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日本磁気歯科学会

J J Mag Dent vol. 27 No. 2 2018

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JJSMAD

Proceedings of the 17th International Conference on Magnetic Applications in Dentistry

The Japanese Society of Magnetic Applications in Dentistry

The 17th International Conference on Magnetic Applications in Dentistry

The 17th 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 26 to Friday, March 16, 2018

Location:

JSMAD web site

http://www.jsmad.jp/international/17/

General Chair:

Assoc. Prof. Yukyo Takada, Tohoku University

Conference Secretariat:

Masatoshi Takahashi, Tohoku 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 18th International Conference on Magnetic Applications in Dentistry General Information

General Information

The Japanese Society of Magnetic Applications in Dentistry (President: Shuji Ohkawa, Meikai University) is a scientific association founded in 1991 and is devoted to furthering the application of magnetism in dentistry. The 18th International Conference on Magnetic Applications in Dentistry organized by JSMAD will take place on the Internet as follows.

Meeting Dates:
Monday, February 25 to Friday, March 15, 2019

Location:
JSMAD web site:
http://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

Registration Information

Registration:
Send e-mail titled "registration for 18th 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 25, 2019
Poster submission: February 15, 2019

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.

Discussion:
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.

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

Note:
Copyright of all posters published on the conference will be property of the Japanese Society of Magnetic Applications in Dentistry. Copies of the posters will be made and transferred to JSMAD web site for continuous presentation after the meeting dates.
For further information,
send e-mail to jiki2018@ngt.ndu.ac.jp

Conference Secretariat

Kazuhiro Nagata, Nippon Dental University at Niigata
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Contents

A basic study on accuracy of a hybrid-resin coping fabricated by CAD/CAM system -Using scanning post and evaluation by µCT-

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

Division of Removable Prosthodontics, Department of Restorative and Biomaterials Sciences, Meikai University School of Dentistry

Abstract

The purpose of this study was to evaluate the fitting accuracy of hybrid resin copings fabricated by the dental CAD/CAM system and manufacturing using a scanning post.

The desktop scanner (Aadva Scan D850,GC) was used in this study, and images were acquired with a scanning post (Scan Posts™,3shape). Designing software (Dental Designer, GC) was employed for creating a hybrid resin coping design, and a milling machine (Aadva Mill LW-1, GC) was used to fabricate the coping from hybrid resin blocks (CERASMART 270,GC) as specimens(n=5). Desktop µCT (SkyScan 1172,SkyScan) was used to measure the marginal and internal fitting accuracy of a hybrid resin coping and 14 measuring points were evolution in this study.

Within limitations, this study suggested that the fitting accuracy of hybrid resin copings fabricated with this CAD/CAM system using a scanning post was within the clinically acceptable range of 100 µm, with the exception of two points (buccal and lingual margins).

Introduction

The progress of dental CAD/CAM systems has made it possible to fabricate various clinical applications including inlays, onlays, crowns, bridges, all-ceramic frameworks, and more dentures in clinical dentistry and has made possible the creation of highly accurate products. Several reports introduced the fabrication of root canal copings or posts and cores using CAD/CAM[1–3]; however, they had scanned the acrylic resin pattern and milled and sintered it onto another material for a root canal coping or post and core instead of investing and casting the pattern into the metal. The technique used the same initial procedures for creating a metal cast coping or post and core.

Our present study[4] introduced a method of fabricating CAD/CAM keeper copings using a scanning post Scan Posts™,3shape) and revealed no significant difference in the cement space for internal fitting; however, the marginal fitting accuracies were not clear.

The purpose of this study was to evaluate the fitting accuracy of hybrid resin copings fabricated by the CAD/CAM system with a scanning post.

Materials and Methods

Prepared epoxy resin mandibular canine teeth (338, Nissin) were selected as the abutment teeth for the copings, and the root canal was recontoured with a drill (ParaPost X Drill, Coltene-Whaledent) to fit the same form of scan posts and pressed to a depth of 5.0 mm, creating a rotational resistance groove and additional reduction to gain more clearance (Fig.1).

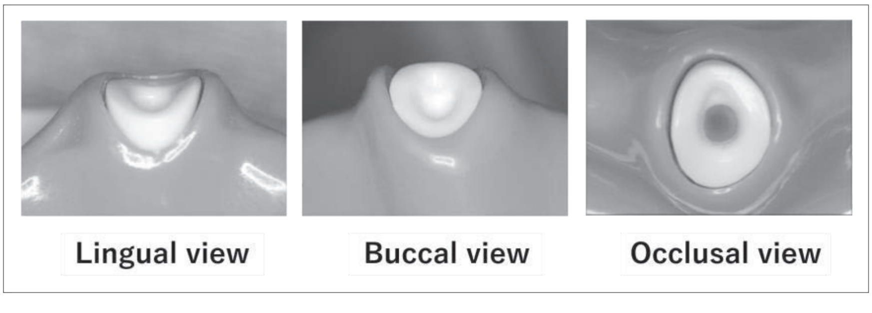

Fig.1 Abutment tooth form for coping

The copings were made from a hybrid resin block (CERASMART 270, GC). They were designed using

CAD software (Dental Designer, 3Shape) after digitalization of the die was performed using a desktop scanner (Aadva Scan D850, GC), and they were fabricated by a milling unit (Aadva MILL LW-1, GC) in this study (Fig.2). The cement space was set based on our study (Fig.3).

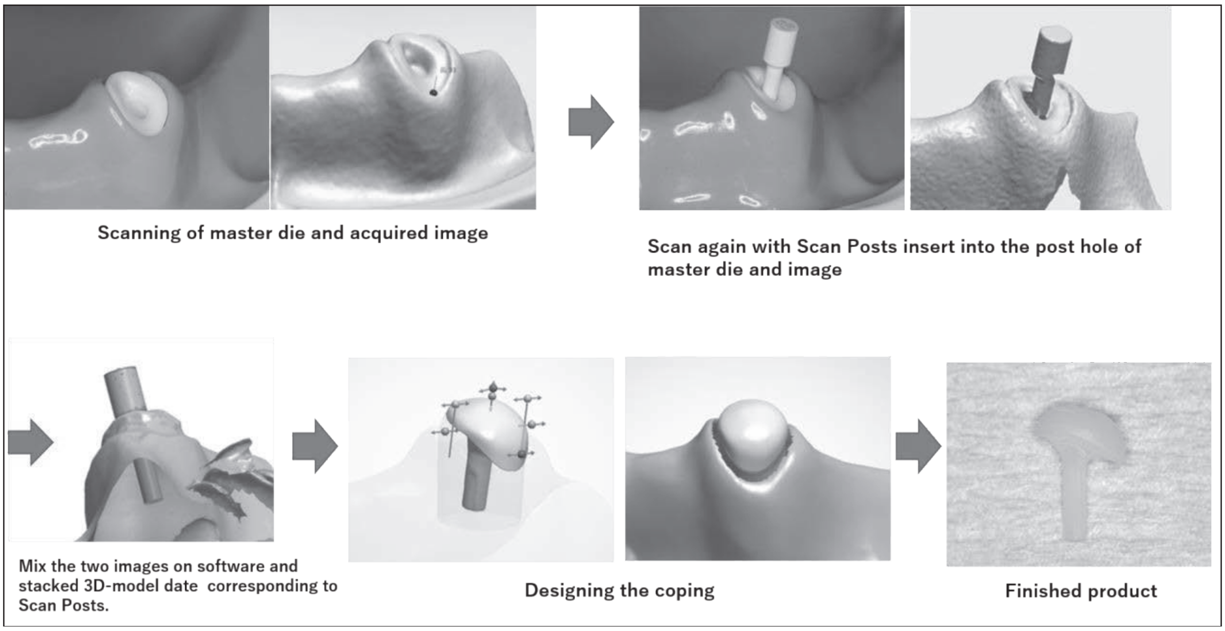

Fig.2 Work flow of scanning and designing coping

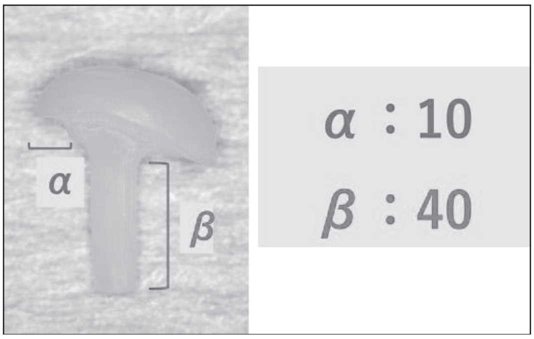

Fig.3 Cement space (㎛)

The hardware device used in this study was a desktop μCT scanner (SkyScan 1172, SkyScan) for the evolution of the fitting accuracy of hybrid resin copings. Images were acquired using 104 kV voltage, 100 μA current, and a 0.5 mm thick aluminum filter. After being scanned, the images were reconstructed in the software (NRecon, SkyScan), and the space between the hybrid resin coping and the abutment was measured using the instrument (CTAn, SkyScan). Measurement points are shown in Fig.4.

