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Proceedings of the 15th International Conference on Magnetic Applications in Dentistry

The Japanese Society of Magnetic applications in Dentistry

The 15th International Conference on Magnetic Applications in Dentistry

The 15th International Conference on The Japanese Society of Magnetic Applications in Dentistry organized by JSMAD was held on the Internet as follows;

Meeting Dates:

February 29 to March 18, 2016

Location:

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http://www.jsmad.jp/international-e.shtml

General Chair:

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Conference Secretariat:

Dr. Manabu Kanazawa, Tokyo Medical and Dental University

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 16th International Conference on Magnetic Applications in Dentistry General Information

General Information

The Japanese Society of Magnetic Applications in Dentistry (President: Shinichi Masumi, Kyusyu Dental University) is a scientific association founded in 1991 and is devoted to furthering the application of magnetism in dentistry. The 16th International Conference on Magnetic Applications in Dentistry organized by JSMAD will take place on the Internet as follows.

Meeting Dates:

Tuesday, February 28 to Friday, March 17, 2017

Location:

JSMAD web site:
http://www.jsmad.jp/international-e.shtml

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Prof. Motonobu Miyao, Asahi University

Subjects:

Researches and developments related to dentistry and magnetism such as:

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- Orthodontic appliances using magnets
- Measurement of jaw movement using magnetic sensors
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Registration:

Send e-mail titled "registration for 16th international conference" with your Name, University or Institution, Postal address, Phone, Fax and E-mail address to conference secretariat.

Registration Fees:

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.)

Guidelines for Presentation

Deadlines:

Entry: January 27, 2017
Poster submission: February 16, 2017

Entry:

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Notice to Contributors:

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Note:

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Contents

Practical application of self- and light-curing resin for attaching a magnetic assembly to the denture base resin

M. Imamura, S. Nakabayashi, T. Ishii, S. Saito, N. Tsukimura, T. Ohyama, D. Akita and T. Ishigami

Department of Partial Denture Prosthodontics, Nihon University School of Dentistry

Abstract

Generally, a magnetic assembly is attached to the inner denture base resin using self-curing resin. However, due to polymerization shrinkage, it is often difficult to demonstrate sufficient retentive force for the air gap between the keeper and the magnetic assembly.

In this study, we compared the retentive force using self-curing resin and low-shrinking light-curing resin.

Ninety magnetic assemblies were placed on the keeper fixed by the resin and attached to inner resin blocks using self- or light-curing resin as categorized in the following three groups: (1) Unifast III (n=30), (2) Unifast LC (n=30), and (3) G-FIX (n=30). The retentive forces between the keepers and the attached magnetic assemblies were analyzed.

A universal testing machine recorded that the magnetic assemblies attached by G-FIX achieved the highest scores. Our results suggest that low-shrinking light-curing resin may suppress the lifting of the magnetic assembly from the keeper due to polymerization shrinkage. Therefore, G-FIX is a promising dental material for attaching magnetic assemblies to the inner denture base resin.

Introduction

Generally, a magnetic assembly is attached to a denture base resin using self-curing resin. However, due to polymerization shrinkage, a sufficient retentive force is often suppressed by the air gap between the keeper and the magnetic assembly.

Objective

In this study, the retentive force was compared with three different height spaces on the magnetic assembly that were filled with self-curing resin or light-curing resin with low shrinkage.

Materials and Methods

GIGAUSS D400 and D600 magnetic assemblies (GC Company®) and a gypsum dummy were used as specimens. The diameters of the magnetic assemblies increased from D400 to D600; however, the height was the same (1.3 mm). The diameter of the gypsum dummy was 0.3 mm wider than that of the magnetic assembly, and the height was 0.3 mm higher than the top surface of the magnetic assembly (Fig. 1).

Ninety magnetic assemblies were placed on the keeper and were fixed by the resin and attached to resin blocks using self- or light-curing resin as categorized in the following three groups: (1) Unifast Ⅲ No. 8 (GC Company®) (n=30), (2) Unifast LC (GC Company®) (n=30), and (3) G-FIX (GC Company®) (n=30). The retentive forces between keepers and attached magnetic assemblies were analyzed.

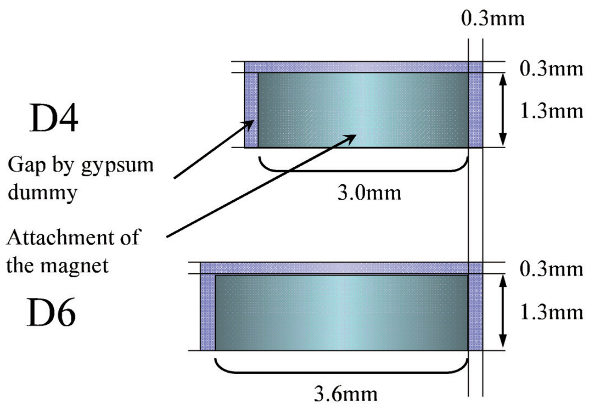

Fig. 1 Diameter and height space of magnetic assembly and gypsum dummy (various)

Additionally, sheet wax of the same thickness as a spacer (0.6 mm and 1.2 mm) was added to the gypsum dummy.

1) Adjustment of the space

The gypsum dummy without added sheet wax was the control (referred to as the C group) (Fig. 2).

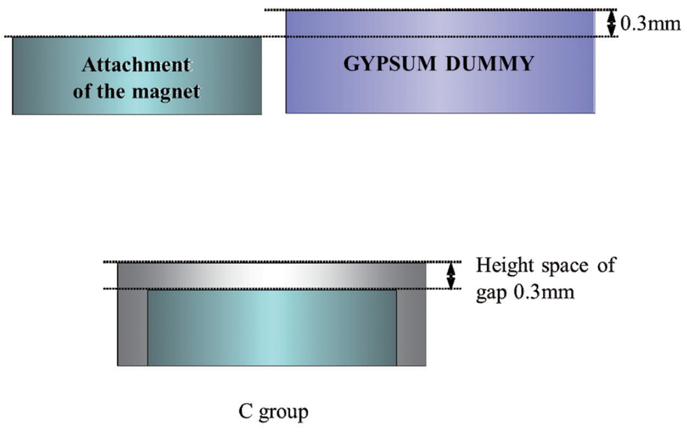

Fig. 2 Amount of gap when sheet wax is not added, and it makes it to spacer

Adding 0.6 mm of sheet wax (two sheets) to the gypsum dummy made the spacer 0.9 mm, which is three times as long as that of the C group (referred to as the 0.9 group) (Fig. 3).

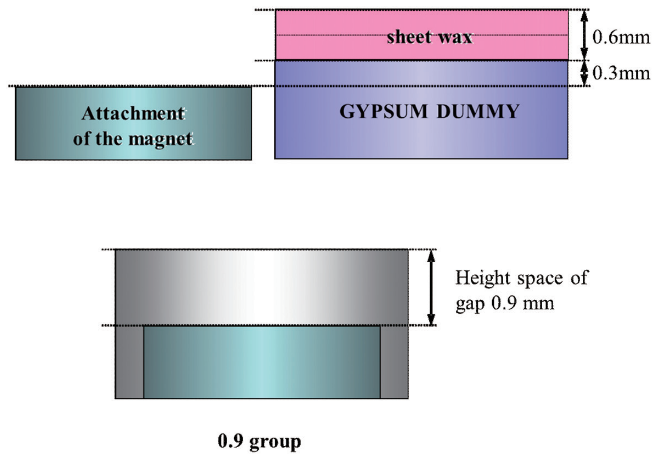

Fig. 3 Gap space when as many as two sheets of wax are added

Adding 1.2 mm of sheet wax (four sheets) to the gypsum dummy made the spacer 1.5 mm, which is five times as long as that of the C group (referred to as the 1.5 group) (Fig. 4).

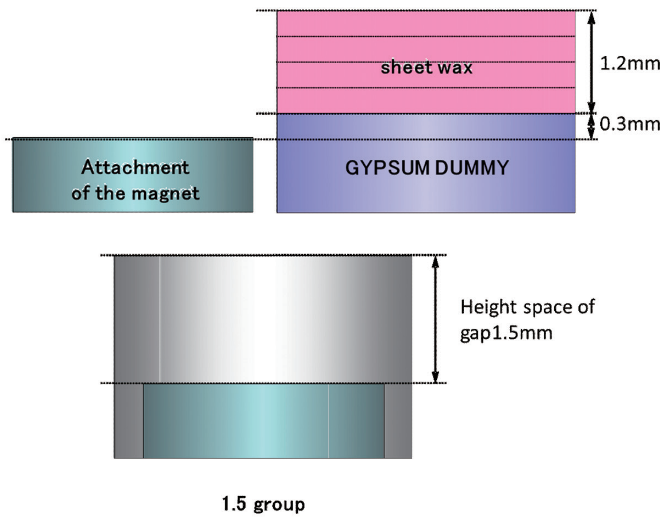

Fig. 4 Gap space when as many as four sheets of wax are added

2) Preparation of the resin block

A resin block (10×10×7 mm) was placed on a specimen with three different spaces (Fig. 5).

A spillway within the resin block was formed with a round bar No. 6 (φ1.6 mm) (Fig. 6).

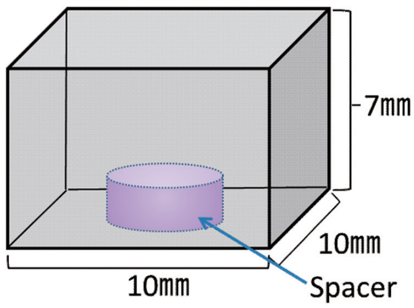

Fig. 5 Resin block from the adjusted spacer

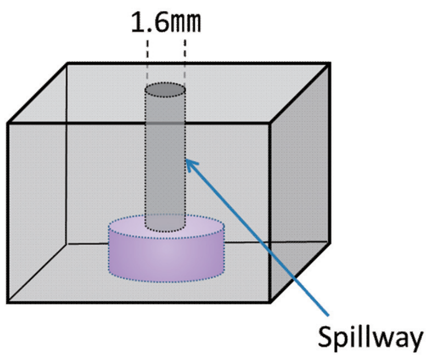

Fig. 6 Resin block after Spillway is formed

3) Attachment of the magnetic assembly

Before attachment, alumina sandblasting was performed on the surface of the magnetic assembly, and metal primer Z (GC Company®) was coated.

With Unifast Ⅲ and Unifast LC, the standard ratio of powder to liquid (2 g/1 ml) was mixed for 10 seconds to fill the same amount in the spacer, and the magnetic assembly was attached within 60 seconds from the start of mixing.

On the other hand, G-FIX was inserted from the spillway using a syringe after resin blocks were held by hand. The material was carefully poured along the edge (Fig. 7).

During attachment of the magnetic assembly using Unifast Ⅲ, 150 g of static loading was applied 150 seconds after the start of mixing at room temperature.[2)]

For Unifast LC and G-FIX, while handheld, the light was irradiated toward the upper surface of the magnetic assembly longitudinally for 20 seconds from the top of the spillway (Fig. 8).

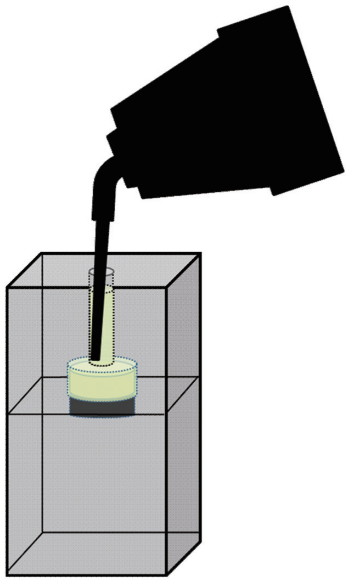

Fig. 7 Insertion by syringe from the spillway

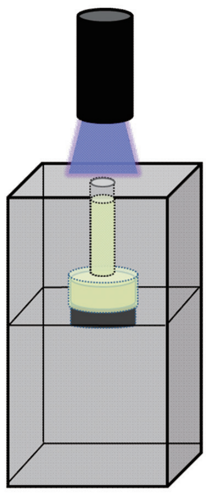

Fig. 8 Irradiation from the top of the spillway with light-curing units

4) Tension test

The retentive force was measured in a universal testing machine (EZ-Test, SHIMADZU, Kyoto, Japan), and D400 and D600 magnetic assembly-keeper compositions were tested five times for each specimen with a crosshead speed of 5 mm per minute. The specimens were pulled, the point at which the magnetic assembly was detached from the keeper was measured, and the mean values were compared.

5) Statistical Analysis

A two-way ANOVA and the multi-comparison of Tukey's test were used to compare attaching space of three different height to the magnetic assembly with self-curing resin or light-curing resin with low shrinkage; < 0.05 was considered statistically significant (Mean g ±SD).

Results

Tables 1 and 2 show comparisons of the retentive forces of three different height spacers attached to the magnetic assembly that were filled with self-curing resin or light-curing resin with low shrinkage.

	G-FIX	Unifast Ⅲ	Unifast LC
C group	334.2(±3.1)	310.1(±1.8)	313.9(±5.8)
0.9 group	319.7(±4.5)	304.9(±16.3)	294(±12.0)
1.5 group	293.4(±6.7)	243.8(±21.2)	251(±5.5)

Table. 1 The average value of the retentive force and the standard deviation in D400 (Mean g ±SD)

	G-FIX	Unifast Ⅲ	Unifast LC
C group	509.8(±7.9)	487.8(±10.4)	463.1(±13.1)
0.9 group	473.4(±14.3)	445.3(±9.3)	418.6(±22.7)
1.5 group	406.4(±14.3)	363(±5.4)	349.2(±6.2)

Table. 2 The average value of the retentive force and the standard deviation in D600 (Mean g ±SD)

In Fig. 9, the retentive force is shown for the different three materials and the three spacers in D400. The underlined value of a vertical axis was a mean of the retentive force of the magnetic attachment alone, which was specified as a standard value.[3)]

In the attached material, the retentive force became progressively smaller in the C group, the 0.9 group, and the 1.5 group. Among the spacers, the C group in G-FIX had the greatest retentive force significantly, which was closest to the standard value in D400.

