodontal tissue around the magnotelescopic crown was kept sound even three years after the denture repair.

Introduction

The cone crown telescope, a type of retainer developed by K.H. Korber, is a so-called rigid-support retainer.[1)] The cone crown telescope consists of a tapered frustoconical inner crown and an appropriate outer crown. The retentive force depends on the frictional force or wedge effect due to contact between the inner and outer crowns and the metal elasticity of the outer crown, but it can be adjusted by the cone angle of the inner crown axial surface. Although it is difficult to adjust the retentive force when making a denture using a cone crown telescope, the retentive force is stable after adjustment. The cone crown telescope is also widely used in clinical practice because it has excellent support and bracing functions. However, in prosthetic treatment using the cone crown telescope, troubles such as detachment of the inner crown and fracture of the abutment tooth have been observed in the course of operation. When the inner crown is detached, an attempt is often made to rebuild it with the outer crown, but it should be noted that easy repairs may have poor prognoses.[2)]

On the other hand, due to their versatility, magnetic attachments are widely used in various clinical situations, including for copings, magnotelescopic crowns (MT crowns), and extra-coronal restorations. Therefore, it is worth considering applying a magnetic attachment even when repairing a denture. However, there have been few reports on prognoses when dentures have been repaired using a magnetic attachment.

One of the inner crowns of a cone telescope denture used for 14 years was removed from the abutment for root canal treatment. As a prosthodontic treatment after a root canal, I used the abutment teeth and dentures to the fullest and repaired the dental prosthesis using a magnetic attachment for the inner crown of the cone crown telescope. This case is reported three years after the denture repair.

From the case

The circumstances of the patient's first visit for denture repair using an MT crown are as shown in the previous report,[3] but the outline is given below. The patient is a 74-year-old female. In December 2000, conical telescopic inner crowns on the maxillary right central incisor, left first premolar, and left second premolar were produced for three tooth defects of the central incisor, lateral incisor, and cuspid on the maxillary left side, respectively. A removable denture equipped with outer crowns conforming to those inner crowns was then set. In November 2014, acute apical periodontitis occurred on the maxillary right central incisor that was one of the abutment teeth. After the inner crown of the tooth was removed, a root canal treatment was performed. Following prosthetic treatment, a magnotelescopic crown (MT crown) was fabricated for the maxillary right central incisor and adapted to the corresponding outer crown. In July 2015, the dental prosthesis was repaired using a magnetic attachment (GIGAUSS C 300, GC, Japan) for the existing outer crown (Fig.1).

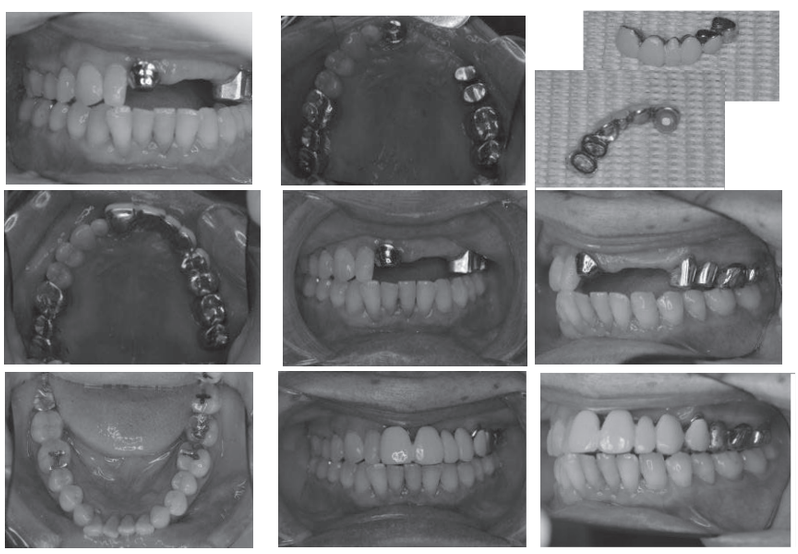

Fig.1 Intraoral view and the denture at the denture repair (2015.7.24)[3]

Specifically, as a method of manufacturing the MT crown, the root canal part of the maxillary right central incisor was waxed according to the metal core production, and the approximate shape was prepared using a room temperature–polymerized resin as a pattern from the cervical portion of the crown. Then, using the denture temporarily borrowed from the patient, a wax pattern of the MT crown was fabricated while directly conforming to the inner surface of the outer crown. At the same time, a space for mounting the magnetic attachment inside the outer crown was secured. The keeper was manufactured by the cast-joining method. The magnetic attachment was attached at the next medical treatment after the patient wore the MT crown. At that time, the facing hard resin of the outer crown was removed, and it was newly built up.

Follow-up of the case

Denture repair was completed in July 2015. Thereafter, this case shifted to one of maintenance and recall. In the meantime, as a restoration, the bridge of the maxillary right molar section was remade due to desorption. Panoramic X-ray photographs taken three years and two months after the denture repair are shown in Figure 2, and Figure 3 shows the periodontal pocket of the abutment tooth at times of wearing the denture in December 2000, repairing the denture, and three years after repairing the denture. While continuing to use not only the maxillary right central incisor tooth with the MT crown attached but also the maxillary left first premolar tooth and the maxillary left second premolar tooth, the periodontal tissue has been generally well preserved. In addition, there was no detachment of the magnetic attachment or the other inner crown by the room temperature–polymerized resin in the outer crown. As of today, the patient is highly satisfied with using the repaired denture (Fig.4).

Fig.2 Panoramic X-ray photographs of three years and two months after the denture repair（2018.9.11）

	#11			#24			#25			#11			#24			#25			#11			#24			#25		
m	0			0			0			0			0			0			0			0			0		
B	3	2	3	3	2	3	3	2	3	4	3	3	3	2	3	2	2	3	4	2	3	2	2	3	2	2	3
P	3	2	3	3	2	3	3	2	3	4	2	3	3	2	3	2	2	3	4	2	3	3	2	3	2	2	3
	wearing the denture in December 2000									repairing the denture in July 2015									three years after the repair of the denture								

Fig.3 Periodontal pocket depth of the abutment teeth

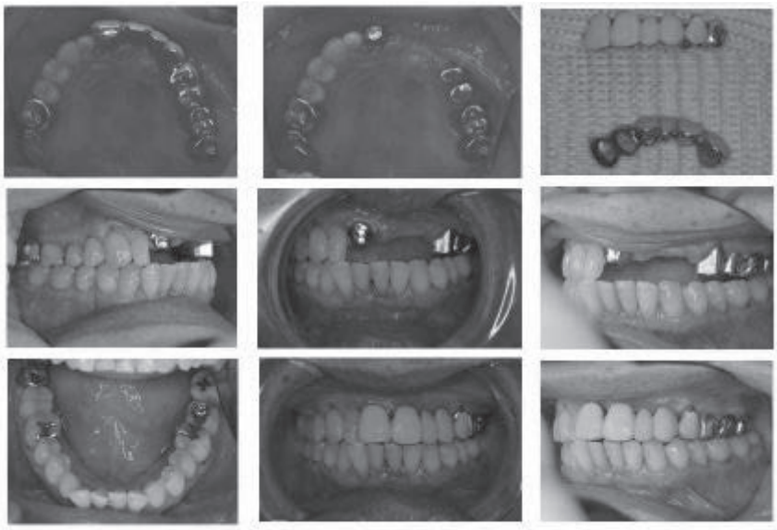

Fig.4 Intraoral view and the denture taken three years and two months after the denture repair（2018.9.11）