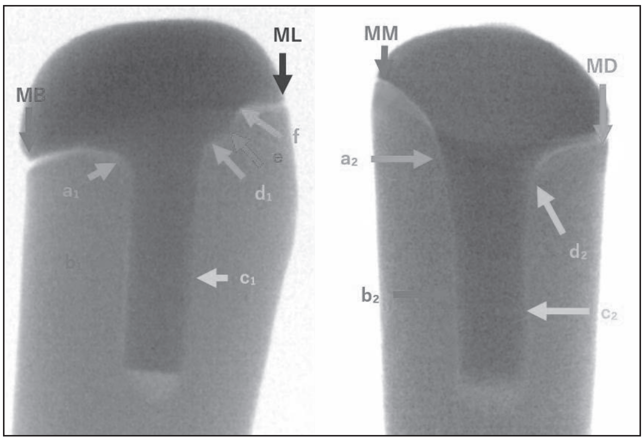

Fig.4 Measurement points in this study. MB: margin of buccal; ML: margin of lingual; MM: margin of mesial; MD: margin of distal

Results

The mean space between the hybrid resin coping and the abutment of each point is shown in Figs.5 and 6.

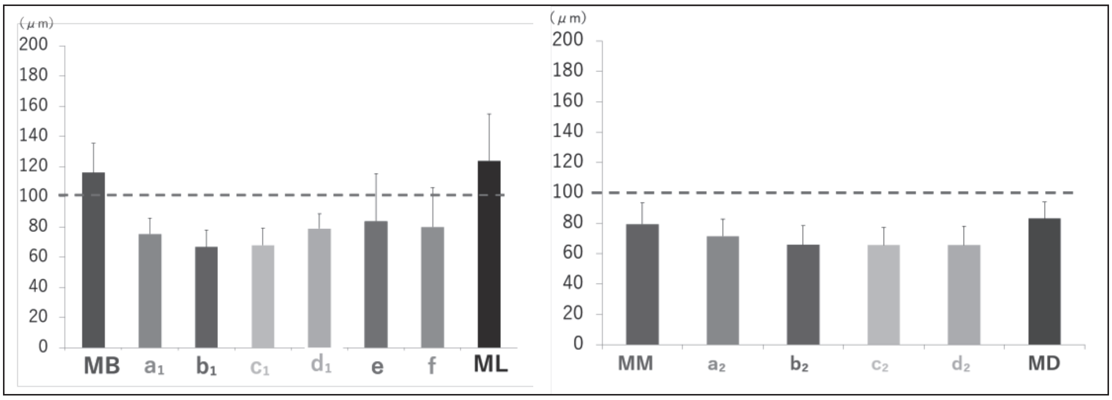

Fig.5,6 The mean space between hybrid resin coping and abutment

All points except MB and ML had spaces of less than 100 μm between the hybrid resin coping and the abutment.

Discussion

The fitting accuracy of Point MB and Point ML were inferior to the clinically acceptable range of 100 μm.[5)] This fact could be attributed to the setting of the sprue position in the software. Point MB was located on the sprue side (Fig.7). This region may be unfavorable for cutting the details of the margin due to the fact that the milling pathway was inhibited by the sprue. Point ML was located on the opposite side of the sprue because Point ML was located at the opposite end of a hybrid resin block, and this area was susceptible to damage during the milling process. The hybrid resin block would be bent in the opposite direction of the milling load side and would be increased. This fact seems to depend on the characteristics of the CAD/CAM milling blocks.

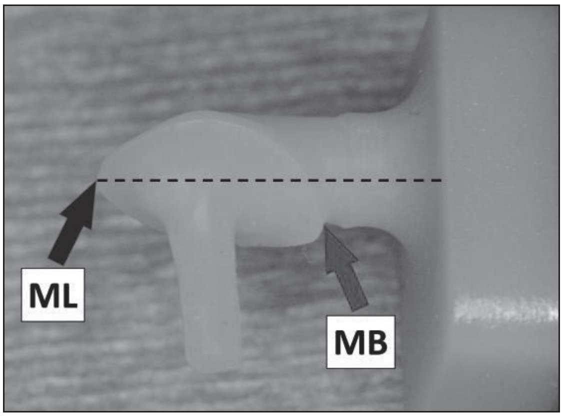

Fig.7 Location of point MB and ML after milling

Conclusion

Within the limitations of this study, it was suggested that the fitting accuracy of hybrid resin copings fabricated with this CAD/CAM system using scan posts was within the clinically acceptable range, excluding MB and ML.

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Clinical study about prognosis investigation of abutment teeth and surrounding tissues using magnetic attachments

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Abstract

Magnetic attachments are universally recognized for their practical value and are being widely used as magnetic attachment dentures in clinical dentistry. However, there are still few reports on the prognostic process of abutment teeth and surrounding tissues when using these magnetic attachments. Given the expansion of more effective magnetic attachment adaptation, the necessity of objective prognostic evaluation is very evident. Therefore, in carrying out integrated and objective evaluation of abutment teeth and surrounding tissues when using magnetic attachment, we aimed to analyze the evaluation methods commonly used by collaborating research institutes.

We collected prognostic data according to the standard protocol using common evaluation manuals and evaluation sheets available in collaborative research institutes.

Although the prognostic evaluation based on the evaluation sheet and protocol was very effective in considering the adaptation of the magnetic attachment, it unfortunately confirmed that objective evaluation of abutment teeth and surrounding tissues remains extremely difficult.

Introduction

Magnetic attachments are recognized for their practical value and are being widely used as magnetic attachment dentures. Although this kind of investigation has previously been reported by Hoshiai et al.,[1,2] there are still few reports on the prognostic process of abutment teeth and surrounding tissues when using magnetic attachments. Given the expansion of more effective magnetic attachment adaptation, the need for objective prognostic evaluation from various viewpoints is very evident.

Objective

The purpose of this study was to compare evaluation methods that have been created in carrying out the integrated and objective evaluation of abutment teeth and surrounding tissues using magnetic attachments that are common among collaborative research institutes.

Methods of investigation

We collected prognostic data according to the standard protocol using common evaluation manuals and evaluation sheets available in collaborative research institutes, and we analyzed various problems of these evaluation methods.

1. The common evaluation sheet

Figure 1 shows the evaluation sheet at the time of setting the magnetic attachment prosthesis. This was created by Nagata, The Nippon Dental University, at the Clinical Evaluation Committee of the Japanese Society of Magnetic Applications in Dentistry.

On the evaluation sheet, patient information, tooth defect type, intraoral photographs, PCR value, and the subjective evaluation of the patient, abutment tooth, and the state of the residual teeth are input. As shown in Figure 2, in addition to the evaluation sheet at the time of setting, there is also an evaluation sheet when the patient is recalled.

However, when the condition of the abutment teeth is input into the setting time sheet, the state of the abutment teeth is automatically reflected on the recall sheet. If there is a change, such as "tooth extraction or loss" in the abutment teeth, it is necessary to make a special effort to correct the abutment tooth information on the recall sheet.

In addition, as a precaution, “the patient identification number can be unique to each university, but in order to make it possible to refer to the list, the responsible person in each university should insure that there are no duplicate numbers.” [Note: If this is quoted material, as indicated by the quotation marks, its source should be indicated.]