The D600 figure demonstrates that, as the space on the magnetic assembly was higher, the retentive force decreased significantly in G-FIX, Unifast Ⅲ, and Unifast LC. In the 0.9 group and the 1.5 group, the retentive force in G-FIX was significantly greater than in other materials, which was also closest to the standard value as shown in Fig. 10.

The retentive force of Unifast LC had mostly the same data as those of Unifast Ⅲ at each spacer, as seen in Figs. 9 and 10.

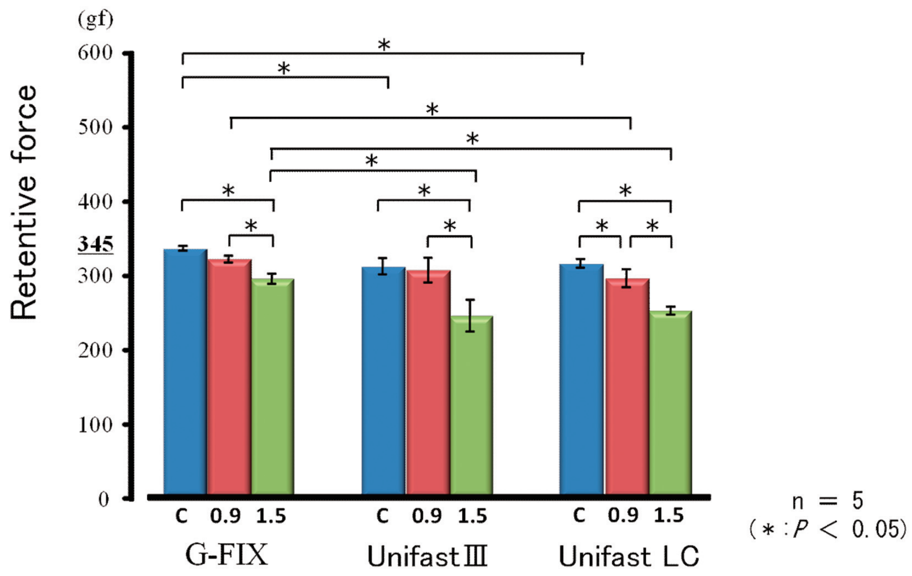

Fig. 9 Retentiveforce when using different materials and spacers in D400

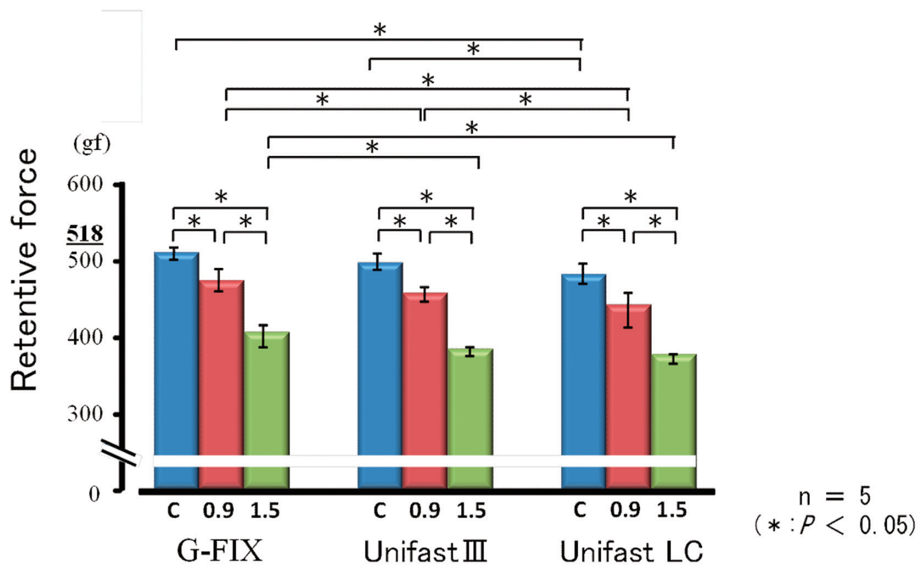

Fig.10 Retentive force when using different materials and spacers in D600

Conclusion

In D400 and 600, the retentive force was clearly reduced in the C group, the 0.9 group, and the 1.5 group in each material as well as in Nakabayashi's previous report.[1)]

In each spacer, G-FIX had the highest retentive force, which was closest to a standard value.

When attaching a magnetic assembly to the denture base resin, a low-shrinkage material, such as G-FIX, was capable of suppressing the occurrence of air gaps. It is supposed to be a material that can demonstrate sufficient reproducibility of the retentive force without the air gap.

References

1. S. Nakabayashi, H. Takimoto, T. Ishigami, et al.: Regarding relations between the amounts of cold-curing resin used for attaching a magnet structure and suction power, The 14th Scientific Meeting of the Japanese Society of Magnetic Applications in Dentistry, Kitakyushu, 2005.
2. S. Endo, T. Ishigami, K. Miyata, et al.: Hardening time of self-curing resin for installing magnets and removing denture, The 18th Scientific Meeting of the Japanese Society of Magnetic Applications in Dentistry, Morioka, 2009.
3. K. Suda, Y. Umekawa, M. Hasegawa, et al.: The retentive force measurement of magnetic attachment in ISO measurement jig using a linear ball slide, The 22nd Scientific Meeting of the Japanese Society of Magnetic Applications in Dentistry, Noboribetsu, 2013.

Long-term fixation of a modified magnet assembly to the denture base using soft resins

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Department of Removable Prosthodontics, Tsurumi University School of Dental Medicine

Abstract

Introduction:

Special care must be taken during the fixation of the magnetic assembly because it may become impossible to remove the denture from the abutment teeth or implant due to the PMMA resin's hardening within the undercut around the keeper. The aim of this study was to investigate the durability of fixation strengths and attractive forces of magnetic assemblies to denture bases using soft resins for long-term use.

Materials and Methods:

Magnetic assemblies with different undercuts and three resins (experimental resin, temporary filling resin, and conventional PMMA resin) as fixation materials to the magnetic assembly were prepared in this study. Tensile testing was performed to evaluate the durability of fixation strength and the attractive force of the magnetic assembly after repeated insertion/removal fatigue testing. The data of fixation strengths and attractive forces were analyzed using a two-way ANOVA, Tukey's multiple comparison, and t-test (α=0.05).

Results and Discussion:

The magnet assembly was detached using experimental resin during fatigue testing. After repeated insertion/removal fatigue testing until 50,000 cycles, the temporary filling resin and conventional PMMA resin demonstrated constant attractive forces without removing the magnetic assembly. This might suggest that when the PMMA resin and temporary filling resin are integrated into the modified magnet assembly, it might be less detachable from denture bases in the long term.

Introduction

The magnetic assembly has been directly fixed to the denture base with autopolymerized polymethyl methacrylate (PMMA) resin using the brush-on technique after the magnetic assembly was placed on the keeper of the abutment tooth or implant. However, special care must be taken during fixation because it may become impossible to remove the denture from the abutment teeth or implant due to the PMMA resin's hardening within the undercut around the keeper. Modified magnetic assemblies and new fixation materials for wearing magnetic assembly to the denture base have been investigated to resolve serious problems. In this study, a modified magnetic assembly and fixation materials were evaluated by fatigue testing for their durability.

Objective

The aim of this study was to investigate the durability of fixation strengths and attractive forces of magnetic assemblies to denture bases using many types of fixation materials.

Materials and Methods

To evaluate the effectiveness of mechanical retention in this study, a commercially available magnetic assembly (PHYSIO MAGNET 35, Neomax, Gunma, Japan; diameter: 3.5 mm; thickness: 0.8 mm; attractive force: approximately 5.5 N) was modified by adding an undercut wing (wing diameter [undercut]: 4.5 mm [0.5 mm]). A conventional magnetic attachment (PHYSIO MAGNET 35, Neomax, Gunma, Japan) of the same size without undercut wings was compared as a control (Fig. 1).

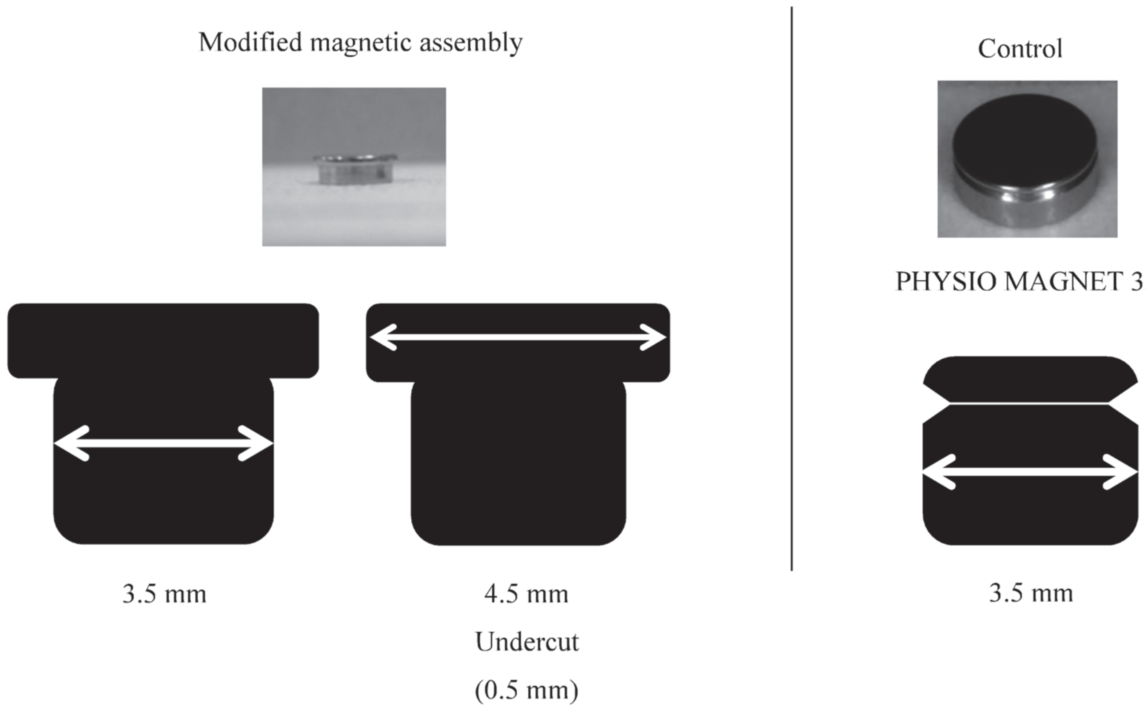


Fig. 1 Magnetic assemblies modified by adding an undercut wing (wing diameter [undercut]: 4.5 mm [0.5 mm])

An experimental resin (70% polyethylene glycol dimethacrylate 23G and 30% MMA in the monomer, 20% polybuthylmethacrylate and 80% PMMA in the polymer), a temporary filling resin (DuraSeal, Reliance Dental Mfg. Co., Worth, IL, USA), and an autopolymerized PMMA resin (UNIFAST III, GC Corp., Ltd., Tokyo, Japan) were selected as fixation materials. Magnetic assemblies were bonded to the lower jig using a cyanoacrylate adhesive (ARON ALPHA, Toagosei Co., Ltd., Tokyo, Japan) for tensile testing (Fig. 2). For repeated insertion/removal fatigue testing, the keeper was mounted in the lower jig, and the magnetic assembly was placed on the keeper without a cyanoacrylate adhesive. After the polymers and monomers of the fixation materials were mixed, they were applied to the magnetic assembly and poured into the housing in the upper jig (Fig. 2). Tensile testing was performed to evaluate the fixation strength and the attractive force of the magnetic assembly using resins after repeated insertion/removal fatigue testing of up to 50,000 cycles (Figs. 3 and 4). Tensile strengths were measured by an autography (EZ-S

200N, Shimadzu, Kyoto, Japan) at a crosshead speed of 1.0 mm/min. The data of fixation strengths and attractive forces were analyzed using a two-way ANOVA, Tukey's multiple comparison, and a t-test (α=0.05).