Discussion

In this case, the right central incisor of the maxilla developed acute apical periodontitis after 14 years of wearing the denture. As the dental prosthesis was designed for three tooth defects of the central incisor, lateral incisor, and cuspid on the maxillary left side, only three teeth—the maxillary right central incisor, the maxillary left first premolar, and the maxillary left second premolar, respectively—were set as abutment teeth. From this point of view, there was concern from the beginning of overloading the right central incisor on the maxilla. However, the maxillary right central incisor and the maxillary right lateral incisor are in close proximity. When the maxillary right lateral incisor is included as the abutment tooth, cleaning efficiency is reduced, and a pulpectomy is necessary to secure the parallelism between the abutment teeth. In addition, the patient strongly requested the minimal prosthetic treatment, which led to the design in this case. However, in manufacturing, the denture was carefully prevented from concentrating the occlusal force transiently at the intercuspal position and lateral movement. As a result, it seems that the occlusal force kept the burden on the right central incisor of the maxilla, and microleakage at the abutment tooth caused acute apical periodontitis. However, the patient in this case seems to have functioned for 14 years with defects of the minority teeth, vertical stoppings of the bilateral molar teeth, and with manufacturing considerations.

Because the patient strongly hoped to use the present denture as a prosthodontic treatment after a root canal treatment, I presented a design that included the maxillary right lateral incisor as an abutment tooth. Therefore, the prosthetic treatment was directed to the right central incisor section of the maxillary. The method of prosthetic treatment was conceived as a method of manufacturing the inner and outer crowns so as to be parallel with other inner and outer crowns, cutting the maxillary right central incisor tooth of the existing denture and soldering the newly manufactured outer crown. However, with this method, I was concerned that it would be difficult to adjust the retentive force, and

the burden would be overloaded. To solve this problem, there was some freedom with respect to the parallelism between the abutment teeth, and the use of an MT crown was presented as a method that is less burdensome on the abutment teeth. The patient selected this method, and I carried out the subsequent prosthetic treatment.

The goal of prosthodontic treatment in this case was to make full use of existing dentures. In order to achieve this goal, the maxillary right central incisor was replaced with an MT crown instead of the inner crown, and the magnetic attachment was attached to the outer crown. Since the maxillary right central incisor was originally a vital tooth, the outer crown was larger than the ideal size, so it was easy to secure space for the magnet structure, which worked favorably at the time of manufacture. By applying a magnetic attachment to only one of three abutment teeth, the MT crown and inner crown were combined in one prosthetic device. However, as of now, there has been no detachment of the inner crown or fracture of the abutment teeth, and the periodontal tissue is also well maintained. Since the patient also uses it without discomfort, it is considered to have been a reasonable denture repair.

Conclusions

One of the inner crowns of the abutment tooth of a cone telescope denture used for 14 years was removed to treat acute apical periodontitis. In a subsequent prosthetic treatment, denture repair using a magnetic attachment took maximum advantage of the existing denture. Three years have passed since the denture repair, and regular maintenance and recall have been performed. As a result, even though the MT crown and inner crown coexisted in one prosthetic device, a good prognosis was obtained. Therefore, prosthodontic treatment with an MT crown is considered to be an effective method at the time of the re-prosthesis of a cone telescope denture's inner crown repair.

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A postoperative investigation of abutment teeth using a magnetic attachment

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Abstract

Magnetic attachments can be small with powerful attractive force by using a neodymium magnet, which is a rare earth magnet. This system can be used for abutment teeth by decreasing the lateral force even if the crown-root ratio is poor. Therefore, the clinical efficacies of magnetic attachments have been widely demonstrated. It is thought that observing the long-term progress of the abutment teeth after setting the magnetic attachment is necessary to obtain a good clinical result. The purpose of this study was to observe the long-term progress of abutment teeth with magnetic attachments. The investigation period was five years, from 2008 to 2013, and it involved regular visits. As a result of a postoperative investigation of abutment teeth, the following knowledge was obtained. There were 257 teeth with magnetic attachments, and the maxillae were more than 1.5 times larger than the mandibles. During the investigation period, 48 abutment teeth with magnetic attachments were lost, most often the maxillary first premolar, followed by the mandibular first premolar and maxillary canine.

Introduction

Newer encased magnets provided improved corrosion resistance and magnetic attachment retention as well as clinical durability. As newer magnetic materials have been developed, the advantages of size reduction, stronger attractive retentive force, and improved clinical utility and use have substantially improved the range of useful applications as compared to versions previously available. While certain types of esthetically hidden precision attachments are considered rigid and inflexible, magnetic attachments are considered more capable of stress release due to an inherent ability to minimize and reduce unfavorable horizontal mechanical force transfer. Reduced horizontal force transfer for prosthetic retentive elements has been considered advantageous in preventing abutment overload and unwanted breakdown. A smaller attachment size is also of greater benefit for esthetic adaptability and application in constrained spaces.[1,2] Observing the long-term progress of abutment teeth after setting dental magnetic attachments is indispensable for obtaining good clinical results and diagnoses, designing dentures, and maintaining the index.[3]

Objective

The purpose of this study was to observe the long-term progress of abutment teeth with dental magnetic attachments and to understand the real condition of abutment teeth.

Materials and Methods

The investigation period was the five years from 2008 to 2013. Dental magnetic attachments were set at a magnetic denture clinic, Aichi Gakuin University Dental Hospital. Patients undergoing regular maintenance were chosen for study. In addition, the abutment teeth were used only for the root cap with the keeper coping, and the magnotelescopic crown and the implant using the magnetic attachment were excluded.