Figure 1: The evaluation sheet at the time of setting magnetic attachment prosthesis

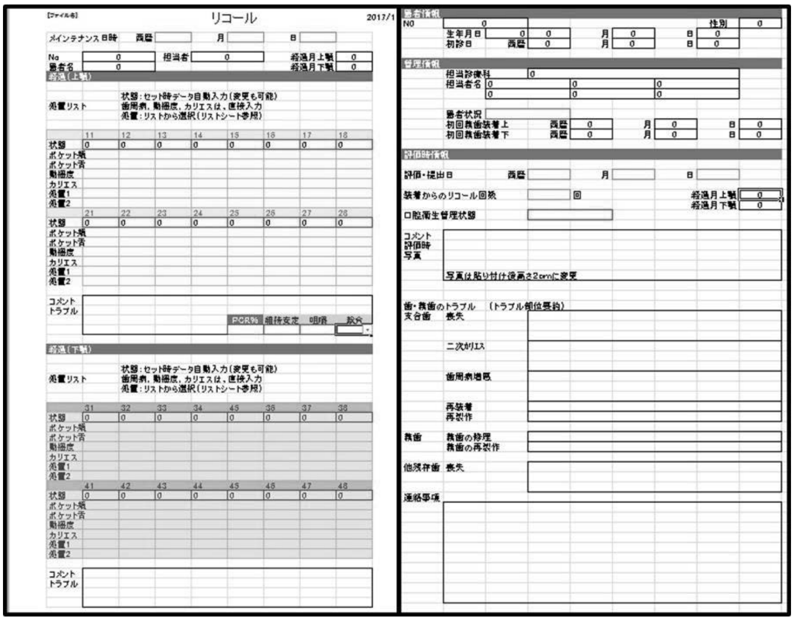

Figure 2: The evaluation sheet at recall

2. The subjects of the magnetic attachment prognostic investigation

These are the subjects of the magnetic attachment prognostic investigation:

・Patients who visited Aichi Gakuin University Hospital, Department of Prosthodontics, from 2013 to 2017

・Patients for whom prostheses were made using magnetic attachments

・Patients who are currently in recall

3. Applicable research subjects

There were 39 suitable research subjects; among these 39, the following conditions and total numbers of incidence were observed: (1) total magnetic attachment dentures—50, and (2) total abutment teeth—84. Of the 50 dentures, 15 were complete overdentures (including two implant overdentures), and 35 were partial dentures including 6 nonmetal clasp dentures. Figure 3 shows the classification of the magnetic attachment dentures.

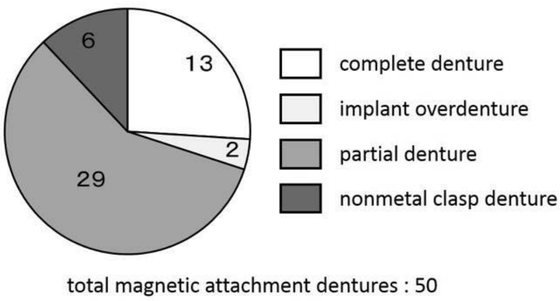

Figure 3: The classification of magnetic attachment dentures

Results of the investigation

1. The classification of abutment teeth by tooth type

Figure 4 shows the results of the classification of the abutment teeth to be investigated by tooth type. It was found that the magnetic attachment was best adapted to both the maxillary and mandibular canine of the 84 abutment teeth we investigated. Conversely, there was little tendency to adapt to the mandibular central incisor and mandibular molar.

3	2	3	2	9	2	2	2	4	13	4	3	3	3
7┘	6┘	5┘	4┘	3┘	2┘	1┘	└1	└2	└3	└4	└5	└6	└7
7┐	6┐	5┐	4┐	3┐	2┐	1┐	┌1	┌2	┌3	┌4	┌5	┌6	┌7
0	0	3	5	6	2	0	0	2	5	3	2	1	0

total abutment teeth : 84

Figure 4: The classification of abutment teeth by tooth type

2. The number of teeth lost

The number of lost abutment teeth to which the magnetic attachment was applied during the five-year investigation period is shown in Figure 5. The total number of lost teeth was 13. Of these, nine were via tooth extraction and four via teeth keeper detachment. Regarding these abutment teeth, statistics do not include continuing recalls after recreating the magnetic attachment.

1	0	0	0	0	0	0	1	2	1	0	0	0	1
7┘	6┘	5┘	4┘	3┘	2┘	1┘	└1	└2	└3	└4	└5	└6	└7
7┐	6┐	5┐	4┐	3┐	2┐	1┐	┌1	┌2	┌3	┌4	┌5	┌6	┌7
0	0	0	1	1	1	0	0	1	2	1	0	0	0

the total lost abutment teeth : 13

Figure 5: The number of abutment teeth lost during the five-year investigation period

3. The 5-year survival rate

The five-year survival rate of the abutment teeth to which the magnetic attachments were applied in this investigation was about 85%.

In a previous prognostic investigation by Hoshiai et al.,[1] the exact same five-year survival rate was about 95%, and the 10-year survival rate was reported to be 88%. A trend very similar to the results obtained in this investigation was seen. Table 1 shows the comparison of the five-year survival rate of the abutment teeth between this investigation and the previous investigation of Hoshiai et al.

Results of the survival rate based on tooth type resulted in a high survival rate of canines and premolars and a low survival rate of anterior teeth and molars. However, the survival rate of molars was high when limited to complete dentures.

Table 1: Comparison of the five-year survival rate of abutments teeth

	the number of abutment teeth	the number of lost abutment teeth	5-year survival rate（%）
This investigation	84	13	84.5
previous investigation of Hoshiai et al.	250	12	95.2

Discussion

In this study, a prognostic investigation into magnetic attachments was conducted using common evaluation methodology used by collaborative research institutes. The following observations were made:

Despite the fact that investigating the loss of abutment teeth is considered to be one of the most stable and simple evaluation methods in the prognostic investigation of magnetic attachments, it was discovered through this investigation that evaluations regarding detachment, resetting, and remaking of the keeper; evaluation of the periodontal pocket; and evaluation regarding the subjective factors of patients were complicated and difficult.

Furthermore, a prognostic evaluation based on the evaluation sheet and protocol was very effective in considering the adaptation of the magnetic attachment; unfortunately, it confirmed that the objective evaluation of abutment teeth and surrounding tissues remains extremely difficult. In the future, we would like to further study the relevance of the evaluation items at the time of data analysis.

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A case report of maxillary IARPD using magnetic attachments and anterior milling teeth

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[1]Department of Removable Prosthodontics, Tsurumi University School of Dental Medicine
[2]Dental Technician Training Institute, Tsurumi University School of Dental Medicine

Abstract

The patient was a 51-year-old female with a partially edentulous maxillary jaw (six anterior teeth remained, Kennedy classification I, Eichner classification B4). Her chief complaints were difficulties of mastication using existing denture and bad aesthetic due to metal clasps on the anterior teeth. Prosthetic rehabilitation was planned using an implant-assisted removable partial denture (IARPD) with magnetic attachments and milling crowns on the anterior remaining teeth.

Two implants (GENESiO Plus, GC, Japan) were placed in the regions of #14 and #24, and magnetic attachments (GIGAUSS D400, GC) were set on custom abutments using adhesive cement (Super-Bond, Sun Medical, Japan). Porcelain fused to metal crowns with milling on their lingual sides was placed on the six remaining anterior teeth. IARPD with a Co-Cr framework was delivered after the vertical dimension was heightened.

Sufficient retention and stability could be provided by the combination of milling crowns and magnetic attachments, and satisfactory aesthetic and function could be achieved using the IARPD.

Introduction

From an aesthetic perspective, patients are distinguished by metal clasps on their anterior teeth. In this case, an implant-assisted removable partial denture (IARPD)[1,2] with magnetic attachments[3] and milling crowns on the remaining anterior teeth was fabricated for aesthetic reasons.

Patient characteristics

The patient was a 51-year-old female with a partially edentulous maxillary jaw, including dental root fractures #16, #15, and #24 (Figs. 1, 2). A maxillary acrylic partial denture had been worn for five years. Her chief complaints were mastication difficulties using the existing denture and bad aesthetic due to metal clasps on the anterior teeth (six anterior teeth remained, Kennedy classification I, Eichner classification B4). She had no significant medical history.

Fig. 1 Intraoral photograph at the first visit

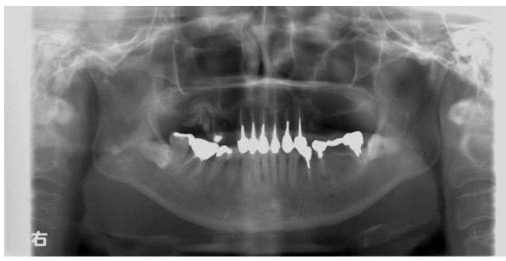

Fig. 2 Panorama radiograph at the first visit

Treatment progresses

2014/ June	First visits are made.
September	Teeth #16, #15, and #24 are extracted.
2015/ February	Two implants (GENESiO Plus, GC, Japan) were placed in the regions of #14 and #24 with socket rifting.
May	Second-stage surgery for the implants is undergone.
November	The vertical dimension is increased using a treatment denture.
2016/ July	Functional Bite Impression (FBI)[4] is made.
2017/ January	Porcelain fused to metal crowns with milling on their lingual sides was placed on the six remaining anterior teeth. An IARPD with Co-Cr framework was delivered.
February,	Magnetic attachments (GIGAUSS D400, GC) were set on the custom abutments using adhesive cement (Super-Bond, Sun Medical, Japan).