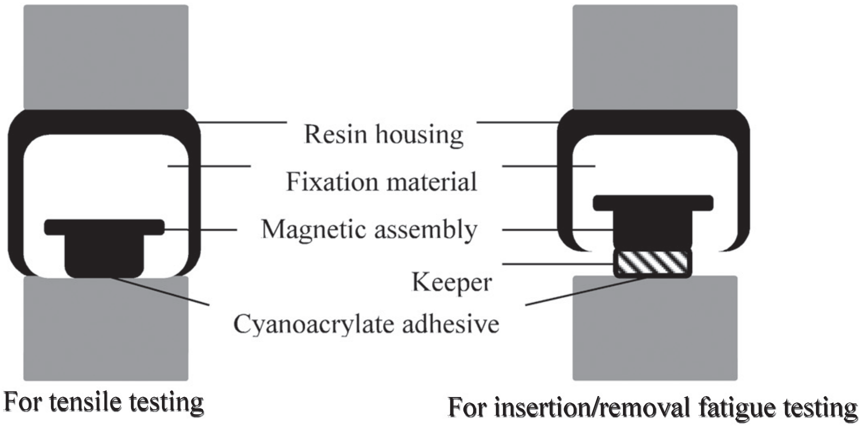


Fig. 2 Fixation of the magnetic assembly for each test

Fig. 3 Autography used for tensile testing

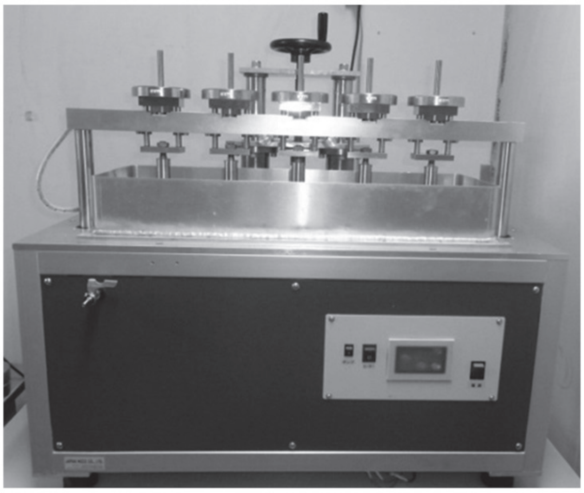


Fig. 4 Insertion/removal testing machine

Results

Figure 5 shows the fixation strengths of magnetic assemblies using three fixation materials, both initially and after 50,000 cycles. The fixation strength of temporary filling resin indicated appropriate potential with a slight decrease. The 4.5-mm modified magnetic assembly was detached from the lower jig, and the fixation strength data could not be measured.

Figures 6 and 7 show the changes in the attractive forces of the magnetic attachments when using fixation materials with and without the undercut wing, respectively. The experimental resins were detached from the magnet assembly during fatigue testing. With and without the undercut wing, the attractive forces of both the temporary filling resin and the conventional PMMA resin showed sufficient attractive forces (4–5 N), and there were no significant differences between the control and the 4.5-mm undercut after repeated insertion/removal fatigue testing of up to 50,000 cycles (p>0.05).

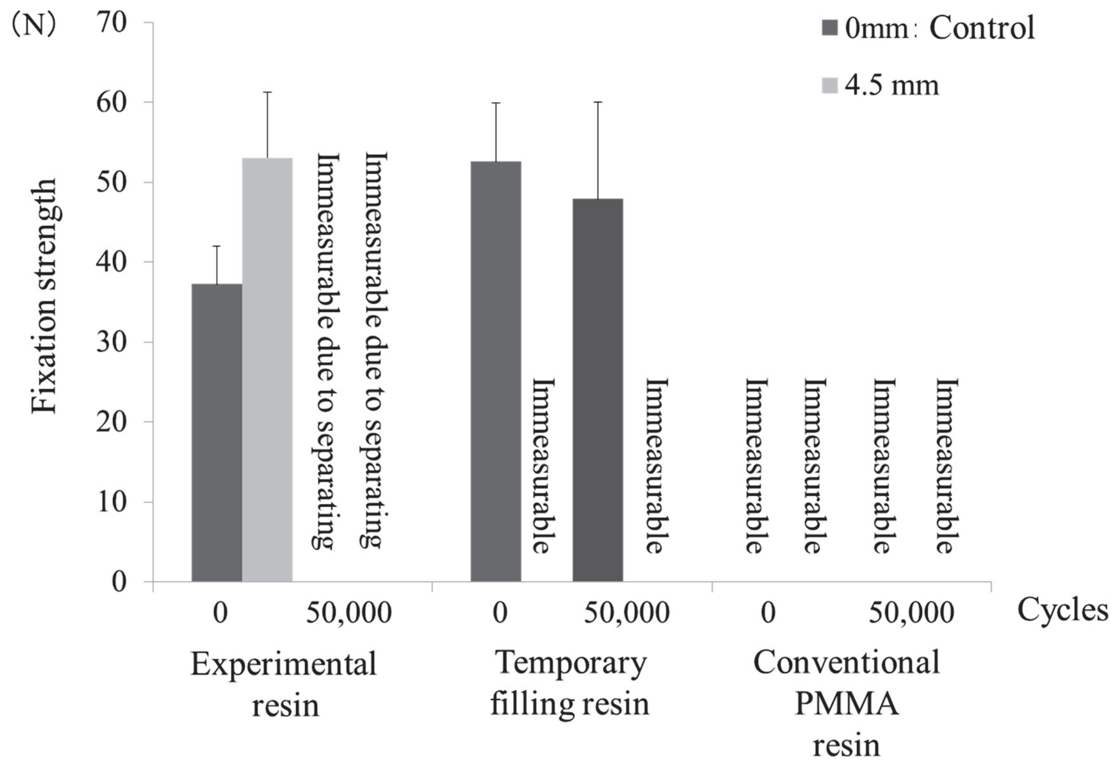


Fig. 5 Fixation strengths of magnetic assemblies using fixation materials

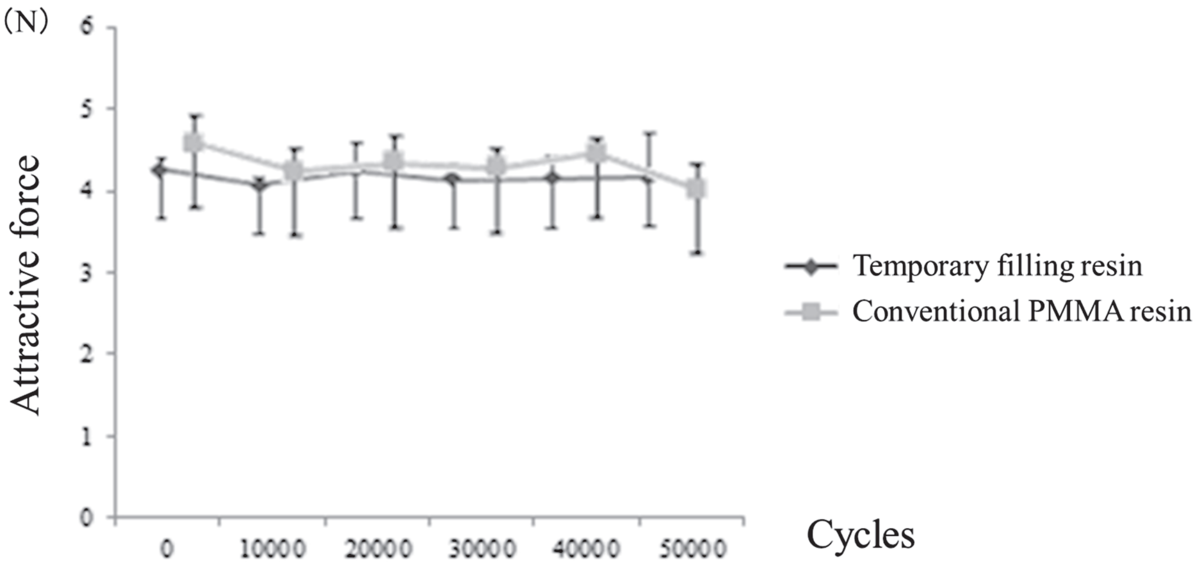


Fig. 6 Changes in attractive forces to the magnetic assembly without an undercut (Control)

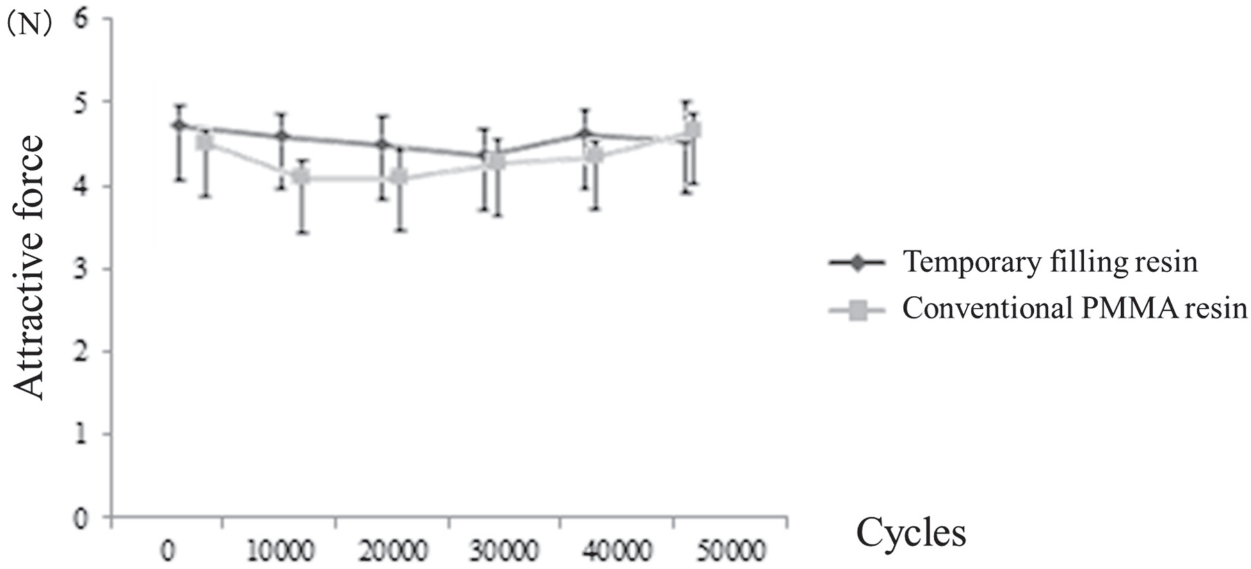


Fig. 7 Changes in attractive forces to the magnetic assembly with a 4.5-mm undercut

Discussion

Regarding the experimental resin, polyethylene glycol (PEG) dimethacrylate 23G and polybuthylmethacrylate were influenced for flexibility, and the polymerization time was expanded. All of the magnetic assemblies were removed from the housing for up to 50,000 insertion/removal cycles. This indicates that the mechanical property of the experimental resin should be improved for rigid fixation. The fixation strengths of the magnetic assemblies using temporary filling resin without undercuts were approximately 50 N after 50,000 insertion/removal motions. The temporary filling resin and the conventional PMMA resin demonstrated constant attractive forces (approximately 4 to 5 N) without removing the magnetic assembly. From the results of fatigue testing, the attempt to use a temporary filling resin as a permanent fixation material similar to conventional PMMA resin would be recommended.

Conclusion

Using an experimental resin, a magnet assembly was detached during fatigue testing, which should improve its mechanical properties. When the temporary filling resin is integrated to the magnetic assembly with an undercut, it might be suggested the less detachment from denture base for long-term similar to using of conventional PMMA resin.

References

1. Okayama S, Suzuki Y, Shimpo H, Ohkubo C: Fixation of magnet assembly to denture base using alternative resins, Dent Mater J, 34(3), 364–370, 2015.
2. Okayama S, Shimpo H, Suzuki Y, Ohkubo C: Fixation of a modified magnet assembly to denture base using alternative resins, J J Mag Dent, 24(2), 23–27, 2015.

Relationship between the thickness and strength of resin bases on top of root caps—Examination of the use of high-impact-resistant denture base resins—

K. Sakurai, E. Nagai, K. Ohtani, S. Nakabayashi, A. Tateno and T. Ishigami

Department of Partial Denture Prosthodontics, Nihon University School of Dentistry

Abstract

Overdenture fractures depend greatly on the thickness of the resin base on top of root caps. However, it is often difficult to have thickness on top of root caps. Therefore, the influence of the thickness of the resin base on top of root caps to denture base strength was evaluated. Two kinds of denture base resin—high-impact resistant and conventional—were compared.

Specimens were made of two kinds of heat-curing denture base resins. Then, each denture base resin was increased in thickness to 2.5, 3.0, and 3.5 mm. The bending strengths with three- and four-point bending of the specimens were measured at a crosshead speed of 5 mm/min in a universal testing machine.

There were significant differences in the thicknesses of specimens and the two kinds of resin. These results indicate that high-impact-resistant denture base resin may be a useful overdenture material.

Introduction

Overdenture fractures depend greatly on the thickness of the resin base on top of root caps. However, it is often difficult to have the thickness on top of root caps. Therefore, the influence of the thickness of the resin base on top of root caps to denture base strength was evaluated. Two kinds of denture base resin—high-impact resistant and conventional—were compared.

Objective

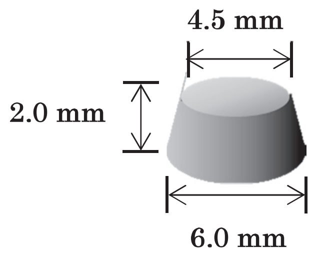
Experiments were performed using two types of bending test (modified 3-point bending test and modified 4-point bending test) on simplified overdenture models.

Materials and Methods

1. Materials

a. Coping models

Figure 1 shows a coping model made of stainless steel (TOKYO GIKEN, Inc.). The coping model's shape was trapezoidal. The trapezoid was 6.0 mm in diameter at the bottom, 4.5 mm in diameter at the surface, and 2.0 mm in height.



Trapezoidal shape coping

Fig. 1

b. Bending specimens

The heat-curing resins used were high-impact resistant (PRO IMPACT, GC) and conventional (ACRON, GC). Rectangular solid bending specimens were fabricated from heat-curing resin. Specimens were 64.0 mm wide, 10.0 mm long, and 2.5, 3.0, and 3.5 mm thick (Figs. 2,3).[1) Polymerized resin blocks were shaped using a semi-automatic polishing machine (Doctor Lap ML 180, NARUTO) and silicon carbide paper.

According to the number of concave portions, two specimen groups were fabricated and named Types A and B. Two specimens were randomly assigned to each group.

Type A had one concave part in the center. Type B had two concave surfaces 9.5 mm and 39.5 mm from the left end of the major axis.