Results

The investigation control group consisted of 87 people—28 males and 59 females—whose average age was 73.4 years old. A total of 103 denture plates used the dental magnetic attachment as the retainer, while 55 plates used it in the maxilla and 49 plates in the mandible (Fig.1). Comparing the materials, 43 maxillary dentures (78%) were metal base dentures, while 12 (22%) were resin base dentures; whereas of mandibular dentures, 28 plates (57%) were metal base dentures and 21 plates (43%) were resin base dentures (Fig.2). There were 257 abutment teeth with dental magnetic attachments. There were 152 abutment teeth in the maxilla and 105 abutment teeth in the mandible (Fig.3). Approximately 1.5 times as many dental magnetic attachments were set to the maxilla as to the mandible. This time, 48 abutment teeth with dental magnetic attachments were lost. Thirty-four were extracted, and the magnetic assemblies of 14 detached from the root cap with the keeper coping. A breakdown of the number of teeth lost from the maxilla shows that 17 were extracted, and the magnetic assembly and the root cap of 11 detached from the keeper coping. A breakdown of the number of teeth lost from the mandible shows that 17 were extracted, while the magnetic assembly and the root cap of 3 detached from the keeper coping (Fig.4). The numbers of teeth lost from the dental magnetic attachment in the investigation period by tooth type of the maxilla and mandible are shown in Table 1. Most teeth lost from the dental magnetic attachment were maxillary first premolars, followed by mandibular first premolars and maxillary canines.

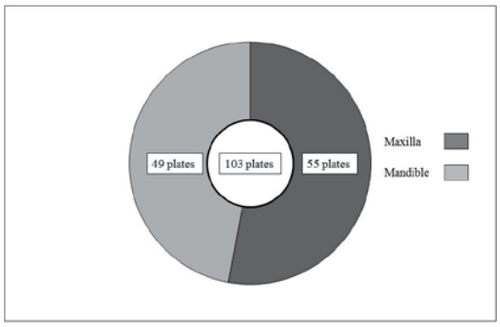

Fig.1 Number of denture

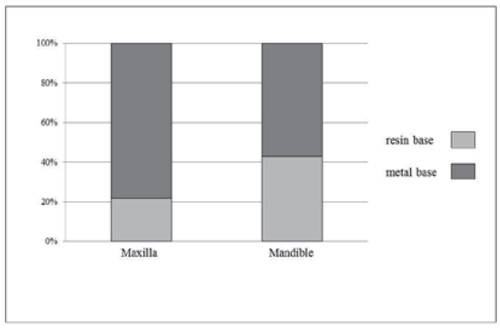

Fig.2 Difference in material of denture base

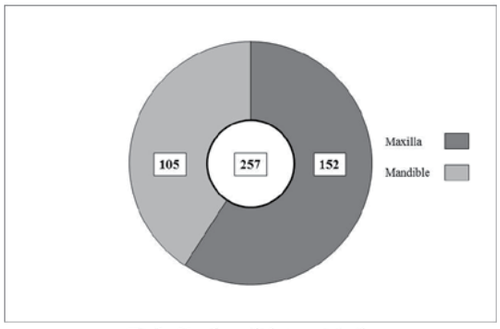

Fig.3 Number of abutment teeth

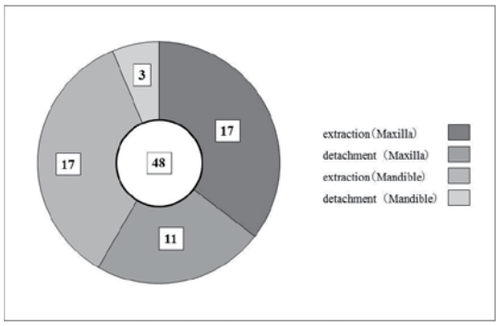

Fig.4 Number of lost teeth

Table 1 number of lost teeth by tooth type

Tooth type	1	2	3	4	5	6	7	8	Total
Maxilla	2	1	7	10	4	2	2	0	28
Mandible	0	2	5	8	2	0	2	1	20
Total	2	3	12	18	6	2	4	1	48

Discussion and Conclusion

From our five-year postoperative investigation of abutment teeth set to dental magnetic attachments from 2008 to 2013 at a magnetic denture clinic, Aichi Gakuin University Dental Hospital, the following knowledge was obtained.

1. Dentures of both the maxilla and the mandible were more metal-based than resin-based.
2. There were 257 abutment teeth with dental magnetic attachments. Dental magnetic attachments set to the maxilla outnumbered those set to the mandible by approximately 1.5 times.
3. During the investigation period, 48 abutment teeth with dental magnetic attachments were lost. The most lost teeth were maxillary first premolars, followed by mandibular first premolars and maxillary canines.

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Stress analysis of the tissue around the abutment tooth based on differences in the keeper angles of the most posterior molar in magnetic attachment dentures

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Abstract

Application of the magnetic attachment to the most posterior molar is effective as the most posterior support region of the denture. However, a good clinical prognosis is rarely obtained if the abutment tooth is located under a denture base with a poor self-cleaning property. In this study, we investigated the mechanical influence of angular differences of the keeper attractive surface applied to the most posterior molar to the abutment teeth and surrounding tissues using the three-dimensional finite element method.

The analysis model was constructed using a mandibular cast model manufactured by Nissin Co., Ltd. In the prosthetic design, the overlay prosthesis was made by applying a magnetic attachment to the mandibular left second molar. Analysis items were modeled by setting the keeper attractive surface parallel to the occlusal plane and a model in which the keeper attractive surface was set perpendicular to the tooth axis of the abutment.

From the analysis results, relaxation of the stress distribution in the mandibular left second molar was observed in the model in which the keeper attractive surface was set perpendicular to the tooth axis of the abutment. In addition, a decrease in the periodontal ligament burden area and increase in the mucous burden area could be confirmed.

Introduction

Application of the magnetic attachment to the most posterior molar is effective as the most posterior support region of the denture. Furthermore, the attractive force of the magnetic attachment assists the retention force of the denture. Changing the attractive force by changing the angle of the keeper attractive surface angle of the magnetic attachment exerts the maximum attractive force in the direction perpendicular to the keeper attractive surface.[1] For this reason, setting the keeper attractive surface of the root cap basically parallel to the occlusal plane is recommended so that the maximum attractive force can be exerted. However, by setting it parallel to the occlusal plane in order to acquire the maximum attractive force, the occlusal force is received in a direction different from that of the tooth axis, and clinical symptoms may be confirmed in the tissue around the abutment tooth.

Objective

The purpose of this study was to investigate the mechanical influence of differences in the angle of the keeper attractive surface applied to the most posterior molar on the tissue surrounding the abutment for a mandibular removable partial denture by using the three-dimensional finite element method.

Materials and Methods

1. Analysis model

The mandibular model used in this study is shown in Fig.1. For model construction, a mandibular plaster model and a skull model (P10–SB.1) manufactured by Nissin Co., Ltd. were used (Fig.2).

Initially, this mandibular plaster model was scanned using a model and impression scanner (7 series, Dental Wings, Montreal, Canada) to make model-shaped data in the STL format. Next, a skull model was CT photographed, and the obtained CT data was prepared in the STL format with mandibular bone data and tooth root shape data using three-dimensional construction software (Mimics version 11.0, Materialise, Leuven, Belgium). We imported these data into computer-aided

Fig.1: Mandibular model used in this study

Fig.2: Mandibular plaster model and skull model

engineering (CAE) pre／post processing software (Patran 2013 Windows 64 bit, MSC software, Los Angeles, CA, USA) and constructed a model. The thickness of the residual ridge mucosa and periodontal ligament were set with reference to the literature values, and the morphology of the mandible was simple.[2]

The design of the removable partial denture is shown in Fig.3. The magnetic attachment was designed for the mandibular left second molar, and the RPI clasp was applied on both sides of the first premolar as the direct abutment device.