Fig. 3 Magnetic attachments (GIGAUSS D400, GC) were set on the custom abutments using adhesive cement (Super-Bond, Sun Medical, Japan).

Functional Bite Impression (FBI)

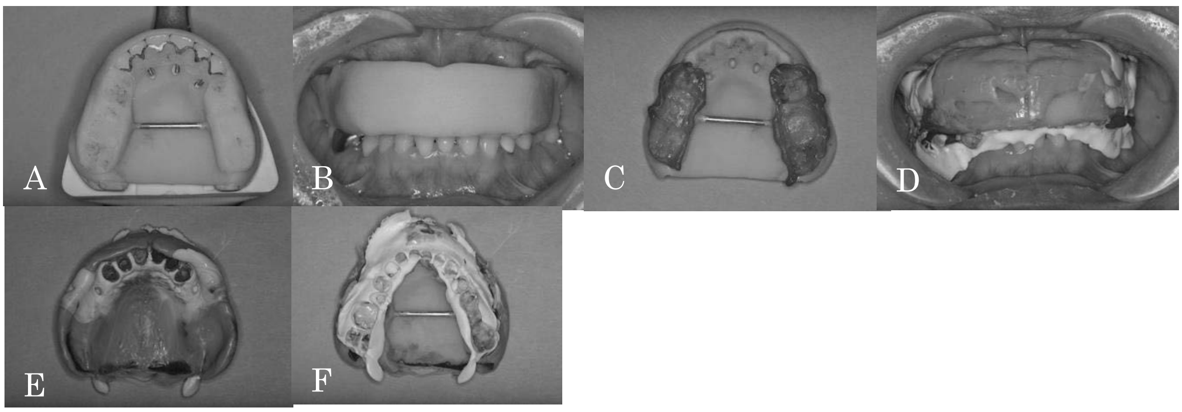

Fig. 4 FBI tray (Fig. A) was fabricated and tried in the oral cavity (Fig. B). Using auto-polymerized resin (pattern resin, GC) on the occlusal surface, the functionally generated path was recorded (Fig. C). The definitive impression (Exafine, GC) was made under occlusal pressure after the border molding, and the anatomical morphologies of the opposite teeth were recorded with white silicone impression material (Fit Checker, GC).

Delivered prosthetic appliances

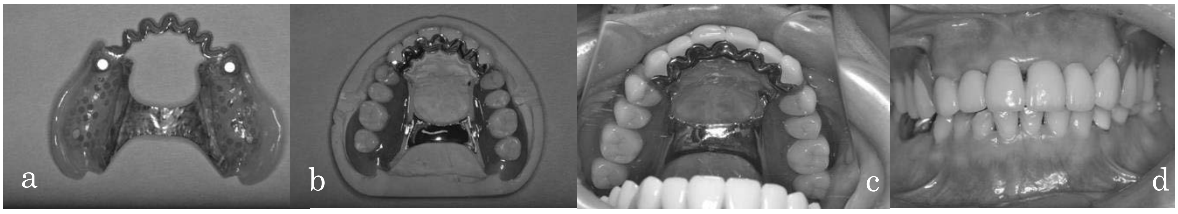

Fig. 5 View of the mucosal surface of a metal-based denture (Fig. a). Fabricated porcelain fused to metal crowns with milling on their lingual sides and an IARPD with a Co-Cr framework (Fig. b). Intraoral photograph when wearing prosthesis (Figs. c, d).

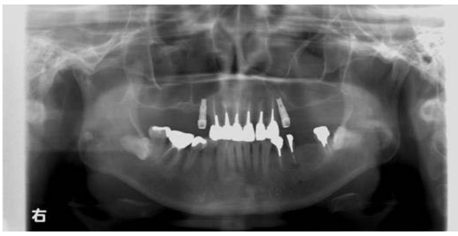

Fig. 6 Panorama radiograph at the postoperative visit

Discussion

Sufficient retention and stability could be provided by the combination of milling crowns and magnetic attachments, and satisfactory aesthetic and function could be achieved using the IARPD.

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Marginal bone loss and survival rate of immediately loaded mandibular two-implant overdentures retained by magnetic attachments: a three-year follow-up

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Abstract

Purpose: The aim of this study was to compare marginal bone loss and survival rate, between immediately and conventionally loaded mandibular two-implant overdentures retained by magnetic attachments.

Method: Nineteen participants with edentulous mandibles were randomly assigned into either an immediate loading group or conventional loading group. Each participant received two implants in the interforaminal region with flapless surgery. In the immediate group, each implant was connected keepers and loaded with mandibular overdentures on the same day of implant placement. In the conventional group, the implants were connected to healing abutments. The healing abutments were replaced with keepers and loaded with overdentures. The marginal bone loss was measured at immediate, 6-month, 1-year, 2-year and 3-year after implant placement using digital X-rays. To compare the marginal bone loss of two groups, Mann-Whitney U test was performed. To compare the survival rate of two groups, log-rank test was performed.

Result & Discussion: There is no significantly difference between marginal bone loss at every evaluation time. One patient in the conventional group withdrew 1 month after implants placement because of implant failure. Therefore the 3-year accumulate survival rate is 100% and 89% for immediate group and conventional group respectively, and there is no significantly difference between the groups.

Introduction

Several recent studies have shown that implant-supported overdentures (IODs) provide adequate denture stability and retention, improve patient quality of life (QoL), and lead to higher denture satisfaction, including better function, speech, and comfort.[1] The McGill consensus suggested that a two-implant overdenture (2-IOD) should become the first treatment choice for the edentulous mandible.[2] Immediate loading of IOD treatment has been attempted to shorten the healing period and to allow earlier use of dentures than with conventional loading.

Objective

The aim of this study was to compare marginal bone loss and survival rate of immediately and conventionally loaded mandibular two-implant overdentures retained by magnetic attachments.

Materials and Methods

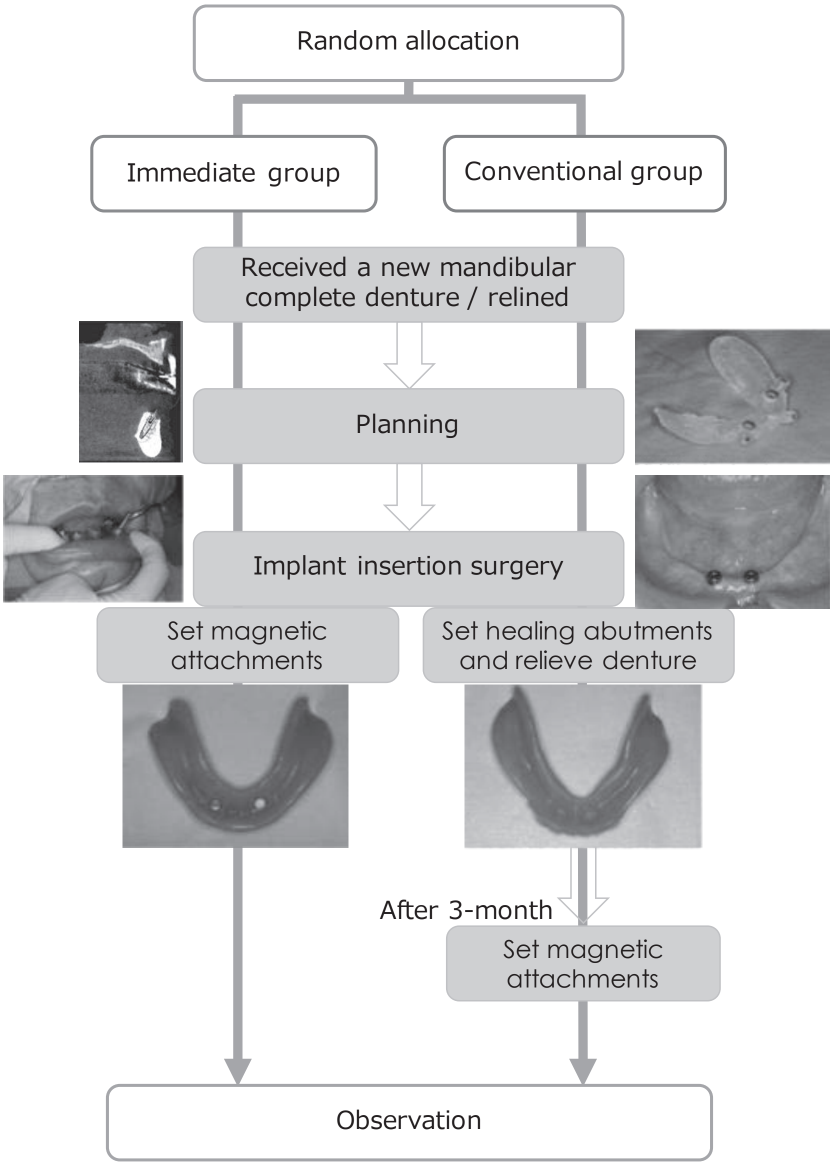


Fig1 Clinical procedures

Figure 1 shows the clinical procedures of this trial. This study was a randomized unblinded parallel-group trial that compared immediately loaded mandibular 2-IODs retained by magnetic attachments with conventionally loaded mandibular 2-IODs. Participants with completely edentulous mandibles and any opposing maxillary remaining teeth were recruited and randomly assigned equally to two groups: the immediate loading group (immediate group) and the conventional loading group (conventional group).