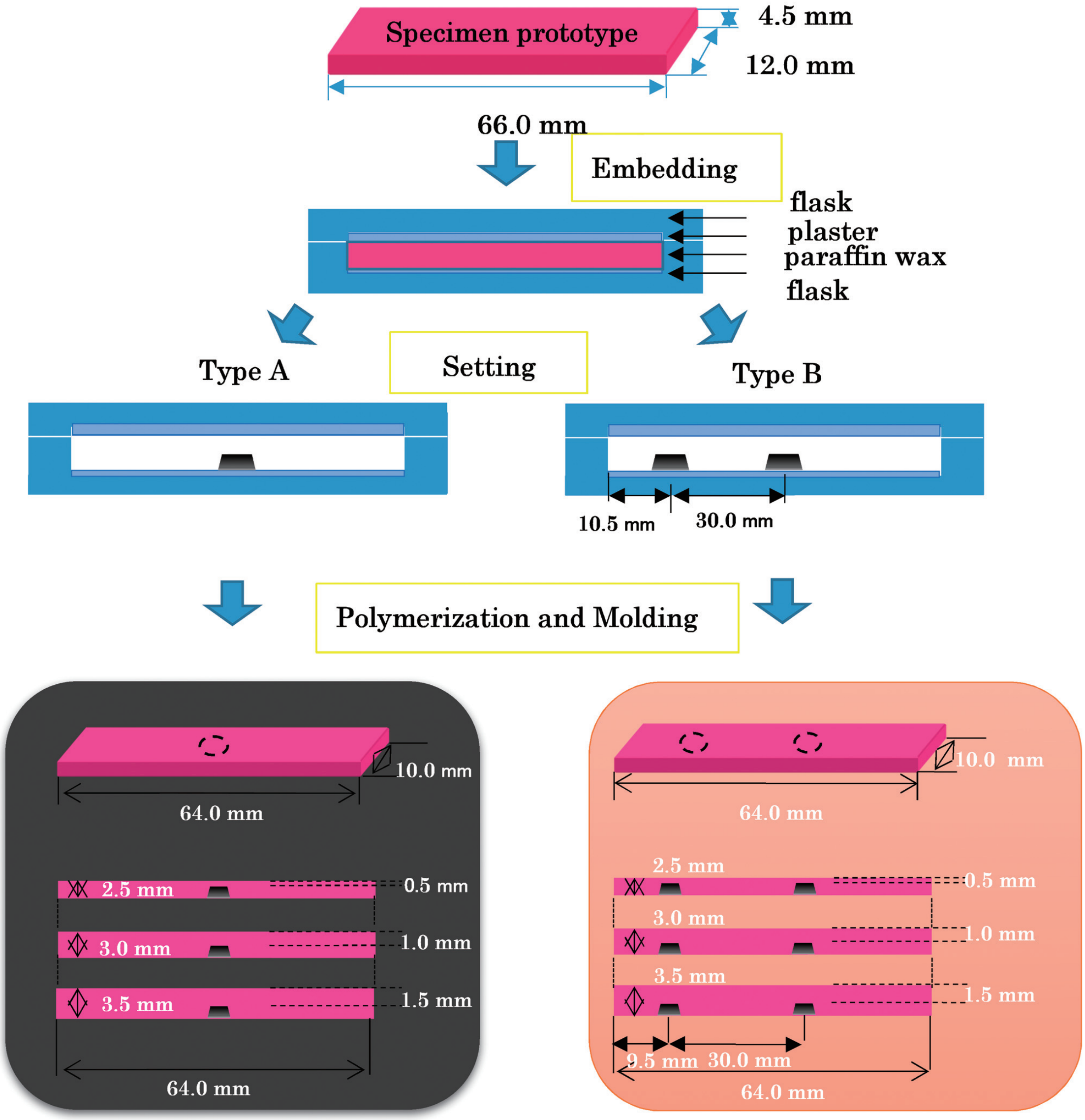


Fig. 2 Fig. 3

2. Methods

Each specimen used in the experiments was soaked in 37℃ water for 48 hours. The bending test utilized a universal testing machine (EZ-test, SHIMADZU). The loading plunger used in the experiments was in accordance with JIS T6501 standards.[2)] The experiments were conducted with two types of bending tests (modified three-point and modified four-point). The modified three-point bending test (3PB) was used for experiment 1, and the modified four-point bending test (4PB) was used for experiment 2.

a. Modified three-point bending test (3PB)

Type A was loaded until it fractured from both sides on a coping model (Fig. 4). The trapezoidal shape coping attached to the universal testing machine and set the Type A on it. The Loading plungers were placed into the crossing head part in the universal testing machine at a distance between fulcrums of 30.0 mm. The bending test was completed at a crosshead speed of 5.0 mm/min. The bending strength of the specimen was measured at the maximum loading point, and the specimen's energy of rupture was measured as the amount of energy until fracture. The average value was also calculated. Acquire data did statistical analysis by critical region 5%. It was used to one-way ANOVA and Tukey's Test for statistical analysis.

Modified four-point bending test (4PB)

Type B was loaded until fracture on the same two kinds of coping models (Fig. 5). The right coping model was loaded from both sides. The left coping model was loaded from one side only. In this state, a unilateral free end was assumed. The bending test was performed at a distance between fulcrums of 30.0 mm and a crosshead speed of 5.0 mm/min. The statistical analysis was similar to that of experiment 1.[3)]

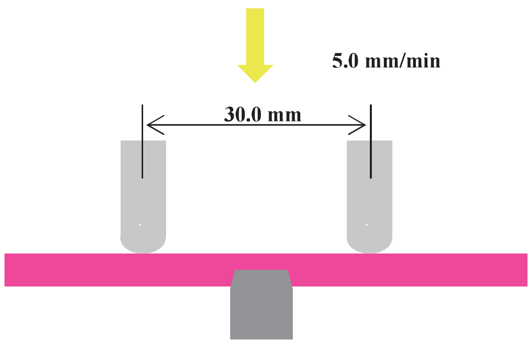


Fig. 4

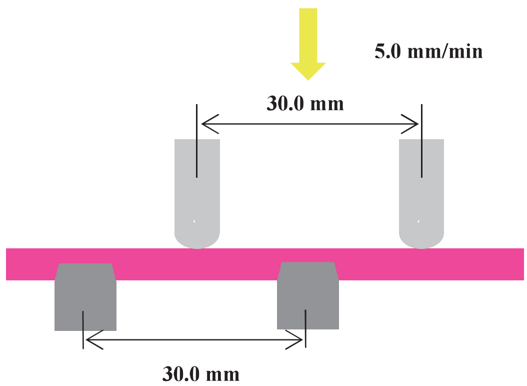


Fig. 5

Results

Figures 6 and 7 show the results of experiment 1. The bending strength and energy of rupture increased significantly in both the ACRON and PRO IMPACT models whenever the thickness of the specimen increased. As a result of the Tukey's test, the PRO IMPACT model showed the lower value significantly than ACRON in each thickness of 2.5 millimeters, 3 millimeters, and 3.5 millimeters for bending strength. The PRO IMPACT model showed significantly higher values of energy of rupture at thicknesses of 2.5 millimeters, 3 millimeters, and 3.5 millimeters.

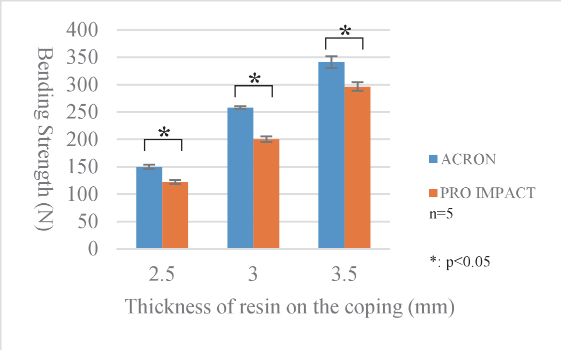


Fig. 6

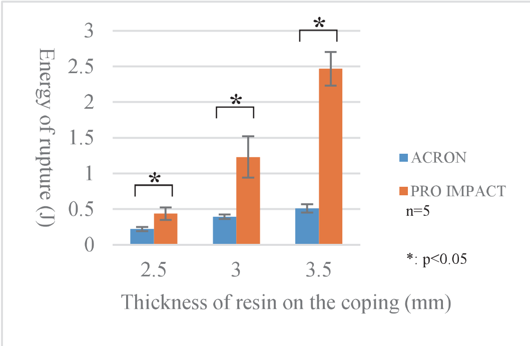


Fig. 7

Figures 8 and 9 show the results of experiment 2. It was not fractured at 3.5 mm in the loading areas of the EZ-test (ACRON and PRO IMPACT). Therefore, the value could not be calculated. Bending strength increased significantly in both ACRON and PRO IMPACT models whenever the thickness of the specimen increased. The significant difference in bending strength was not caused by the bending strength of the PRO IMPACT and ACRON at 2.5 millimeters and 3 millimeters and each thickness. As a result of the Tukey's test, the PRO IMPACT model indicated significantly higher values of energy of rupture than did the ACRON model at each thickness of 2.5 millimeters and 3 millimeters. Values of energy of rupture in the ACRON model increased intentionally whenever the thickness of the specimen increased; however the significant difference of the PRO IMPACT was not observed by thickness.

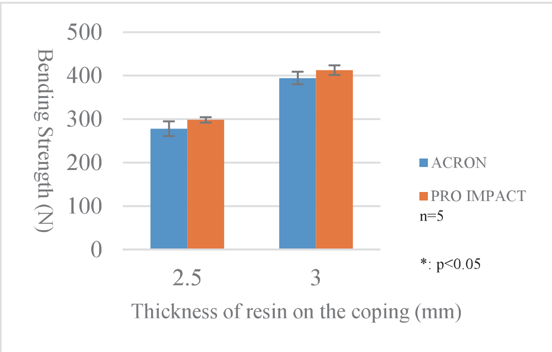


Fig. 8

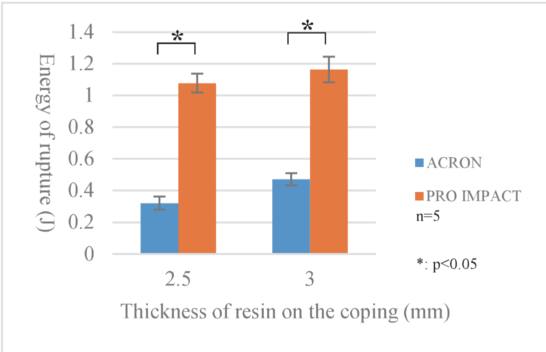


Fig. 9

Discussion

The bending strength of PRO IMPACT was significantly smaller than that of ACRON for the 3PB; there was no significant difference between the ACRON and PRO IMPACT for the 4PB. For the 3PB, PRO IMPACT had the largest elastic modulus in the denture base resin, so the bending strength was smaller.

Conclusion

Bending strength increased significantly in both ACRON and PRO IMPACT models whenever the thickness of the specimen increased. Bending strength was significantly smaller in PRO IMPACT than in

ACRON for the 3PB; there was no significant difference between the ACRON and PRO IMPACT for the 4PB. When comparing ACRON's energy of rupture with that of PRO IMPACT, PRO IMPACT's was considerably larger. Therefore, when compared at the same thickness, PRO IMPACT was suggested to be the material more difficult to fracture.

References

1. E. Kishimoto, K. Ogata, K. Kawahara: The effect of the overdenture abutment teeth on toothbrushing: evaluation with a simulator, J Dent Hlth, 47, 132–138, 1997.
2. JIS T6501: Acrylic denture base resins, 2012.
3. T. Kanazawa, Y. Umekawa, T. Ishii, et al.: Denture base strength influence of its thickness surrounding magnetic assembly: Examination by model experiments, J J Mag Dent, 24(2), 15-18, 2015.

The usefulness of the test procedure for measuring retentive force of dental magnetic attachments as stipulated in the ISO 13017 standard

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Abstract

A detailed procedure for measuring the retentive forces of dental magnetic attachments was published as ISO 13017:2012/Amd.1:2015. However, the effectiveness of the standard procedure has not been established. The aim of this study was to investigate the usefulness of the test procedure instructions. Five participants whose native language was not English conducted the experiment for the first time. Samples of magnetic attachments used include two flat types and one post type. Each participant conducted the experiment in three stages. Each set of measurements was taken after fulfilling the following conditions:
First—Each participant read the ISO standard test procedure manual alone.
Second—Participants discussed only the procedure instructions with an expert.
Third— The experiment was demonstrated practically by an expert.

Two of five participants generated significantly low values after the first stage only. All of the other values (of three participants at the first stage and all participants at the second and third stages) corresponded more than 85% with the figures quoted in the manufacturer's literature accompanying the package. Moreover, participants were more accurate after the second stage discussion.

These results indicate that the test procedure standard in ISO 13017 is a useful guide for measuring retentive force.

Introduction

The international organization for standardization of dental magnetic attachments, ISO 13017, was published in 2012.[1)] However, measuring the retentive force of dental magnetic attachments, one of the items specified by the standard, was difficult because instructions regarding a standard set of procedures had not been developed. Problems pertaining to repeatability, accuracy, and ease of measurements were common. Therefore, the Japanese Society of Magnetic Applications in Dentistry designed a specific device for measuring retentive force and developed the method for carrying out the measurements. Afterward, the proposal was evaluated,[2)] and the detailed test procedure method for measuring retentive force was published in 2015 as ISO 13017 Amendment 1.[3)] However, the effectiveness of the amended standard procedure has not been established with regard to those conducting the experiment, guided by the standard, for the first time.

Objective

The aim of the study was to evaluate the usefulness of the amended test procedure instructions for a first-time user. The specific steps to be improved would also be investigated as part of the process.