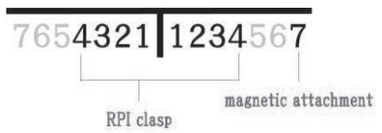

Fig.3: Design of the removable partial denture

The constructed analysis model is shown in Fig.4. The magnetic attachment applied in this research was GIGAUSS D1000, which accurately reproduced its high diameter and width for model construction.

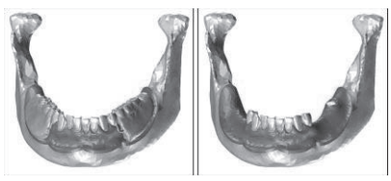

Fig.4: Constructed analysis model

2. Analysis Items

Analysis items are shown in Fig.5.

The analysis items were an occlusal plane parallel model in which the keeper attractive surface was set parallel to the occlusal plane and a tooth axis vertical model in which the keeper attractive surface was set perpendicular to the tooth axis of the mandibular left second molar.

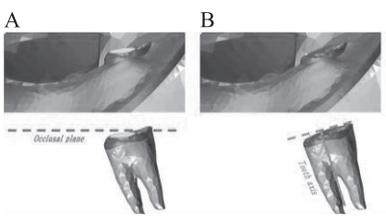

Fig.5: The analysis items
A: Occlusal plane parallel model
B: Tooth axis vertical model

The mechanical property values of the analysis model are shown in Table 1. Regarding the periodontal ligament and the residual ridge mucosa, these nonlinear viscoelastic properties were introduced by a material constant conversion program (Table 2).

Table 1: Mechanical property values

	Young Modulus (MPa)	Poisson Ratio
mandibular bone	11,760	0 . 250
enamel	41,400	0 . 350
dentin	18,600	0 . 350
metal	70,000	0 . 300
resin	2,450	0 . 300

Table 2: Material constant conversion program

	Young Modulus (MPa)	Poisson Ratio
Periodontal Ligament	0.020	0 . 200
	0.085	0 . 300
	1.500	0 . 350
	2.500	0 . 400
	4.000	0 . 490
Residual Ridge Mucosa		
	0.150	0 . 300
	0.700	0 . 350
	3.000	0 . 350
	3.900	0 . 350
	4.600	0 . 450
	11.000	0 . 470
	16.500	0 . 490

3. Analysis Conditions

Load conditions are shown in Fig.6. Loading sites included a total of six places on the mandibular bilateral denture occlusal surface, and the loading direction was perpendicular to the occlusal plane. Based on the literature value, the load amount was set to a total of 300 N.[3] The inferior border of the mandible was defined as a constraint condition in the x, y, and z directions. In the contact condition, the relationship of the tooth and the mucosa in contact with the denture was added by the Coulomb friction, and the coefficient of the defined Coulomb friction was set at $\mu = 0.090$ for this study.[4]

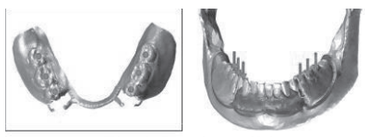

Fig.6: Load conditions

Analysis Results

The stress in this analysis was evaluated by Von Mises stress.

1. Mandibular alveolar bone

Figure 7 shows the stress distribution of the alveolar cavity of the mandibular left second molar. As compared to the occlusal plane parallel model, stress relaxation was confirmed in the tooth axis vertical model.

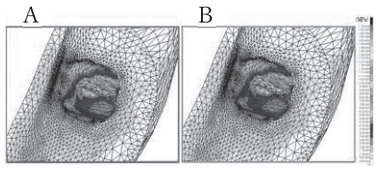

Fig.7: Stress distribution of the alveolar cavity of the mandibular left second molar
A: Occlusal plane parallel model
B: Tooth axis vertical model

2. Mandibular left second molar

The stress distribution of the mandibular left second molar is shown in Fig.8. Both models showed stress spreading from the mesial root to the furcation. Especially in the mesial root, more relaxation of stress was confirmed in the tooth axis vertical model than in the occlusal plane parallel model.

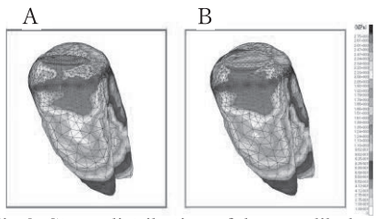

Fig.8: Stress distribution of the mandibular left second molar
A: Occlusal plane parallel model
B: Tooth axis vertical model

3. Right supporting denture base mucosa

Figure 9 shows the stress distribution of the right supporting denture base mucosa. Expansion of the stress distribution was greater in the tooth axis vertical model than in the occlusal plane parallel model. An increase in the mucosal burden zone was confirmed.

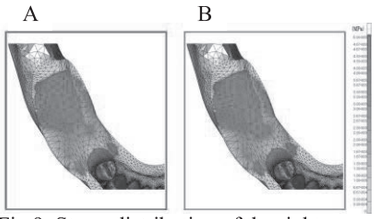

Fig.9: Stress distribution of the right supporting denture base mucosa
A: Occlusal plane parallel model
B: Tooth axis vertical model

Discussion and Conclusion

In the finite element analysis studied this time, as compared to the design in which the keeper attractive surface is set parallel to the occlusal plane, greater stress relaxation was confirmed in the design in which the keeper attractive surface is set to be perpendicular to the abutment tooth axis. It was also confirmed that in the burden form of the dental prosthesis,

the region of the periodontal ligament burden decreases, and the mucosal burden zone increases.

The difference in the angle of the keeper attractive surface examined this time is 15°. According to the report of Nakabayashi, the reduction rate of the attractive force is about 17%.[1]

Based on this result, when applying a magnetic attachment to the most posterior molar, it is extremely important to clarify the condition of the abutment to determine whether priority should be given to the attractive force of the magnetic attachment or to stress relief of the abutment tooth.

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Implant-supported removable partial dentures with magnetic attachments using selective laser-sintered frameworks: A case report

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Abstract

【Objective】
A removable partial denture framework can now be fabricated with Co-Cr and titanium alloys by selective laser melting (SLM), a rapid prototyping technology. The advantages of this technology are high precision, appropriate mechanical strength, and the ability to make complicated framework shapes. In this case, CAD/CAM technology was used to fabricate a denture framework and bar attachment with magnets for an implant-supported removable partial denture (IRPD).

【Method】
A bar attachment for an IRPD was milled from a pure titanium disk within the wax denture, and the magnetic attachment keeper was placed on it. After the working cast with a bar attachment and the wax denture were both scanned, the denture framework was designed by CAD. The framework was then fabricated by SLM with Ti-6Al-4V alloy powder.