Each participant received two implants in the interforaminal region with flapless surgery. In the immediate group, each implant was connected to each keeper and loaded with mandibular overdentures on the same day as implant placement. In the conventional group, the implants were connected to healing abutments. The inner aspects of the denture base around the healing abutments were relieved. Three months after surgery, the healing abutments were replaced with keepers and loaded with overdentures.

Digital X-rays were taken immediately and at six months, one year, two years, and three years after implant placement. Marginal bone loss was measured by the difference in the marginal bone level immediately after the implant placement and in each observation period. To compare the marginal bone loss of the two groups, a Mann-Whitney U test was performed. To compare the survival rate of two groups, a log-rank test was performed to determine the three-year accumulated survival rate.

The study protocol was approved by the Ethics Committee at Tokyo Medical and Dental University (Number: 693) and registered with the UMIN Center (UMIN-CTR Clinical Trial, Universal Trial Number: UMIN000009889).

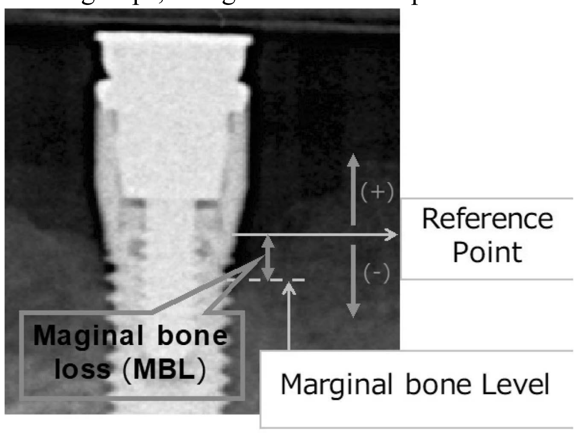


Fig2 Measurement of marginal bone loss

Results

Participants were randomly allocated into the immediate group (n = 10) or the conventional group (n = 9). One patient in the conventional group withdrew one month after implant placement because of implant failure.

Figure 4 shows the marginal bone loss results. The three-year marginal bone loss medians are 1.17 mm for the immediate group and 1.43 mm for the conventional group. At every evaluation time, there was no significant difference in marginal bone loss. One patient in the conventional group withdrew one month after implant placement because of implant failure. Therefore, the three-year accumulated survival rates are 100% and 89% for the immediate group and the conventional group, respectively (Fig. 5), and there is no significant difference between the groups.

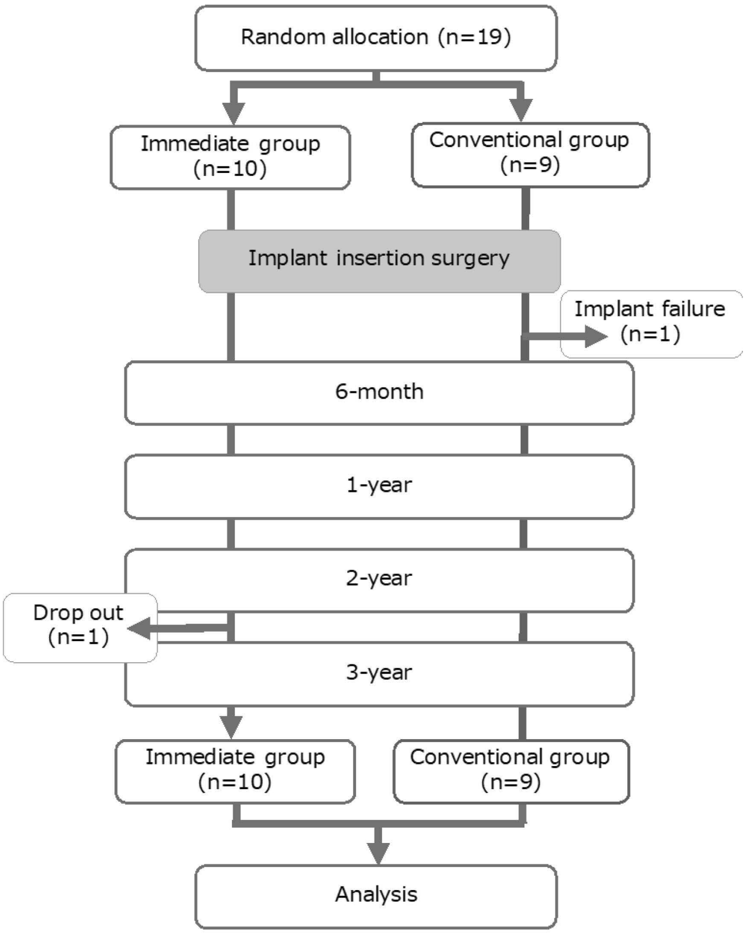


Fig3 Study flow

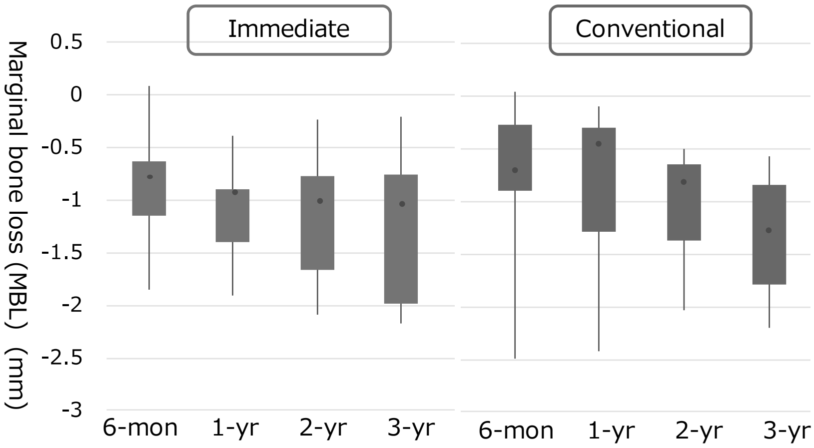
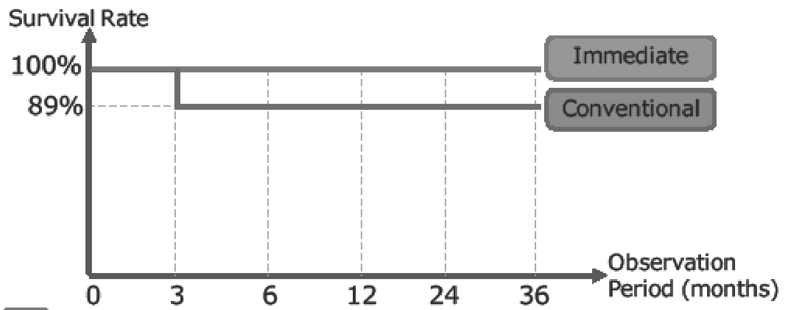


Fig4 Marginal bone loss (MBL)



	0	3	6	12	24	36	
Immediate	20/20	20/20	20/20	20/20	20/20	18/18	Remaining implants/ Total implants
	100	100	100	100	100	100	Survival rate (%)
Conventional	18/18	16/18	16/18	16/18	16/18	16/18	Remaining implants/ Total implants
	100	89	89	89	89	89	Survival rate (%)

Fig5 Accumulate survival rate

Discussion

Elsyad et al. concluded that immediately loaded two implants supporting a ball-retained mandibular overdenture are associated with more marginal bone resorption as compared with conventionally loaded implants after three years.[3] On the other hand, in this study, significant difference in marginal bone loss was not observed. This might be because, with regard to retention mechanisms, magnetic attachments appear to reduce lateral force on implants.

Conclusion

Although the tendency to have more marginal bone loss could be observed in the immediately loaded group, there are no significant differences between the two groups in either marginal bone loss or survival rate.