Materials and Methods

1. Participants, samples, and the measuring device

Five dental students (A, B, C, D, and E) were randomly selected to participate. Inclusion criteria included a native language other than English and having never conducted the experiment before. Three different samples of dental 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 ISO 13017:2012/Amd.1:2015. The device was connected to a digital force gauge (ZPS, Imada). The crosshead speed was controlled by a hydraulic check unit (Kinecheck 3022-19-1-1/4, Meiyu Airmatic).

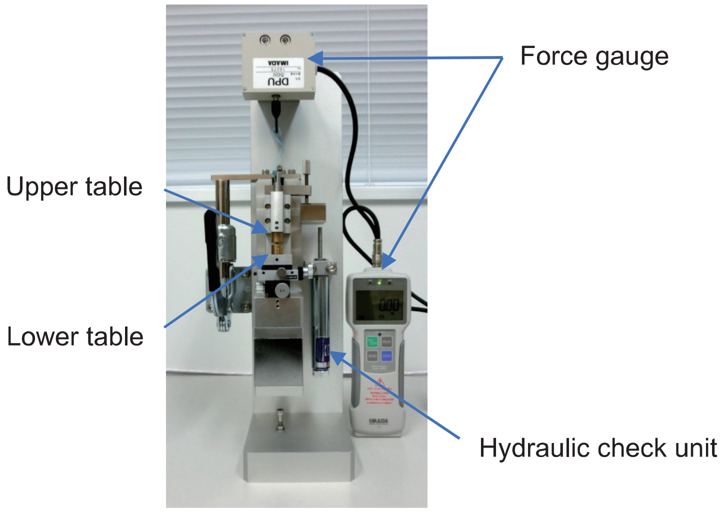

Fig. 1 Device for measuring retentive force

2. Prerequisite conditions for the various stages of the experiment

The experiment was conducted in phases. Each participant repeated the experiment, and a set of measurements was recorded after fulfilling the conditions of the particular stage.

First: Each participant was required to read the ISO standard test procedure instructions alone and then carry out the experiment. No discussions were allowed among participants at this level.

Second: Discussion of the procedure instructions only was allowed between the participants and an expert who was well versed in the technique. The experiment was repeated and a second set of data generated.

Third: Detailed practical demonstration of the experiment was given by an expert to the group of participants. Afterward, a third set of measurements was generated.

3. Test procedure instructions for measuring retentive force

The experiment was conducted as detailed by the ISO Manual. The outline of the test procedure instructions for measuring retentive forces applied in this study is as follows:

a) The dental magnetic attachments are fixed on the upper and lower tables by use of a cyanoacrylate adhesive only or reinforced with a self-curing acrylic resin.
b) The specimens are loaded in tension on the device at a crosshead speed of 4.5 mm/min.
c) Readings are recorded from the digital force gauge as detailed in the manual and calculations done to establish the retentive force value.
d) The lower table is raised to establish contact between the keeper and the magnetic assembly, and steps b and c are repeated five times to yield five readings.
e) The median value from the data set is determined.
f) A different magnetic attachment sample is fixed, and steps b to e are followed. The procedure is done three times, corresponding to the three samples, at every stage.

4. Statistical analysis

The data generated was statistically analyzed using an ANOVA and Tukey's HSD test ($\alpha = 0.05$).

Results

Retentive force measurements (median values) by each participant are shown in Fig. 2. All of the values generated corresponded more than 85% with the figures quoted in the manufacturer's literature accompanying the package. The retentive force of each magnetic attachment sample in the second and third stages tended to be higher than that of the first stage, although there was no significant difference ($p>0.05$), except in the case of Gigauss by participant E. The standard deviation of Hicorex was relatively large compared to that of the other magnetic attachments among participants B, D, and E.

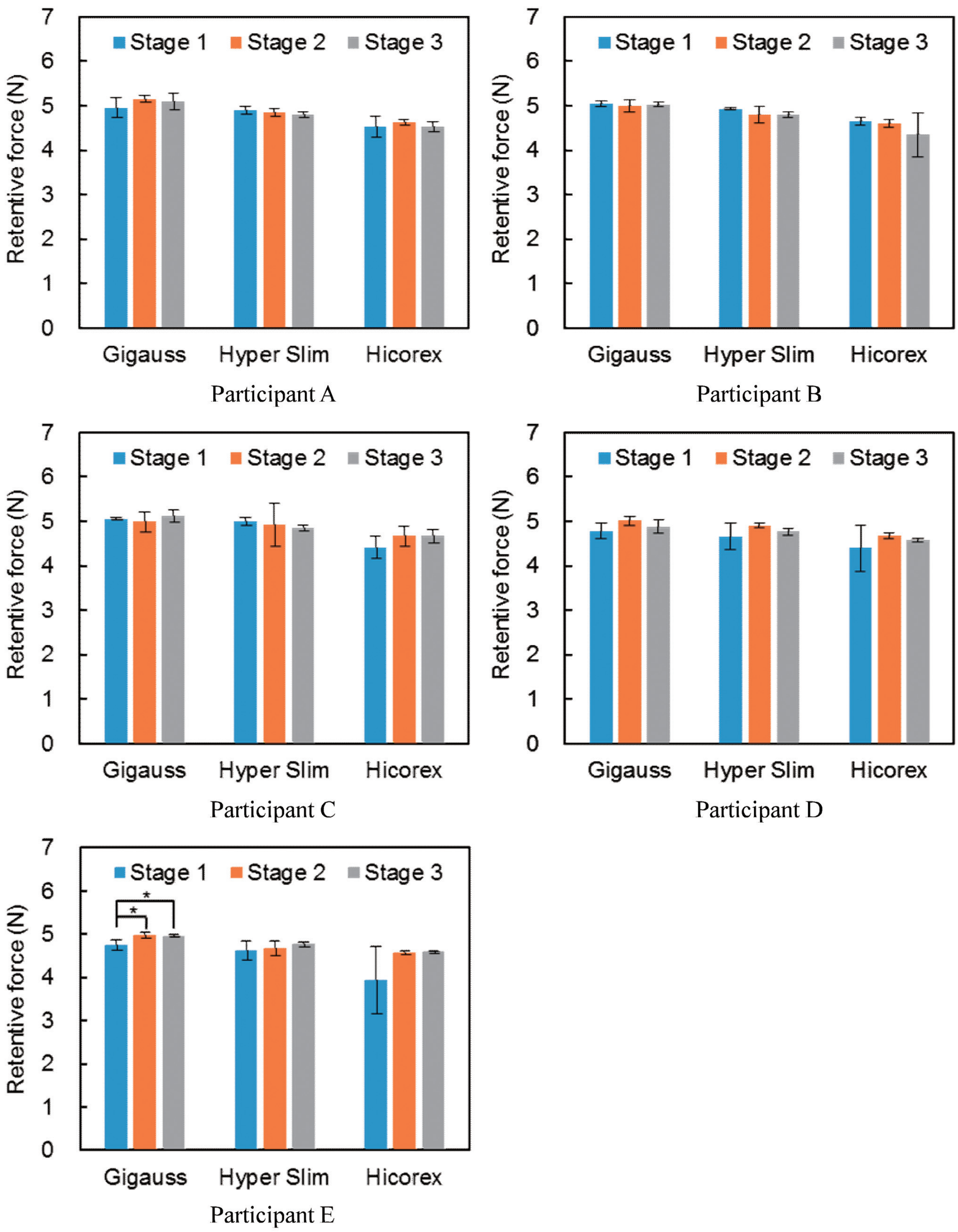

Fig. 2 Retentive forces measured by each participant (*p<0.05)

Retentive forces during the first stage are indicated in Fig. 3, which shows a comparison of the values among participants. Participants D and E generated lower values during the first stage in all of the magnetic attachment samples as compared to the other participants, although there was no significant difference (p>0.05). However, in the second and third stage, the values were almost identical among all participants for each particular magnetic attachment sample. The force values for Hicorex tended to be lower than those for Hyper Slim and Gigauss at all stages.

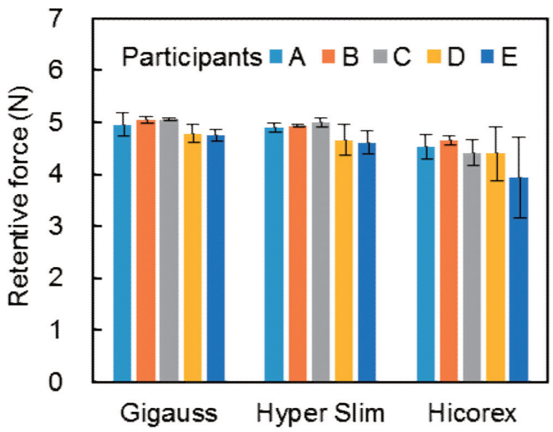

Fig. 3 Retentive forces in the first stage

Discussion

An error in executing the test procedure instructions is indicated by low readings. Similarly, high values or measurements indicate that the setup was done correctly as a result of proper interpretation of the instructions and understanding of technique. The values attained in the second stage were higher than those of the first stage. This suggests that discussing the procedure instructions with an expert improves the technique for carrying out the measurements, thereby leading to higher and more accurate values. This pattern concurs with an evaluation of the proposed testing procedure's accuracy.[2)] Errors emanating from the first stage were observed by an expert as the participants carried out the experiment and were noted to be as follows:

(i) The words *magnetic assembly* were confused with *a set of a magnetic assembly and keeper* (participant D).

(ii) A table was moved before the adhesive had completely set (participant E), thereby increasing the possibility of movement during the experiment.

(iii) After removing the double-sided adhesive tape, the mating face, which was initially adherent, was not cleaned (all participants).

(iv) The X-Y stage for adjusting the alignment of upper and lower tables was not used (except by participant B).

The above errors may cause a warp alignment of the magnetic attachment and result in reduced retentive force values. The error mentioned as (iii) above was occasioned by the lack of a specific clause in the manual stipulating that cleaning should be done. The test procedure manual should be amended to include: "the adherent surface is cleaned after the removal of the tape." More so, "use double-sided tape only when needed," should be added, as it is not always necessary to temporarily secure the magnetic assembly with tape before final fixation with the adhesive.

The other errors may have been corrected by a careful reading of the manual. Since the values at the third stage did not differ significantly from those of the second stage, the influence of a practical demonstration by an expert is minimal. The results revealed that many participants could gain satisfactory retentive force values for the first time by reading the ISO standard test procedure manual alone. Moreover, participants obtained more accurate figures after the second stage discussion as compared with the first stage.

Hyper Slim and Hicorex use the same magnetic assembly. In addition, the keepers are made of the same material, although the shapes are different. Therefore, the retentive force values should, ideally, be the same. However, Hicorex retentive force values were generally lower and with a higher standard variation than those of Hyper Slim. This is because the alignment of Hicorex easily warps, due to difficulty in fixing its keeper, which is a post type on a lower table. If the keeper is fixed correctly, accurate values can be obtained regardless of the keeper's shape.[4)] More precise values can be attained by gaining more experience in the procedure or by using a dedicated jig.

Conclusion

These results indicate that the amended test procedure standard as stipulated in ISO 13017 is a useful guide for measuring retentive force.

Acknowledgments

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References

1. ISO 13017:2012. Dentistry—Magnetic attachments.
2. Kanbara R, Evaluation of testing procedure accuracy described for the measurement of magnetic attachment attractive force in ISO 13017, J J Mag Dent 23(2):7–12, 2014.
3. ISO 13017:2012/Amd.1:2015 Dentistry — Magnetic attachments.
4. Takahashi M, Retentive force of dental magnetic attachments applied to implant superstructures, J J Dent Mater 34(2):112, 2015.

A basic study on the fitness of a zirconia keeper coping fabricated by the CAM system

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Abstract

The purpose of this study was to evaluate the fitness of a zirconia keeper coping fabricated by the CAM system (Cercon® brain, DeguDent).

Specimens were made of a semi-sintered zirconia block (Cercon® base, DeguDent). Fitting accuracy was evaluated by a cement-replica technique with silicone materials. For the keeper coping specimens, the mean fitting gaps were 0.23±0.08 ㎜ at the finish line of coping, 0.26±0.04 ㎜ at the interface between the coping and the post, and 0.32±0.06 ㎜ at the tip of the post. This study found that the adaptation of a zirconia keeper coping fabricated by this system was not recommended.

Introduction

The dental CAM and CAD/CAM systems generally have been used in clinical dentistry to fabricate various prostheses. However, the keeper coping of the magnetic attachment was still cast by a lost wax method used in dental casting. In the past, although the method of manufacturing the keeper coping using the dental CAD/CAM system using a scanning probe has been reported,[1)] it usually has not been used.

Recently, the dental CAM and CAD/CAM systems by laser scanning have primarily been used because of their high-precision performance, and zirconia ceramics have become popular materials in clinical dentistry. Zirconia ceramics have excellent mechanical strength for prosthetic appliances and biocompatibility with a significant reduction in plaque.[2)] These facts suggest that zirconia ceramics are clinically useful for keeper copings of magnetic attachments.

The purpose of this study was to evaluate the fitness of a zirconia keeper coping fabricated by the dental CAM system using laser scanning.

Materials and Methods

Materials: The prepared epoxy resin tooth at the lower canine (338: NISSIN) was selected as the abutment tooth of the keeper coping with a root canal length of 5 mm. The keeper coping was fabricated using the dental CAM system (Cercon® brain, DeguDent), and a semi-sintered zirconia block (Cercon® base, DeguDent) was employed for the keeper coping material (Table 1).

Figure 1 shows the wax pattern used for scanning and the zirconia keeper coping fabricated by this CAM system.