【Results, Discussion】
A titanium milled bar attachment with magnets and a laser-sintered framework were used for the IRPD. Greater retention, as well as increased strength and accuracy, can be obtained using magnetic attachments and CAD/CAM technology.

Introduction

In recent years, CAD/CAM technology has been successfully introduced to restorative dentistry and maxillofacial technology. Moreover, selective laser melting (SLM) rapid prototyping technology can be applied successfully for the fabrication of a removable partial denture alloy framework. The advantages of this technology are high precision, appropriate mechanical strength, and the ability to make complicated framework shapes. This case report describes the fabrication of a denture framework and bar attachment with magnets for an implant-supported removable partial denture (IRPD) using CAD/CAM technology.

Outline of the Case

The patient was a 67-year-old partially edentulous woman with five remaining teeth (#17, #23, #25, #26, and #27) in the maxillary arch and four missing teeth (#36, #37, #46, and #47) in the mandibular arch. Her chief complaint was an unstable existing maxillary denture. A panoramic radiograph showed severe ridge resorption in the maxillary molar regions (Figs.1,2).

The patient was informed about the possibility of using a conventional removable partial denture, implant-fixed prosthesis, and IRPD for the maxillary and mandibular jaws. After giving informed consent, the patient selected an IRPD for the maxillary jaw and an implant-fixed prosthesis for the mandibular jaw.

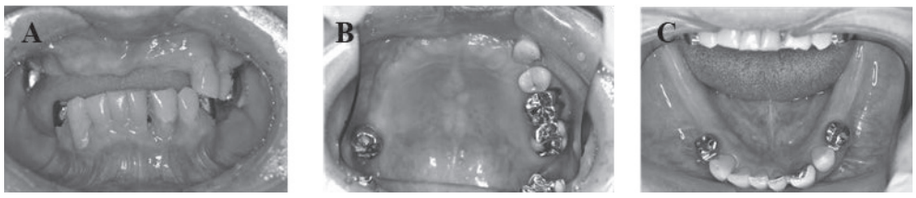

Fig.1 Intraoral view before treatment:
A. Frontal view B. Maxillary occlusal view C. Mandibular occlusal view

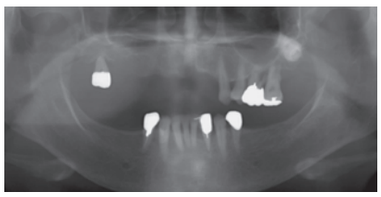

Fig.2 Pretreatment panoramic radiograph

Clinical Procedure

After CT scanning to produce 3D computer-generated images, the position and direction of implant placement were virtually planned using 3D planning software. The simulation data of implant placement were sent to the dental laboratory for the fabrication of the surgical template (Fig.3).

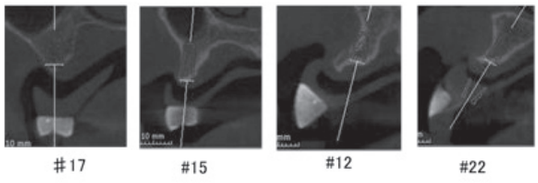

Fig.3 Simulation of implant placement for the maxillary jaw

After #17 was extracted and the surgical template was fixed in the patient's mouth, the implants were placed using the Guided Surgery System (Straumann Japan, Tokyo) (Fig.4). According to the surgical guide, four implants were placed in the #17, #15, #12, and #22 regions in order to minimize denture displacement under bite force in the maxillary jaw (Fig.5). In the mandibular jaw, four implants were placed in the #47, #46, #36, and #37 regions for implant-fixed prosthesis (Fig.6). After implant placement, two remaining teeth (#26 and #27) were extracted due to severe periodontal disease.

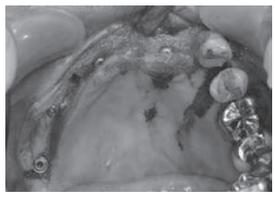

Fig.4 Surgical guide fixed in the mouth Fig.5 Placement of four implants in the maxillary jaw

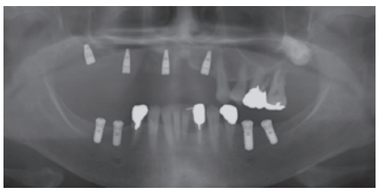

Fig.6 Postoperative panoramic radiograph

After a period of healing, implant-fixed prostheses were fabricated for the mandibular jaw using CAD/CAM. The frameworks of implant superstructures were virtually designed and milled using commercially pure titanium (CP Ti). After implant-fixed prostheses were completed, they were placed on the implant using a retaining screw (Fig.7). In the maxillary jaw, working casts were produced in accordance with the conventional impression technique. The jaw relationship was recorded, and the artificial teeth were conventionally arranged (Fig.8).

Fig.7 Completed mandibular prosthesis

Fig.8 The artificial teeth were conventionally arranged.

The working cast was scanned with a laboratory scanner (D2000, 3Shape). The bar attachment was virtually designed within the wax denture using 3D CAD software (Dental Designer, 3Shape) and milled from a CP Ti disk (Figs.9,10). The keeper of the magnetic attachment (Physio Magnet, NEOMAX) was attached to the bar. After the working cast with a bar attachment and the wax denture were both scanned, the denture framework was virtually designed with 3D CAD software (Dental Lab System, SensAble Technologies) (Fig.11). During the SLM process, the support was attached on the occlusal surface of the denture framework. The framework was fabricated by SLM with 50 μm Ti-6Al-4V alloy powder (Fig.12). After the metal framework was cut from the support, it was finished and polished.

Fig.9 The bar was designed virtually.

Fig.10 The bar was milled from a CP Ti disk.

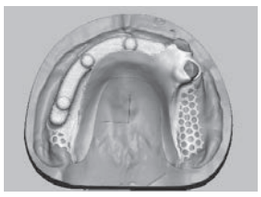

Fig.11 Screen captures of the virtual IRPD framework

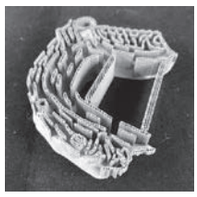

Fig.12 The support was attached on the occlusal surface of the framework.

Fig.13 Completed denture framework

Using heat-polymerized PMMA (Acron, GC Corp.), an IRPD with a laser-sintered framework was conventionally completed (Figs.14,15). The magnetic assembly was connected to the denture base with auto-polymerized resin under occlusal force. Sufficient retention was obtained with a titanium milled bar and magnetic attachments. No clinical problems, such as detachment of the magnetic attachment, decreased retentive forces, or denture breakage, were observed.