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Influence of the inclination angle of attractive surfaces on the attractive force of a magnetic attachment with an optimal structural design

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Abstract

We analyzed and investigated the influence of the inclination angle of attractive surfaces on the attractive force of a magnetic attachment with an optimal structure design by using a three-dimensional finite element method. Two types of analysis models were constructed: a basic model and an optimal model with an optimal structural design. The analysis considered the attractive force when the magnetic assembly and the keeper were in contact with each other and the inclination and the detachment with the one end of the keeper as a fulcrum. There were 21 different inclination angles of the attractive surface, ranging from 0 to 20 in one-degree increments. The keeper was observed with regard to an increase in the inclination angle of the attractive surface and the related decrease in the magnetic flux density inside the magnet assembly using both the basic and optimal models. In both the basic and optimal models, the attractive force decreased in inverse proportion to the inclination angle of the attractive surface. The results of this analysis suggest that the magnetic attachment with the optimal structural design is strongly influenced by the inclination angle of the attractive surface.

Introduction

Magnetic attachments have continued to improve. Various magnetic circuits have been designed so that a magnetic attachment of minimal size can exert a higher attractive force. A magnetic attachment consists of a magnet assembly and a keeper. A magnet in the magnetic assembly is encapsulated by magnetic and nonmagnetic materials. Magnetic flux can penetrate a magnetic body but cannot penetrate a nonmagnetic material. Magnetic flux is the magnetic line of forces. It penetrates magnetic materials and forms a closed magnetic circuit that exerts attractive force when a magnetic assembly and a keeper come into contact.

Until now, to further improve the attractive force of a magnetic attachment, the following methods have been used: (1) changing the magnetic circuit of magnetic attachment structure, (2) analyzing the attractive force, and (3) using a three-dimensional finite element method.[1] Using these methods, the central portion of the keeper and magnet set of nonmagnetic material is applied to the optimal structure, confirming that there was an improvement in the attractive force of the magnetic attachment.[2]

Objective

A three-dimensional finite element method was used to analyze the influence of attractive surface inclination on the attractive force of a magnetic attachment with an optimal structural design.

Materials and Methods

1. *Analysis model*

The magnetic assembly was 3.6 mm in diameter and 1.3 mm in height; a magnet inside the magnetic assembly was round and was 2.6 mm in diameter and 0.5 mm in height. The ring was 0.2 mm wide and 0.2 mm high. The disk yoke had a diameter of 2.2 mm and a height of 0.2 mm. The keeper was round and sharp; it had a diameter of 3.6 mm and a height of 0.7 mm.

Considering the models had line symmetry, half of a model is shown as a basic model (Fig. 1), and the other half is shown as an optimal model (Fig. 2). The structural design of the optimal model is the same as that of the basic model but also has nonmagnetic material inserted into the magnetic attachment.

The analysis range was 3.0 mm around a magnetic assembly and a keeper. Marc Mentat 2010 (Multi-Purpose Finite Element Pre and Post Processor, MSC) was used for model construction, and μ-MF (electromagnetic field analysis system, μ-TEC) analysis software was used. The element was a three-dimensional pentahedron and hexahedron element type. The element count was 107,604, and the nodal point count was 112,468.

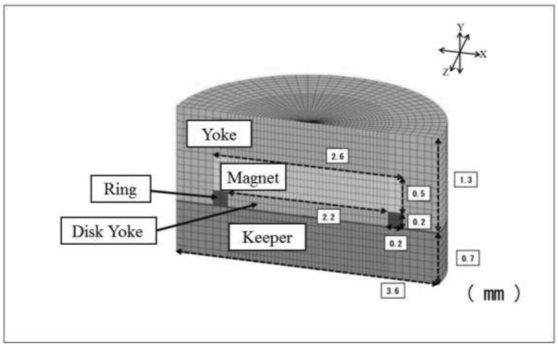

Fig.1 Basic model

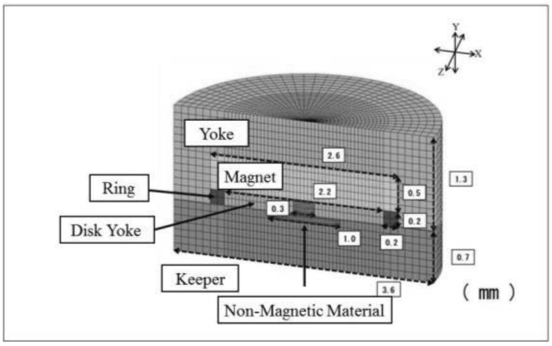

Fig. 1 Basic model

2. *Analysis condition*

The components of the magnet were Nd-Fe-B (neodymium, ferrum, boron), and its magnetic properties were calculated based on the thermal property of GIGAUSS D 600 and values provided by the manufacturer.[3] The component of the disk yoke and the keeper was the measurement of the magnetic properties of SUSXM27, and the B-H curve of the magnetic properties was calculated by the approximation formula (Table 1).[4]

Table 1 Analysis conditions

Magnet	
Nd-Fe-B	(BH) max = 46 MGOe Residual magnetic jnduction = 1. 22 T
Keeper & Yoke	
SUS XM27	Saturation magnetic induction = 1. 35 T
B-H curve	$B = Bs \{ 1 - \exp (-\mu_r \cdot \mu_0 \cdot H / Bs) \}$

3. *Analysis items*

From the condition where the magnet assembly and the keeper were in contact with each other in the optimal model, the attractive force when inclined and detached from one end of the keeper as a fulcrum was analyzed. The attractive surface had 21 different inclination angles ranging from 0 to 20 in one-degree increments. In addition, the same analysis item was used in the basic model (Fig. 3).

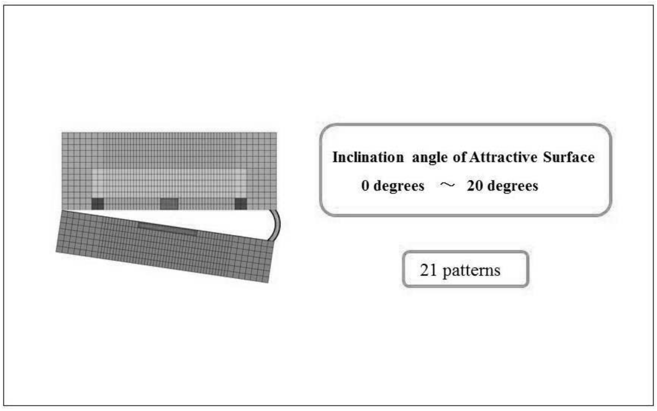

Fig. 3 Analysis items

Results of the analysis were evaluated as the magnetic flux density vs. the attractive force.

Results

1. *Magnetic flux density distribution*

Representative magnetic flux density distribution (Figs. 4, 5).

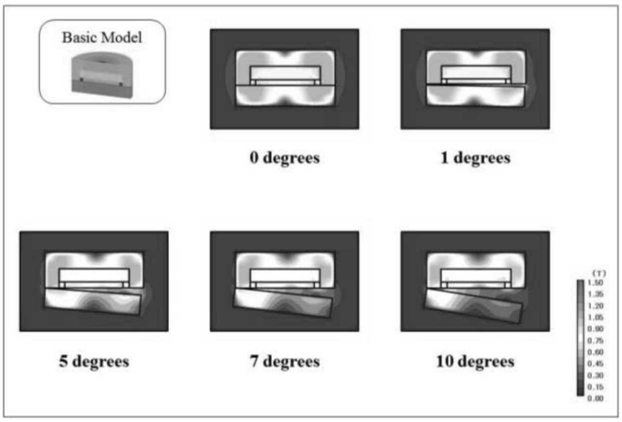

Fig. 4 Magnetic flux density distribution (Basic model)

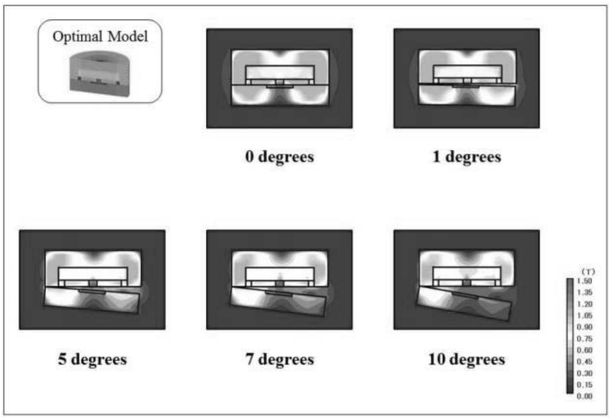

Fig. 5 Magnetic flux density distribution (Optimal model)

In both the basic and optimal models, concurrent with an increase in the inclination angle of the attractive surface, we observed a decrease in the magnetic flux density inside the magnet assembly, the keeper, and the magnetic flux density in the disk yoke on the right side of the magnet assembly. In addition, an increase in magnetic field leakage at the top of the keeper of the attractive surface was observed with the increase of the inclination angle of the attractive surface in both the basic model and the optimal model. When comparing the basic and optimal models, inclination angles of 0, 1, and 5 degrees of the attractive surface showed an increase in the magnetic flux density at the shield disk of the magnet assembly in the optimal model. However, at 7 and 10 degrees, this increase in magnetic flux density was not observed.