Methods (Cement-replica technique): Fitting accuracy was evaluated using a cement-replica technique. Each keeper coping was placed in the master die with a white silicone material (FIT CHECKER ADVANCED, GC). After curing the white silicone material, the keeper coping with the white silicone material was removed from the master die. Then, the keeper coping with it was embedded in a blue silicone material (EXAMIXFINE Regular Type, GC). The keeper coping was demounted from the cured silicone material, and the blue silicone material filled the space (Fig.2).

Table 1 Material composition in this study

Puroduct	Composition
Cercon® base	ZrO_2 89.2%
	Y_2O_3 5.0%
	HfO_2 5.0%
	other oxides

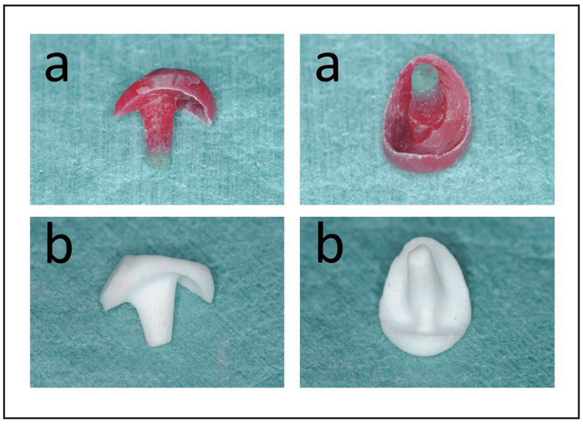

Fig.1 Keeper coping specimens in this study
(a: Wax pattern; b: Zirconia keeper coping)

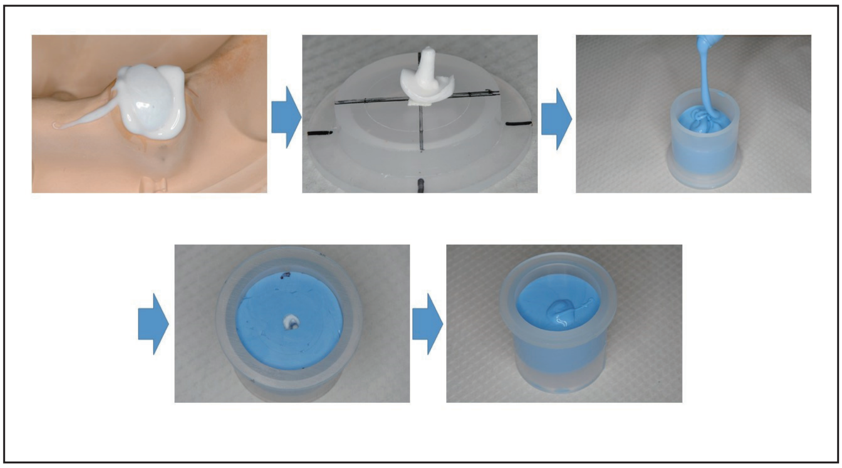

Fig.2 Procedure for fabricating specimens (Cement-replica technique)

Determination of fitting accuracy: Each silicone replica specimen was sectioned in the buccolingual direction through the center of the coronal root (Fig.3). The measuring points of the white silicone layers are shown in Fig.4. The maximum value was picked up from the range of each part.

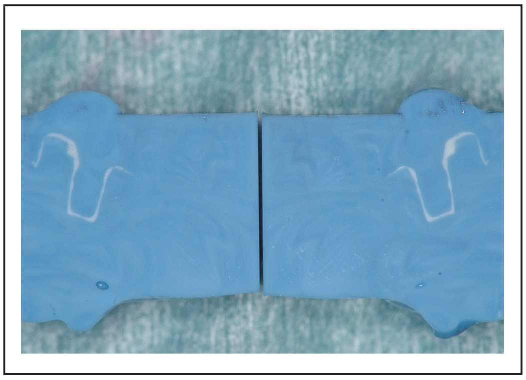

Fig.3 Section of the silicone replica specimen in the buccolingual direction

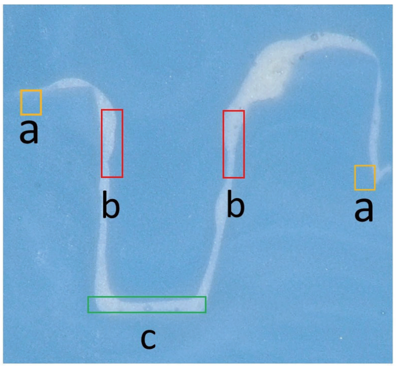

Fig.4 Measuring points
(a: Finish line of coping; b: Interface between coping and post; c: Tip of post)

Results

The mean thicknesses of the white silicone layers, namely the mean fitting gaps, were 0.23±0.08 ㎜ at the finish line, 0.26±0.04 ㎜ at the interface between the coping and the post, and 0.32±0.06 ㎜ at the tip of the post (Fig. 5). There were no significant differences in the mean thicknesses of the white silicone layers between the 3 measuring points by one-way ANOVA and the Tukey–Kramer method ($p<0.05$).

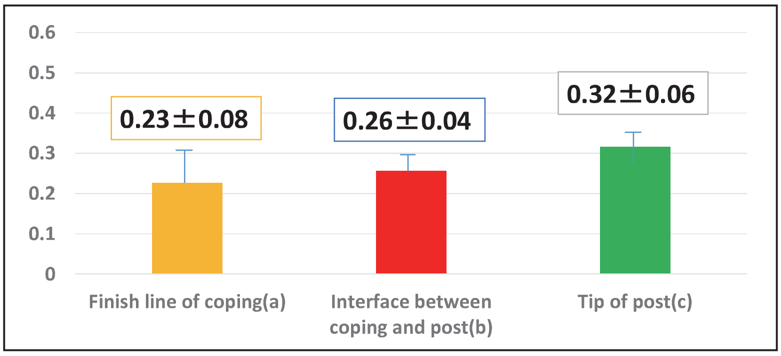

Fig. 5 The mean thicknesses of the white silicone layers at 3 measuring points

Conclusion

It was concluded that the fitness of a zirconia keeper coping fabricated by this system was poorer than the fitness of other prostheses reported in the past (permissible fitting gap: 0.1~0.15 ㎜). Therefore, the adaptation of a zirconia keeper coping fabricated by this system was not clinically recommended. We will make further refinements to the manufacturing method by laser scanning.

References

1. K. Tsuda, Y. Tanaka, T. Kanazawa, M. Sakane, and K. Kumano: Fabrication of a keeper coping by use of the CAD/CAM system, J J Mag Dent, 13(1), 9–17, 2004.
2. T. Miyazaki, T. Nakamura, H. Matsumura, S. Ban, and T. Kobayashi: Current status of zirconia restoration, J Prosthodont Res, 57, 236–261, 2013.

A case report of same-day denture repair using magnetic attachments

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Abstract

We report clinical uses of magnetic attachments for the repair of dentures and retainers on the same day.

This report describes three clinical cases. In all cases, the abutment teeth that act as retention elements for the dentures were detached due to secondary caries, and, without abutment teeth, retention was extremely poor. The patients were dissatisfied with the dynamic stability and retention of their dentures. Therefore, keepers of the magnetic attachments were fixed with composite resin material to the remaining radicular teeth, and magnetic assemblies were attached to the dentures. The magnetic attachments used were MAGFIT® RKR (AICHI STEEL, Japan) in cases 1 and 2 and GIGAUSS® (GC, Japan) in case 3.

As a result, patients' complaints of functional dissatisfaction were resolved.

Introduction

Magnetic attachments that have the unique feature of "retention without bracing" protect abutments from excessive force.[1] Thus, the magnetic attachments can be applied to damaged crowns and short roots.[2] We report the clinical use of dental magnetic attachments for abutments damaged by secondary caries and, on the same day, denture repair.

Case 1

Clinical History: The patient, a 66-year-old female, complained of masticatory dysfunction. The patient had a partially edentulous maxilla and mandible (Eichner B3). At the initial examination, a fixed bridge on #7, 8, and 9 as abutment teeth for the removable partial denture was detached, and #7 was found to have been damaged by caries. The patient was dissatisfied with the dynamic stability and retention of the denture (Figs.1–3).

Treatment Procedure: The fixed bridge was cut off between #8 and #9, and the magnetic attachments that act as retention elements were applied to the remaining radicular tooth of #7. MAGFIT® RKR (AICHI STEEL, Japan) magnetic attachments were used in this case. Keepers of the magnetic attachment were fixed with adhesive resin cement on the abutment teeth (G-CEM LinkAce, GC, Japan). Then, the magnetic assembly was attached to an additional tooth (Zen Opal Shell, GC, Japan) by denture repair (Fig.4). As a result, the patient's complaints of functional dissatisfaction were resolved (Fig.5).

Fig.1 Intraoral view after amputation of bridge

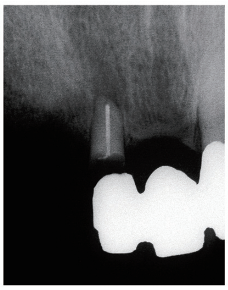

Fig.2 Dental radiograph at #7

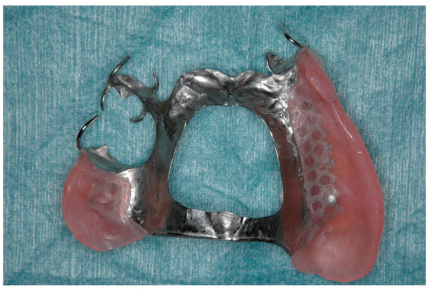

Fig.3 Previous denture

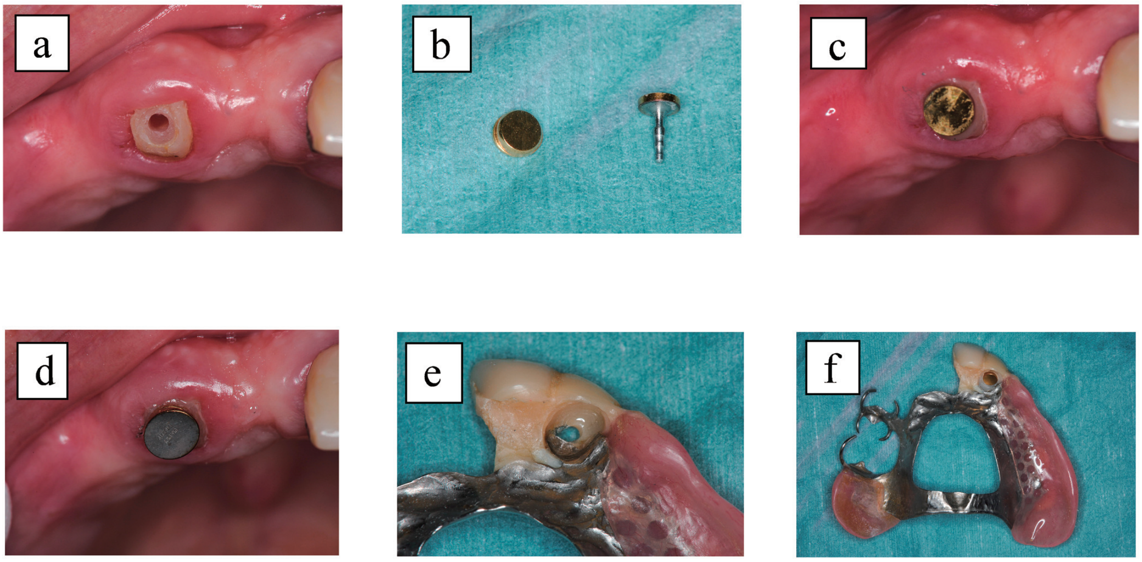

Fig.4 Treatment procedure of the magnetic attachment
(a. preparation of root, b. magnetic attachment,
c. seating of the keeper, and d–f. seating of the magnetic assembly)

Fig.5 Intraoral view after prosthetic treatment

Case 2

Clinical History: The patient, a 77-year-old female, complained of masticatory dysfunction. The patient had a mandibular overlay complete denture. At the initial examination, a magnotelescopic crown of #22, as the abutment tooth for a removable partial denture, was detached (Fig.6). The patient was dissatisfied with her retention of the denture and demanded immediate recovery of function.

Treatment Procedure: A magnetic attachment (MAGFIT® RKR, AICHI STEEL) that acts as a retention element was applied to the remaining radicular tooth of #22 (Fig.7). As a result, the patient's complaints of functional dissatisfaction were resolved.

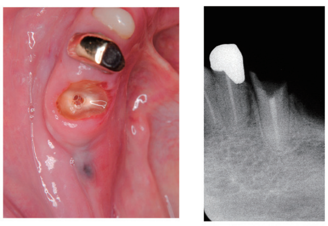

Fig.6 Intraoral view and dental radiograph of #22 at the initial examination

Fig.7 Intraoral view and denture after prosthetic treatment

Case 3

Clinical History: The patient, a 65-year-old male, had a partially edentulous mandible (Eichner B1: missing mandibular second premolar and first molar teeth) with the chief complaint of masticatory dysfunction. All maxillary prostheses had failed, with a marginal discrepancy and caries damage (Figs.8 and 9).

Treatment Procedure: First, the prostheses with marginal discrepancies were removed, and the #6, 7, and 8 teeth were extracted due to severe caries and periodontitis. Then, an immediate denture in the maxilla was set on a portion of the edentulous area (Fig.10). The magnetic attachments that act as retention elements were applied to the remaining radicular teeth (#3, 10, and 11). GIGAUSS D400® (#10 and 11 teeth) and GIGAUSS D1000® (#3 tooth) (GC, Japan) magnetic attachments were used in this case. Keepers of the magnetic attachment were fixed with adhesive resin cement on the abutment teeth (Multilink® Automix, Ivoclar Vivadent, Liechtenstein) (Fig.11). As a result, the patient's complaints of functional dissatisfaction were resolved immediately.