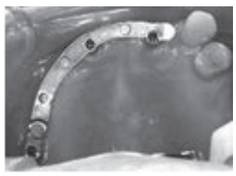

Fig.14 Trial placement of the bar with keepers of the magnetic attachment

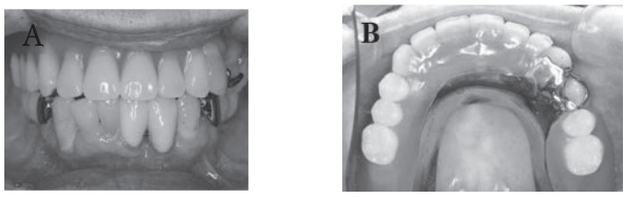

Fig.15 Completed maxillary IRPD: A. Frontal view B. Maxillary occlusal view

Results

Greater retention, as well as increased strength and accuracy, can be obtained using magnetic attachments and CAD/CAM technology.

Experimental verification of the test procedure for measuring the retentive force of magnetic attachments as stipulated in DIS 13017 (Ed.2)

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Abstract

DIS 13107 was established by combining ISO 13017 and its Amendment 1. The test procedure for measuring the retentive force of magnetic attachments was stipulated in the DIS. However, the usefulness of the procedure of the latest DIS 13107 (Ed.2) has not been verified. The aim of this study was to investigate the effectiveness of the test procedure instructions.

Five participants, whose native language is not English, conducted the experiment for the first time. The magnetic attachments used were two flat types and one post type. Measurement was conducted at three stages. Stage 1: Each participant read the DIS standard test procedure manual alone. Stage 2: Participants discussed the procedure with other participants. Stage 3: Participants discussed the procedure with an expert. The validity of the procedure was estimated by comparing the obtained values with a value measured by the expert.

All participants generated adequate values at the second stage. The values at the second and third stages were almost the same. In many cases, the values increased by adjusting the alignment after the samples were fixed. These results indicate that DIS 13017 (Ed.2) is a useful guide for measuring retentive force. More accurate measurement can be performed by appending the following instruction: “Align samples after the fixation.”

Introduction

The International Organization for Standardization, Dentistry—Magnetic attachments, ISO 13017, was published in 2012[1)]. ISO 13017 only outlined the procedure for measuring retentive force. Afterward, the detailed test procedure was established in 2015 and incorporated into ISO 13017 Amendment 1[2)] .

All ISO standards are revised every five years after issuance. Revision meetings for ISO 13017 started in 2017 with amalgamation of ISO 13017 and its Amendment 1 and reconsideration of the procedure for measuring retentive force of dental magnetic attachments. However, the usefulness of the test procedure as stipulated in the latest DIS 13107 (Ed.2) has not been verified.

Objective

The aim of the study was to investigate the effectiveness of the test procedure instructions.

Materials and Methods

1. Participants, samples, and the measuring device

Undergraduate/graduate dental students (A, B, C, D, and E) whose native language is not English, were selected to participate in and conduct the experiment for the first time. Three different samples of magnetic attachments were used—two flat types (GIGAUSS D600, GC; and Hyper Slim 3513, Morita) and one post type (HICOREX post keeper 3513, Morita). The measuring device used (Fig.1) matched that described in DIS 13107 (Ed.2). Measurements were recorded by digital force gauge (ZPS, Imada). The crosshead speed was controlled by a hydraulic check unit (Kinecheck 3022-19-1-1/4, Meiyu Airmatic).

Fig.1 Device for measuring retentive force

2. Prerequisite conditions for the various stages of the experiment

Measurements were conducted in three stages. The validity of the procedure was estimated by comparing the values students obtained with those of an expert.

Stage 1: Each participant reads the DIS standard test procedure manual alone before carrying out the experiment. Discussions among participants are not allowed at this stage.

Stage 2: Participants discuss the instructions among themselves and then repeat the experiment.

Stage 3: Participants discuss the instructions with an expert and carry out the experiment for a third time.

3. Instructions for measuring retentive force

Details of the test method are found in the DIS manual. The outline of the procedure for measuring the retentive force is as follows:

a) Align the centers of the upper and lower table.
b) Place the mating face of the magnetic assembly onto the lower table.
c) Place a drop of the cyanoacrylate adhesive on the top surface of the magnetic assembly. Lower the upper table until it makes contact with the magnetic assembly.
d) Place the keeper on the mating face of the magnetic assembly, and make sure that it is properly aligned with the magnetic assembly.
e) Place a drop of the cyanoacrylate adhesive on the lower table, then move the upper table down until the bottom surface of the keeper makes contact with the lower table. If necessary, reinforce the bonding area with a self-curing acrylic resin.
f) Load the specimens in tension on the device at a crosshead speed of 2.0 mm/min.
g) Acquire the retentive force of the magnetic attachments [C, Fig.2] by subtracting the dead weight of the device including its moving friction [B, Fig.2] from the separation point value [A, Fig.2].
h) Repeat the retentive force measurements for each of the three specimens four times to generate five measurements for every stage of instructions per specimen. In this study, the average value is obtained from five measurements.

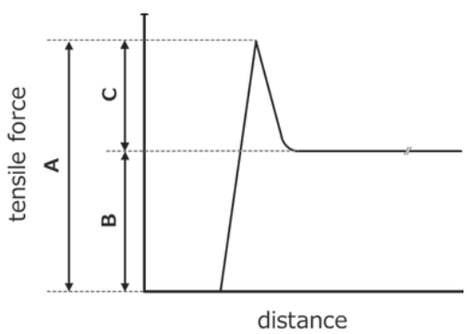

Fig.2 Retentive force curve

4. Statistical analysis

Generated data were statistically analyzed using an ANOVA and Tukey's HSD test (α=0.05).

Results

The retentive forces measured by each participant are shown in Fig.3. All of the values attained during the second stage, except in the case of HICOREX by participant A and GIGAUSS by participant B, matched the values measured by the expert. The retentive force values of all magnetic attachment specimens in the second and third stages were higher than those of the first stage ($p<0.05$). The values for each magnetic attachment sample during the second and third stages were nearly same for all participants ($p>0.05$).