2. Attractive force

A graph of the analysis of the attractive force results is shown (Fig. 6). Attractive forces in both the basic and optimal models decreased in inverse proportion to the inclination angle of attractive surfaces. The inclination angles of attractive surfaces up to 5 degrees were greater in the optimal model than in the basic model; thus, it was confirmed that the attractive force is large.

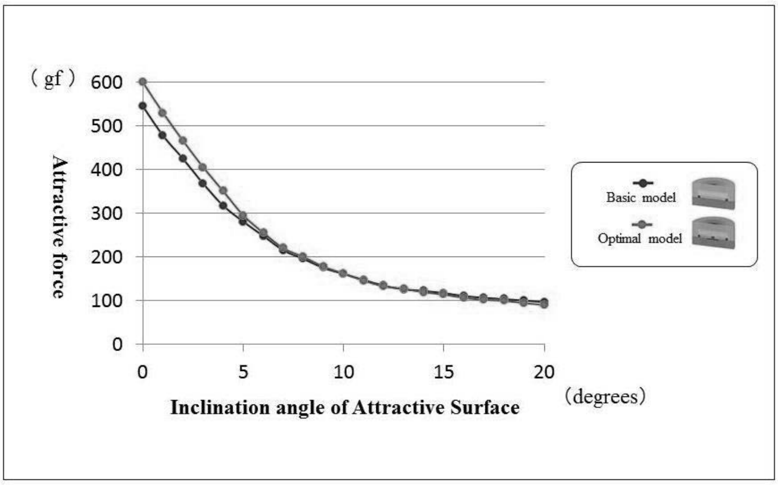

Fig. 6 Attractive force

When the inclination angle of an attractive surface was 6 degrees or more, it was confirmed that the attractive force was almost the same for both the basic and optimal models.

The reduction rate of the attractive force in the inclination angle of an attractive surface of 6 degrees was about 44% in the basic model and about 58% in the optimal.

Discussion

1. Efficiency of the finite element method

It is difficult to measure and observe details of the behavior of attractive and repelling forces created by a magnet. This is because the magnetic field has a gradient in all directions; therefore, a simple calculation formula cannot be established. The finite element method allows the visualization and simulation of the inner behavior of the magnetic circuit by adding various conditions. Searching for optimal magnetic circuits using the finite element method is considered time-efficient and cost-effective.

2. Efficiency of the analysis model

Magnets have a magnetic field distribution in space defined as a "leaky magnetic field." In other words, it has a magnetic field around the magnetic attachment. Therefore, the accuracy of the analysis results will be increased if the analysis range of the magnetic structure of the magnetic attachment and the circumference of the keeper are analyzed. In this study, we confirmed the range of magnetic field leakage and analyzed the elements of the magnet assembly and the keeper at around 3 mm in the construction model. In the final analysis, the accuracy of analysis in this model is high.

3. The relationship between attractive force and magnetic flux density

The attractive force of a magnet can be expressed as $F = (1/2\mu_0) \cdot S \cdot B^2$ {μ_0: space permeability, S: attractive surface area, B: magnetic flux density}.[5] The attractive force of a magnetic attachment is affected more by the magnetic flux density than the attractive surface area. Therefore, the attractive force can be increased efficiently by increasing the magnetic flux density. The magnetic circuit changes by replacing part of a keeper of a magnetic attachment with a nonmagnetic material, resulting in an increase in the magnetic flux density on the attractive surface. The attractive force was affected more by an increase in the magnetic flux density than by a decrease in the attractive surface area, resulting in an increase in the attractive force.

However, the results of this analysis showed that the reduction rate of the attractive force was larger in the optimal model than in the basic model. This is because the optimal model sets the nonmagnetic material in the center of the magnet assembly and keeper, so as to increase the magnetic flux density as much as possible. Therefore, in the optimal model, since the attractive surface of the keeper is inclined and detached, the magnetic flux density distribution inside the magnetic assembly and the keeper are strongly influenced, so that the reduction rate of the attractive force becomes larger than that of the basic model considered.

Conclusion

The results of this analysis using a three-dimensional finite element method for determining the effect of the inclination angle of the attractive surface on the magnetic flux density distribution and the attractive force in the magnet attachment, which produced an optimal structural design, produced the following conclusions:

1. The influence on the magnetic flux density distribution by the inclination angle of the attractive surface was larger in the optimal model than in the basic model. rface was larger in the optimal model than in the basic model.
2. The reduction rate of the attractive force by the inclination angle of the attractive su
3. The results of this analysis suggested that the magnetic attachment with the optimal structural design is strongly influenced by the inclination angle of the attractive surface.

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Effect of changes in the protocol of fixing a magnetic attachment onto the stage of an ISO device that measures retentive forces

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Abstract

Retentive forces are an important and sensitive aspect of dental magnetic attachments. The existing ISO 13017/Amd. 1 on measurements of retentive forces outlines the method of fixing magnetic attachments on a table that has been reported to be complicated. The aim of this study was to establish whether the location, method of temporary stabilization, and adjustment of the center of magnetic attachments on the table of an ISO measuring device influence retentive forces.

Two types of magnetic attachments, GIGAUSS D600 and HYPER SLIM 3513, were mounted on a measuring device connected to a digital force gauge.

The position at which a magnetic attachment is fixed on a table has no influence on retentive forces, since there was no significant difference between values measured when set up and placed on the left, right, back, or front as compared with the center (reference) position.

The use or avoidance of double-sided adhesive tape to stabilize the magnetic assembly did not affect the retentive forces since there was no significant difference in measurements for the various styles of temporary fixation.

Gross adjustments using the X-Y stage have a negative effect, as some of the retentive forces measured were statistically significantly lower than the reference values for both attachments.

Introduction

One of the most important aspects of dental magnetic attachments is the retentive force. However, retentive force is sensitive to changes in the test methods and conditions. ISO 13017/Amd. 1 was published in 2012/2015[1,2] and includes a detailed test procedure method for measuring retentive force that was developed and adopted as an international standard. Repeatability and accuracy of the retentive force data measurements are attainable using the measuring device and method prescribed in ISO 13017. The findings of our previous study proved that the test procedure in the ISO 13017 standard serves as a useful guide for measuring retentive force for first-time users.[3,4] However, participants who contributed to this verification test[4] and members of domestic/international ISO meetings stated that “the method of fixing a dental magnetic attachment on the table is complicated,” and “there is a possibility that the relative location on the table where the sample magnetic attachment is fixed has an influence on retentive force.” To improve the clarity of ISO 13017, a revision on the fixation method of a sample magnetic attachment was considered useful.

Objective

The aim of this study was to determine whether the method of fixing a magnetic attachment on a table influences the retentive force measured. This involves the manner in which temporary stabilization is achieved, the relative location on the table where specimens are placed, and the use of an X-Y adjustment table for aligning grossly mismatched magnetic attachment centers. The retentive force of a dental magnetic attachment fixed in various conditions and locations was measured, and the relationship between the fixation method and retentive force was evaluated.

Materials and Methods

Dental magnetic attachments

Two dental magnetic attachments were used: GIGAUSS D600 (GC) and HYPER SLIM 3513 (Morita).

Retentive force measuring device

The measuring device used in this study matches the basic description in ISO 13017:2012/Amd. 1:2015. This device allows the pulling of magnetic attachment when fixed on a table in a direction strictly perpendicular to the mating surface without any inclination. This is achievable through the incorporation of a linear motion bearing a slide guide of low friction resistance (0.02 N). The device was connected to a digital force gauge (ZPS, Imada). The crosshead speed was controlled by the use of a hydraulic check unit (Kinecheck 3022-19-1-1/4, Meiyu Airmatic).

Double-sided adhesive tape

Two types of double-sided adhesive tape were used: a thin type (thickness of 110 μm) and a thick type (thickness of 400 μm).