Fig.8 Intraoral view at the initial examination

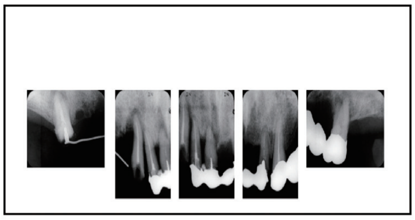

Fig.9 Dental radiographs at the initial examination

Fig.10 Intraoral view with an immediate denture

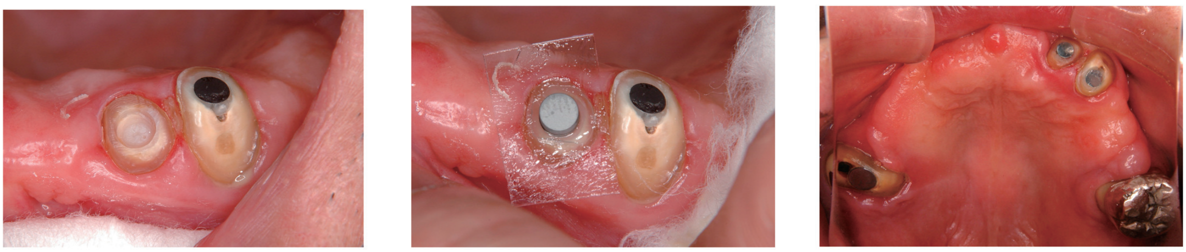

Fig.11 Seating of keepers on the abutment teeth

Conclusion

A magnetic attachment could be provided as a useful retentive appliance for alleviating patient complaints regarding function. In the interval, the remaining dentition, periodontal condition, and retentive forces of the prostheses have been examined as part of a maintenance program.

References

1. H. Mizutani: Characteristics and clinical indications of magnetic attachment, J Jpn Prosthodont Soc, 48, 10–19, 2004.
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, J J Mag Dent, 24(2), 10–14, 2015.

Randomized controlled clinical trial of immediately loaded mandibular 2-implant overdenture retained by magnetic attachments: Masticatory performance

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Abstract

[Purpose] The aim of this 1-year study was to compare the masticatory performance between immediate and conventional loading mandibular two-implant overdentures retained by magnetic attachments.

[Materials and methods] Nineteen mandibular edentulous participants were randomly allocated into 2 groups: an immediate loading group or a conventional loading group (prostheses were loaded on the same day or 3 months after implant surgery, respectively). Masticatory performance was measured by mixing ability, using color-changeable chewing gum, and shearing ability, using gummy jelly. Assessments were performed at the baseline and 1, 2, 3, 4, 5, 6, and 12 months after surgery. The differences in masticatory performance before and after implantation were compared using the Wilcoxon test, and the median differences between the baseline and each monthly score were compared using the Mann–Whitney U test.

[Results and discussion] In both groups, there were significant improvements in masticatory performance 12 months after implant treatment. The immediate loading group showed higher scores in mixing and shearing ability than the conventional loading group; however, the difference was not statistically significant. In addition, the immediate loading mandibular overdenture tended to improve mixing ability earlier than a conventional loading protocol.

Introduction

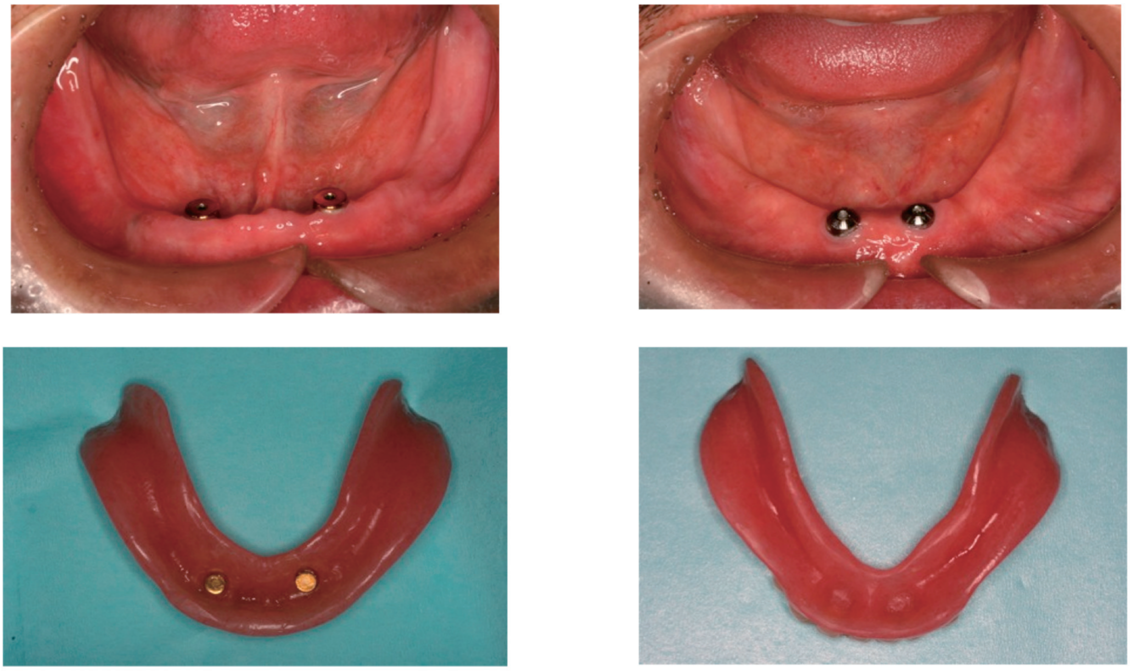
Compromised masticatory performance in edentulous patients has led to various nutritional disadvantages with significantly lower dietary intakes of some nutrient-rich foods than those of dentate patients.[1] The McGill consensus suggested that a two-implant overdenture (2-IOD) should become the standard option of treatment for the edentulous mandible.[2] Many studies have showed that masticatory performance and patient satisfaction significantly improved after implant treatment.[3,4] In addition, with regard to retention mechanisms, magnetic attachments appear to reduce lateral force to implants. To our knowledge, no study had compared the masticatory performance of immediate and conventional loading protocols with 2-IOD using magnetic attachments.

Objective

The aim of this 1-year study was to compare the masticatory performance of immediate and conventional loading mandibular two-implant overdentures retained by magnetic attachments.

Materials and Methods

1. This study was a randomized controlled clinical trial.
2. Nineteen mandibular edentulous patients were randomly allocated into 2 groups: an immediate loading group or a conventional loading group. Each patient received 2 implants (NobelSpeedy Groovy, Nobel Biocare) with magnetic attachments (Magfit IP, Aichi Japan) (Fig. 1).
3. Mixing ability[5] and shearing ability[6] were recorded at the baseline and 1, 2, 3, 4, 5, 6, and 12 months after implant surgery (Figs. 2, 3).
4. The difference in masticatory performance before and after implantation was compared using the Wilcoxon signed-rank test. Also, the median difference between the baseline scores and each monthly score of the immediate and conventional groups were compared using the Mann–Whitney U test.



Immediate loading group
- Loaded on the same day as implant surgery

Conventional loading group
- Relieved the mucosal surface
- Loaded 3 months after implant surgery

Fig. 1 Allocation into 2 groups

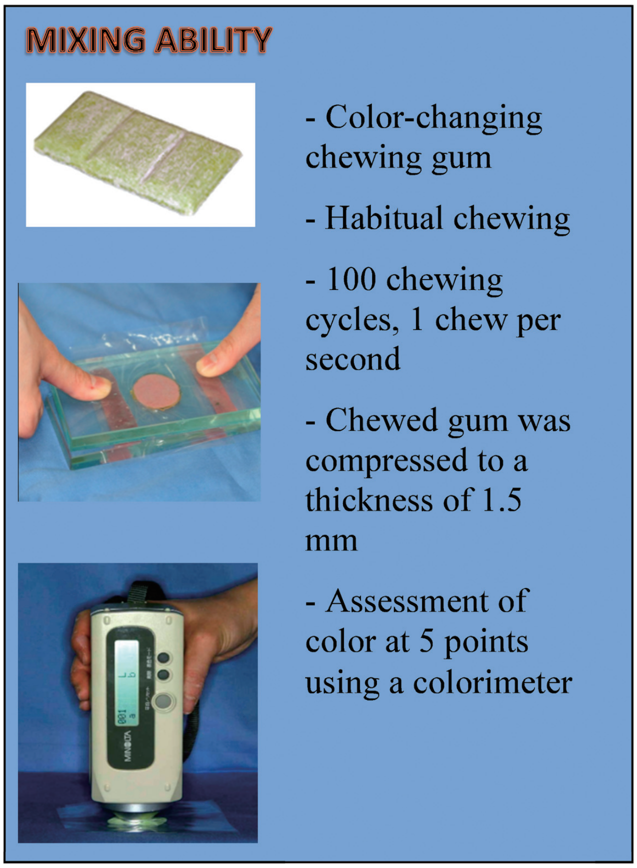


Fig. 2 Mixing ability measurement

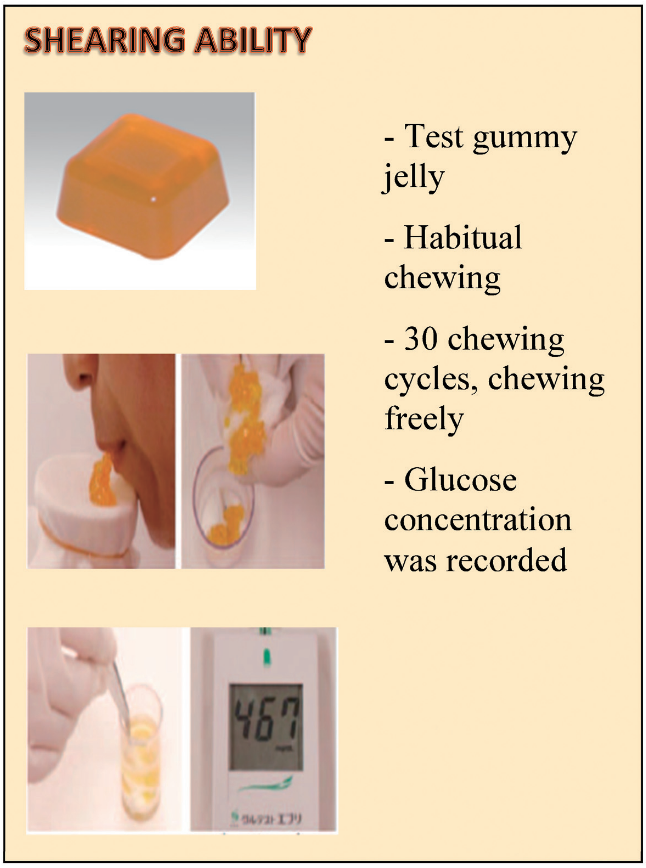


Fig. 3 Shearing ability measurement

Results and Discussion

Nineteen participants (9 males and 10 females) with a mean age of 68.4 years (ranging from 46 to 86 years) were enrolled in this study. One participant in the conventional loading group, who lost both implants 1 month after surgery, was excluded from analysis.

There were no significant differences in age, gender, or masticatory performance between the 2 groups at the baseline.

1. Mixing Ability

Subjects in the immediate loading group showed an early improvement in mixing ability after insertion of the attachment, with statistically significant changes at 1, 6, and 12 months, while those in the conventional loading group showed improvement only at 12 months after surgery (Fig. 4).

In detail, the immediate loading group showed a slight growth one month after implant surgery, and remained nearly stable over the next 12 months. In contrast, the mixing ability of the conventional loading group declined in the first 3 months after implant placement (when attachments had not yet connected), and then showed a tendency to rise from 4 months after surgery. It suggested that the denture stability created and maintained through attachment connection could be associated with an improvement in mixing ability.

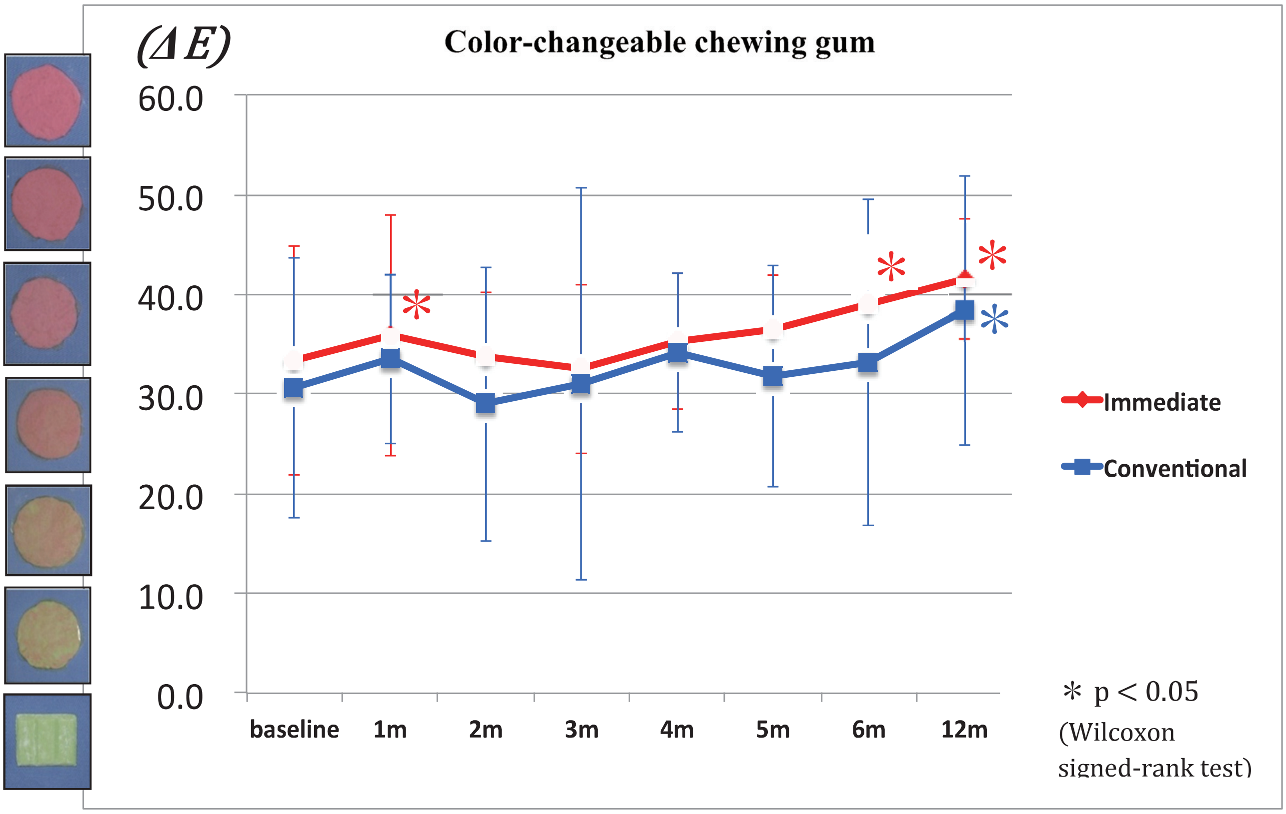


Fig. 4 Changes in mixing ability from the baseline to 12 months post-operation

With regard to the disparity in mixing ability scores between the baseline and monthly evaluation periods, no statistically significant differences between the 2 groups were observed in this 12-month study (p>0.05, Mann-Whitney U test) (Fig. 5).