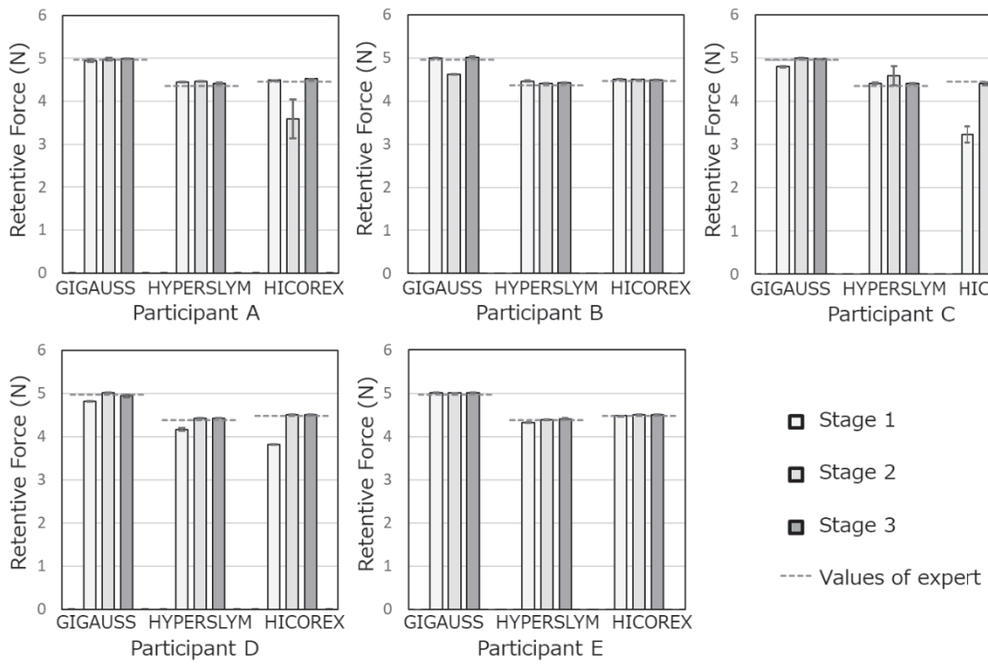

Fig.3 Retentive forces measured by each participant

Discussions

Retentive force values of the second stage mostly matched those of the expert. This demonstrates that discussing the instructions with other participants aids in understanding the test procedure and improves the measurement technique. Second- and third-stage values, which were almost the same, prove that accurate measurements can be obtained by individuals carrying out the test for the first time without help from an expert.

The values measured by participants C and D during the first stage did not match those of the expert. Differences in participants' carrying out of the measurements involved the factors discussed below.

(i) The type of cyanoacrylate adhesive used

Cyanoacrylate adhesive is available in liquid and jelly formulations. Theoretically, the retentive force does not change based on the formulation used as long as the glue sets completely. However, the setting time is different for the two types. The jelly type, being thicker, has a longer setting time, as compared to the liquid type. Moreover, the setting reaction of cyanoacrylate adhesives starts from the surface in contact with the air and proceeds inward[3] . Since participants A (stage 2, HICOREX) and C (stage 1, HICOREX) used the jelly type and measured retentive force before the setting process was complete, the values acquired were lower. In order to measure retentive forces accurately, measurement should only be carried out after the cyanoacrylate adhesive has set completely.

(ii) Temporary fixation while securing a magnetic assembly on the upper table

ISO 13017 Amendment 1[2] stipulates that the magnetic assembly should be attached to the lower table using an adhesive double-sided tape. That description was deleted and does not appear in the current DIS, as recent research has proven that there was no difference in the retentive force measured whether or not double-sided tape was used[4] . However, the following sentence remained in the DIS: "*Provisionally place the mating face of the magnet (or magnetic assembly) toward the center of the lower table.*" Participants D and E interpreted "*provisionally*" as "temporary adhesion/fixation" and used the double-sided tape. The double-sided tape did not affect the retentive force—a finding that is in agreement with that of the previous study[4] .

(iii) Alignment after fixation of the magnetic assembly and keeper

The DIS presumes that the center of the magnetic assembly and that of the keeper are automatically congruent when a keeper is placed onto the mating face of a magnetic assembly that is bonded to the upper table. However, the centers may be out of alignment because the placement of the keeper onto the mating face depends on the tactile sensation of the operator doing the experiment and his visual ability to ascertain that the centers are not horizontally displaced. Alignment between the magnetic assembly and the keeper is the most important factor in measuring retentive forces[5] . Therefore, after fixing the magnetic assembly and keeper on the tables, the alignment should be adjusted and confirmed by the X-Y stage. However, the need to readjust the alignment is not contained in the DIS. During the first stage, participants B, C, D, and E measured the retentive force without readjusting the alignment (see Fig.4). Since the measured values improved during the second stage after the addition of the sentence "align the centers of samples after the fixation"; it would be important to append the phrase to the test procedure.

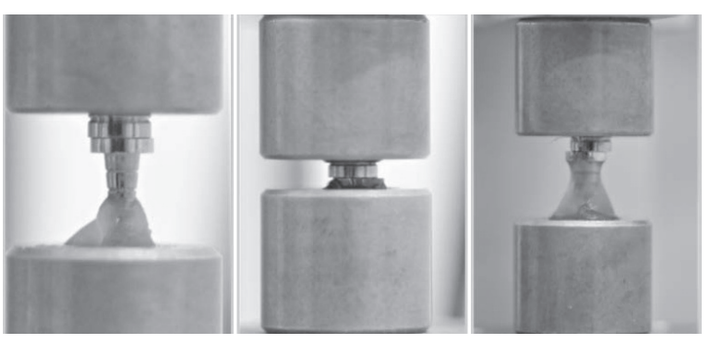

Fig.4 Possible misalignment between the magnetic attachment and the keeper

(iv) Fixation technique of the post keeper type

The participants used different methods to secure the post keeper to the table. One participant used a table with a hole for the post, whereas another reinforced the bonding area between the post keeper and lower table using self-curing acrylic resin. However, the measured values did not differ significantly among participants. As long as the post keeper is fixed correctly, the retentive force can be measured with sufficient accuracy, a finding that is in agreement with that of a previous study[6] .

Conclusions

These results indicate that DIS 13017 (Ed.2) is a useful guide for measuring retentive force. More accurate measurements can be performed by appending the following clause: “Align samples after the fixation.”

Acknowledgments

The authors gratefully acknowledge Dr. Mary Kanyi for her English proofreading.

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Esthetic denture using a magnetic attachment for a patient with anterior teeth missing: A case report

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Abstract

【Introduction】

The patient was a 62-year-old female with three anterior teeth removed due to odontogenic myxoma in her mandibular jaw. Her chief concerns were esthetics and a functional prosthetic rehabilitation. For the missing teeth with a defect of the alveolar bone, a sectional removable partial denture (RPD) was fabricated using a magnetic attachment.

【Materials and Methods】

The metal base denture was composed of labial and lingual segments to utilize the undercut of adjacent teeth for denture retention. The framework of the lingual segment was first cast with a Co-Cr alloy and then placed on the master cast. Next, the labial segment framework was cast to completely fit to the lingual segment. Both segments were connected using a magnetic attachment (PHYSIO MAGNET, NEOMAX). After artificial incisors were arranged on the labial segment framework, denture base resin was poured and polymerized, and the sectional RPD was finally completed.

【Results, Discussion】

Using magnetic attachments, the sectional RPD could be fabricated without a metal clasp, providing better esthetics and greater function and retention. However, long-term follow-up is necessary for keeping the connective strength between the labial and lingual segments and confirming the clean condition of the joint area.

Introduction

This case report describes the fabrication of a sectional removable partial denture (RPD) using magnetic attachments for missing anterior teeth and a large bone defect to recover function and esthetics.