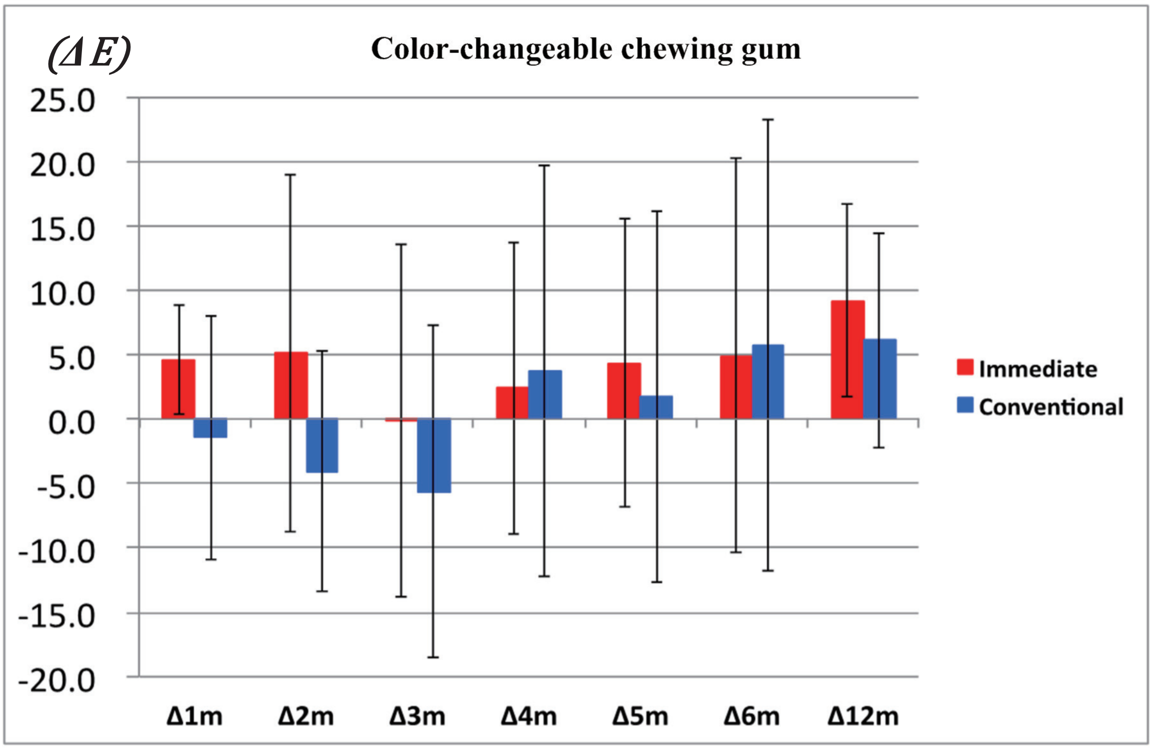


Fig. 5 Median difference in mixing ability between the baseline and each monthly evaluation period

2. Shearing Ability

Both groups showed significant improvement in shearing ability after 4, 5, 6, and 12 months (Fig. 6).

To be specific, the shearing ability of both groups gradually increased from the first month after surgery, and there was no statistically significant difference between the 2 groups (p>0.05, Mann-Whitney U test) (Fig. 7).

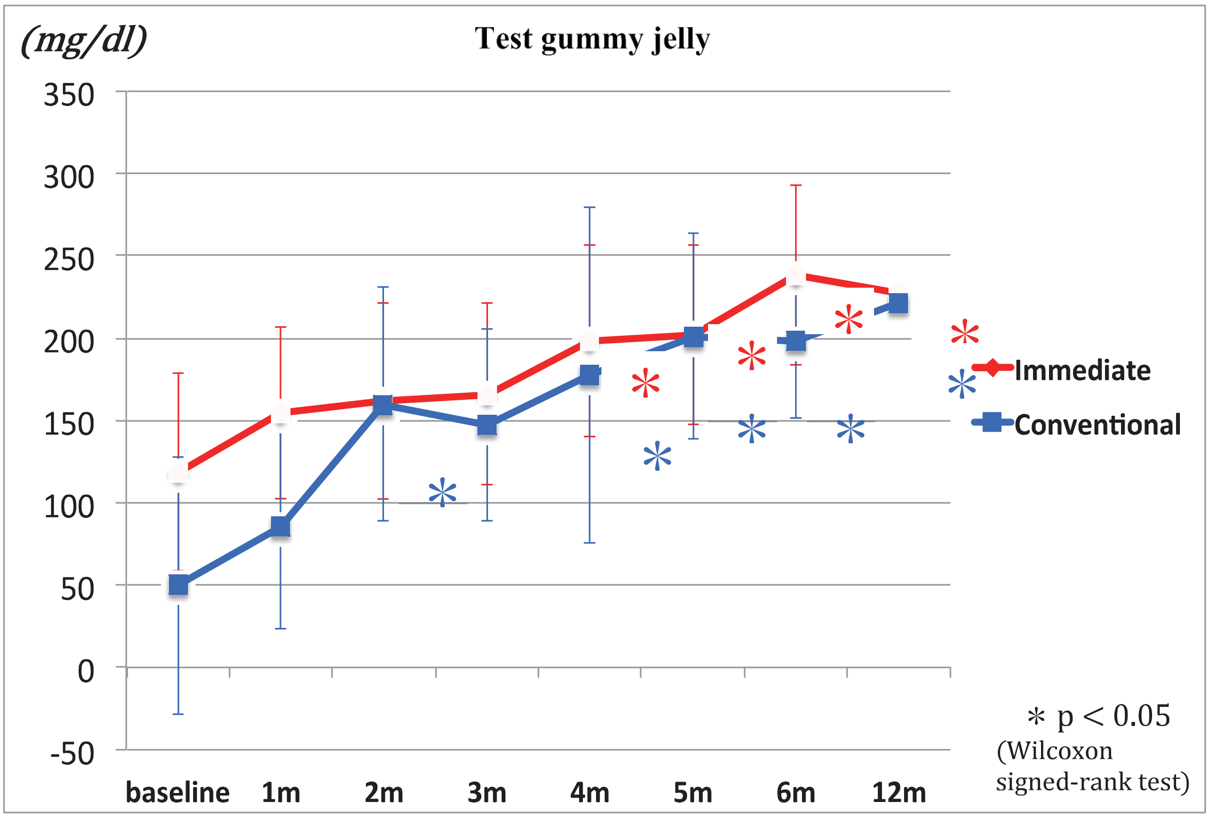


Fig. 6 Changes in shearing ability from the baseline to 12 months post-operation

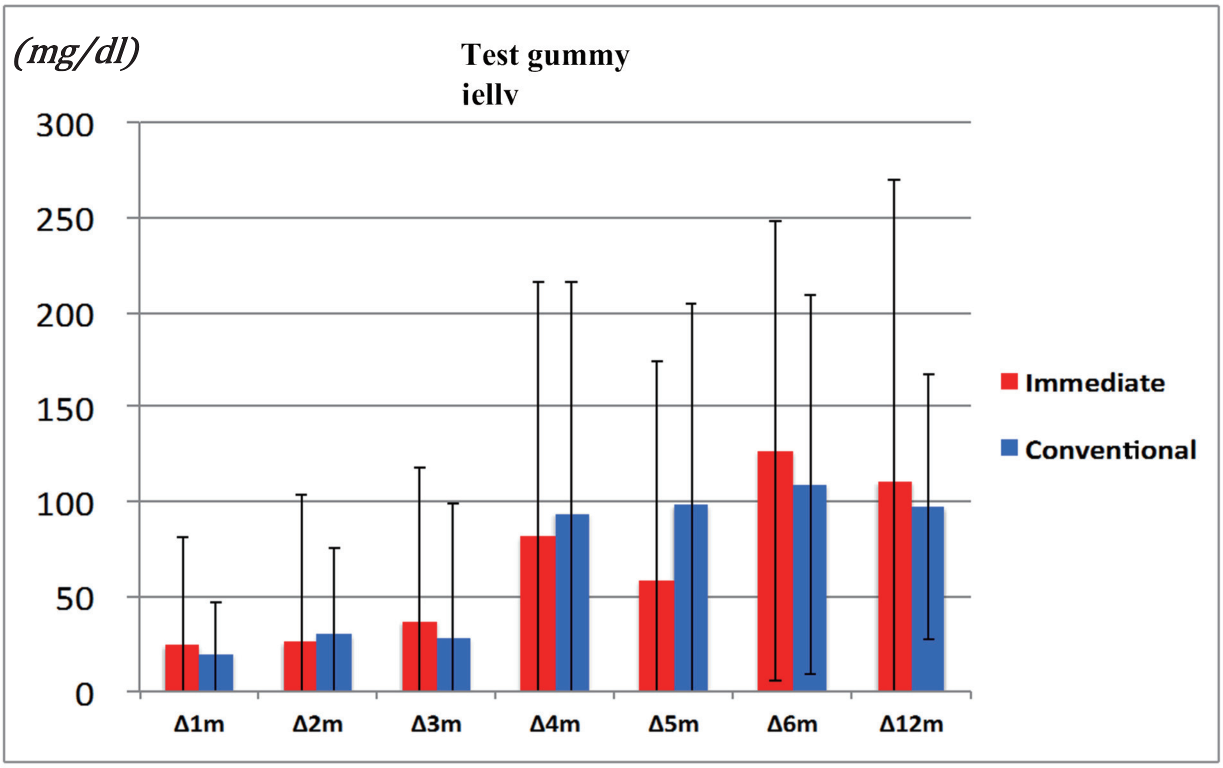


Fig. 7 Median difference of shearing ability between the baseline and each monthly evaluation period

Because of the hard and elastic nature of the test gummy jelly, it required additional time and occlusal force to be comminuted into a fine bolus. In previous studies, the test gummy jelly was significantly correlated with occlusal force and the occlusal contact area.[7] Thus, it was suggested that in addition to denture stability, others factors relating to teeth or masticatory muscles may be involved in shearing ability.

Conclusion

Immediate loading and conventional loading of mandibular two-implant overdentures with magnetic attachments showed significant improvement in mixing ability and shearing ability as compared to complete dentures.

The immediate loading mandibular overdenture tends to improve mixing ability earlier than that observed with a conventional loading protocol.

References

1. RE. Nowjack-Raymer and A. Sheiham: Association of Edentulism and Diet and Nutrition in US Adults, J Dent Res, 82, 123-126, 2003.
2. JS. Feine, GE. Carlsson, MA. Awad, A. Chehade, et al: The McGill consensus statement on overdentures. Mandibular two-implant overdentures as first choice standard of care for edentulous patients, Int J Oral Maxillofac Implants, 19, 3-4, 2002.
3. T. Cheng, G. Sun, J. Huo, X. He, Y. Wang and Y.-F. Ren: Patient satisfaction and masticatory efficiency of single implant-retained mandibular overdentures using the stud and magnetic attachments, J Dent, 40, 1018-1023, 2012.
4. X. Sun, JJ. Zhai, J. Liao, MH. Teng, A. Tian and X. Liang: Masticatory efficiency and oral health-related quality of life with implant-retained mandibular overdentures, Saudi Med J, 35, 1195-202, 2014.
5. Y. Hama, M. Kanazawa, S. Minakuchi, T. Uchida and Y. Sasaki: Properties of a color-changeable chewing gum used to evaluate masticatory performance, J Prosthodont Res, 58, 102-106, 2014.
6. K. Ikebe, K. Morii, K. Matsuda, T. Hazeyama and T. Nokubi: Reproducibility and accuracy in measuring masticatory performance using test gummy jelly, Prosthodont Res Pract, 4, 9-15, 2005.
7. K. Ikebe, K. Matsuda, R. Kagawa, K. Enoki, M. Yoshida, Y. Maeda and T. Nokubi: Association of masticatory performance with age, gender, number of teeth, occlusal force and salivary flow in Japanese older adults: Is ageing a risk factor for masticatory dysfunction?, Arch Oral Biol, 56, 991-996, 2011.

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