Treatment Progress

2016/ June	Initial visit
July	Surgical removal of a tumor and extraction of #43, #42, and #41
December	Delivery of the acrylic denture
2018/ March	Start of the sectional RPD fabrication
October	Delivery of the sectional RPD

Fig.1 Missing anterior teeth with alveolar bone

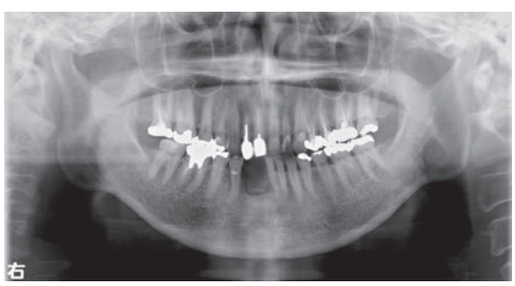

Fig.2 Panoramic X-ray

The patient was a 62-year-old female who visited the Tsurumi University School of Dental Medicine with swelling in the mandibular right anterior tooth region. After the diagnosis of an odontogenic myxoma, the tumor was removed, along with three anterior teeth and the alveolar ridge (Fig.1,2). Six months after the operation, an acrylic denture with metal clasps was delivered (Fig.3), and its impression surface was adjusted to the alveolar ridge resorption. One year later, a sectional RPD was fabricated using a magnetic attachment.

Fig.3 Delivery of the acrylic denture with a clasp

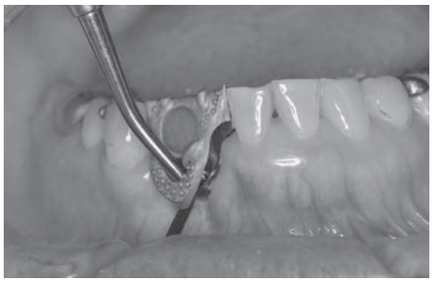

Fig.4 Try-in of the RPD framework

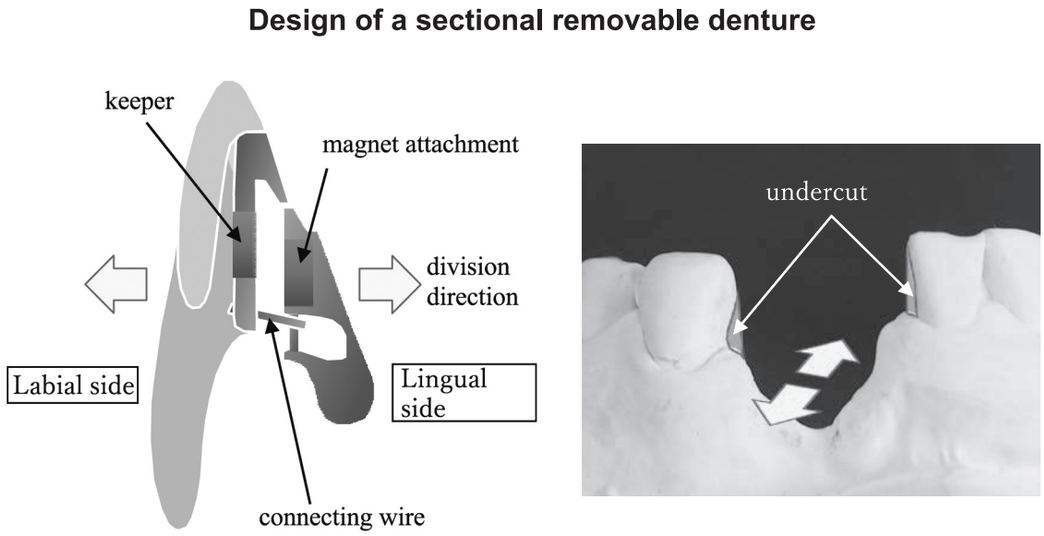

Fig.5 Design structure of the sectional RPD

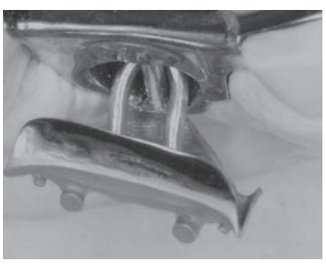

Fig.6 Connecting two segments with wire to prevent separation

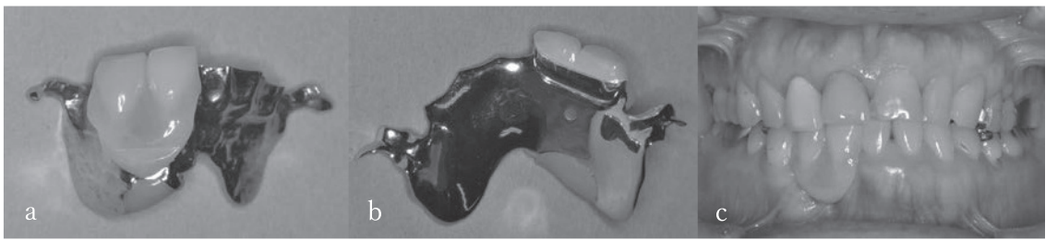

Fig.7 a, b: Sectional RPD (a: labial side, b: lingual side), c: Frontal view after delivery

The metal base denture was composed of labial and lingual segments to utilize the undercut of adjacent teeth for denture retention. The framework of the lingual segment was firstly cast with a Co-Cr alloy and then placed on the master model. Next, the labial segment framework was cast to completely fit to the lingual segment. Both segments were connected using a magnetic attachment (PHYSIO MAGNET, NEOMAX) and Co-Cr wire (Figs.4–6).

After artificial incisors were arranged on the labial segment framework, denture base resin was poured and polymerized, and the sectional RPD was finally completed (Fig.7).

Results and Discussion

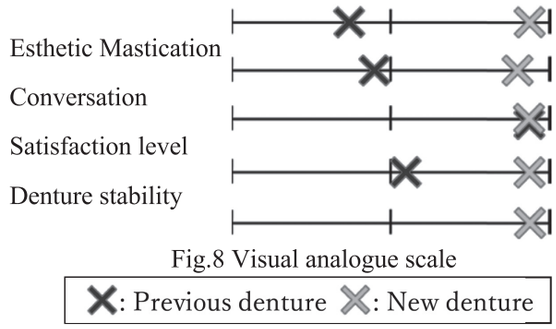

Fig.8 Visual analogue scale

Using magnetic attachments, a sectional RPD could be fabricated without a metal clasp. Patient satisfaction could be obtained because it provided better esthetics, function, and retention (Fig.8). However, long-term follow-up is necessary for maintaining the connective strength between the labial and lingual segments and to confirm the clean condition of the joint area.

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Affiliation: Times New Roman 11 pt, ex. Division of Dental Biomaterials, Graduate School of dentistry, Tohoku University
[1]Depatrtment of Magnet Science, School of Dentistry, Inaka College
[2]Laboratry of Magnet, Institute of Sendai

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Conclusion
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2. Book (example): R. Kunin, On Exchanging Resins, pp 88, Robert E. Kreiger Publishing Company, New York, 1972.