Test procedure for measuring retentive forces

Retentive forces of dental magnetic attachments were measured in accordance with the test procedure stipulated in ISO 13017. The crosshead speed was set at 4.5 mm/min. Data (retentive force readings) was obtained corresponding to the nine different conditions of fixation different from those stipulated by the ISO. The standard reference conditions for fixation according to the ISO 13017 manual are as follows:

1. A magnetic assembly was temporarily secured on a lower table by use of a thin type of double-sided adhesive tape on the mating face before transfer and steady fixation of the same assembly on the upper table by use of a cyanoacrylate adhesive applied on the upper surface of the assembly.
2. After removal of the double-sided adhesive tape, a keeper was temporarily attached to the assembly in a position in which the center of the assembly and that of the keeper matched and the two were congruent. Thereafter, the keeper was fixed on the lower table by use of a cyanoacrylate adhesive applied on its bottom surface.

Experimental fixation conditions

Several aspects involving the conditions of magnetic attachment fixation were varied in this study as follows:

1. Magnetic attachments fixed in different positions of the table (Fig. 1)

a) center (C)—as is specified in the ISO standard

b) back (B)

c) front (F)

d) left (L)

e) right (R)

2. Method of intermediate stabilization of the magnetic assembly on the lower table

a) use of a thin type of double-sided adhesive tape: 110 μm—as specified in the ISO standard

b) use of a thick type of double-sided adhesive tape: 400 μm

c) no temporary adhesion done using tape. The magnetic assembly was placed on the lower table with the mating surface directly in contact with the table. Glue was applied to the free surface before lowering the upper table so as to transfer and firmly attach the assembly.

3. Centering of the magnetic attachment specimen on the tables (Fig. 2)

The magnetic assembly was, at the time of fixation, deliberately set in positions that involved gross displacement of the center of the keeper on a horizontal plane along the X, Y, or combined XY axis away from that of the assembly. This resulted in a surface overlap of both the assembly and the keeper that covers about 1/3 of the diameter. Afterward, the X-Y stage was used to adjust the setup, making the center of the assembly and the keeper congruent. The retentive forces were measured after each adjustment.

a) Initially shifted along the X-axis direction

b) Initially shifted toward the Y-axis direction

c) Initially shifted toward the X + Y axis direction

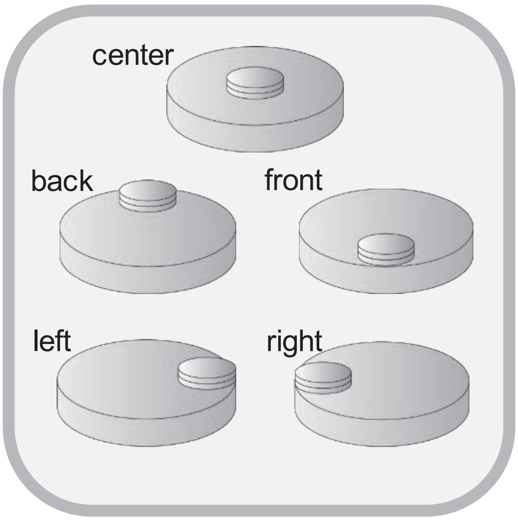


Fig. 1 Different locations on the table

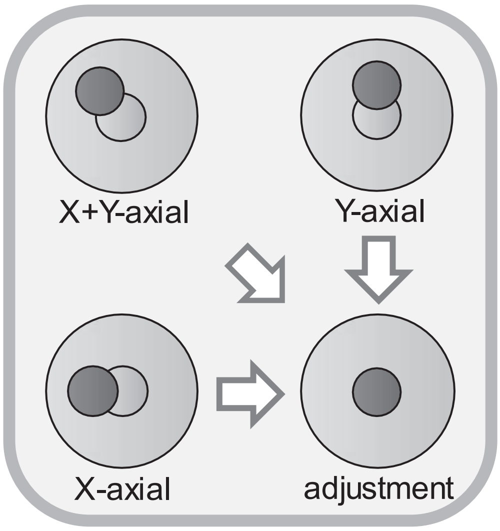


Fig. 2 Center displacement/overlap positions before adjustment

Statistical analysis

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

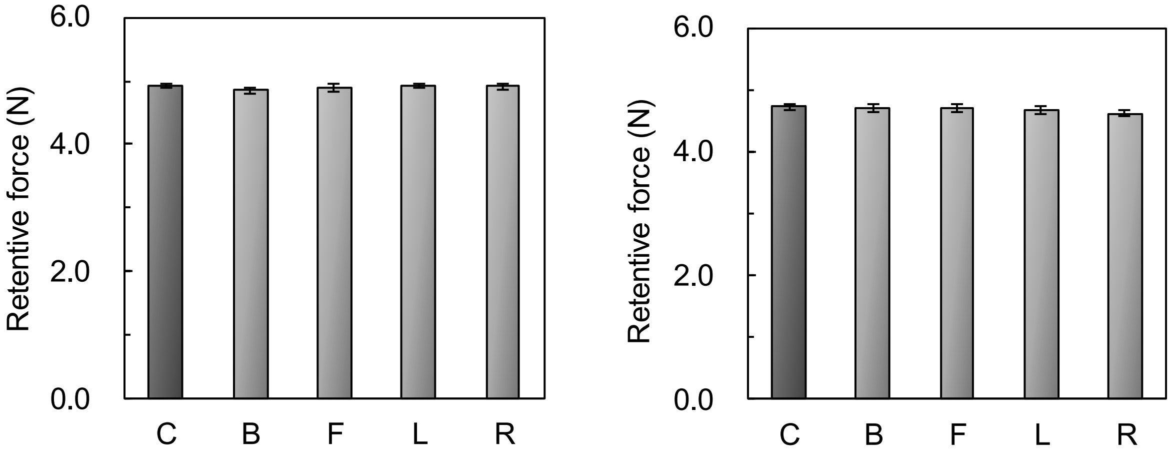
Results

1. Retentive force measured in accordance with the test procedure stipulated in ISO 13017 (reference values)

The retentive force values of both GIGAUSS and HYPER SLIM measured in accordance with the test procedure in ISO 13017 were more than 85% in absolute value as compared with the figures quoted in the manufacturer's literature accompanying the package.

2. The influence on retentive force associated with the placement of the assembly at different relative locations on the table

The retentive force values measured with the assembly in different positions on the table are represented in Fig. 3. There were no significant differences in either GIGAUSS or HYPER SLIM data as compared with the reference value (p>0.05).

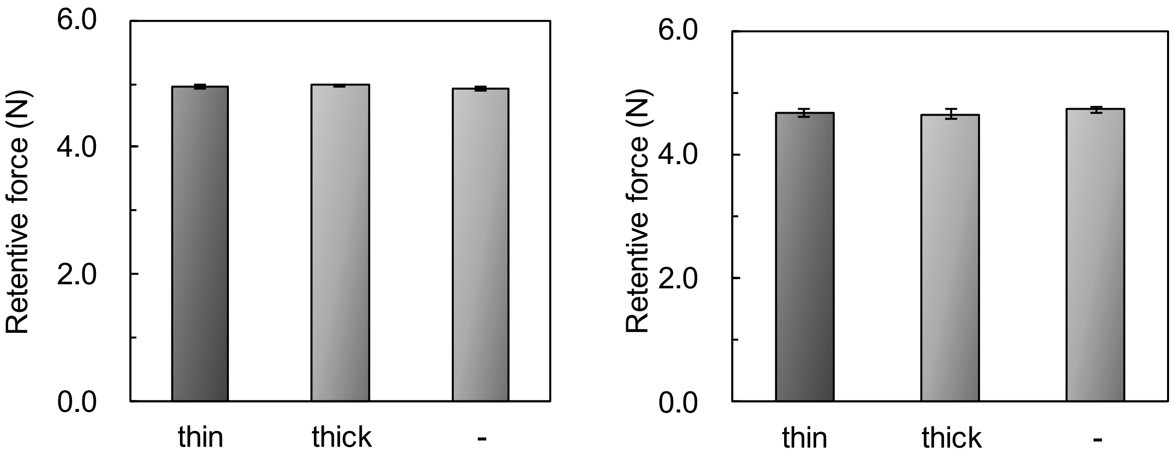


(a) GIGAUSS (b) HYPER SLIM

Fig. 3 Retentive forces for magnetic attachments fixed at different relative positions on the table

3. The influence of intermediate fixation conditions on the retentive force

Retentive forces according to the varying temporary conditions of fixation are shown in Fig. 4. All of the data for both GIGAUSS and HYPER SLIM did not differ significantly from the reference value ($p>0.05$).

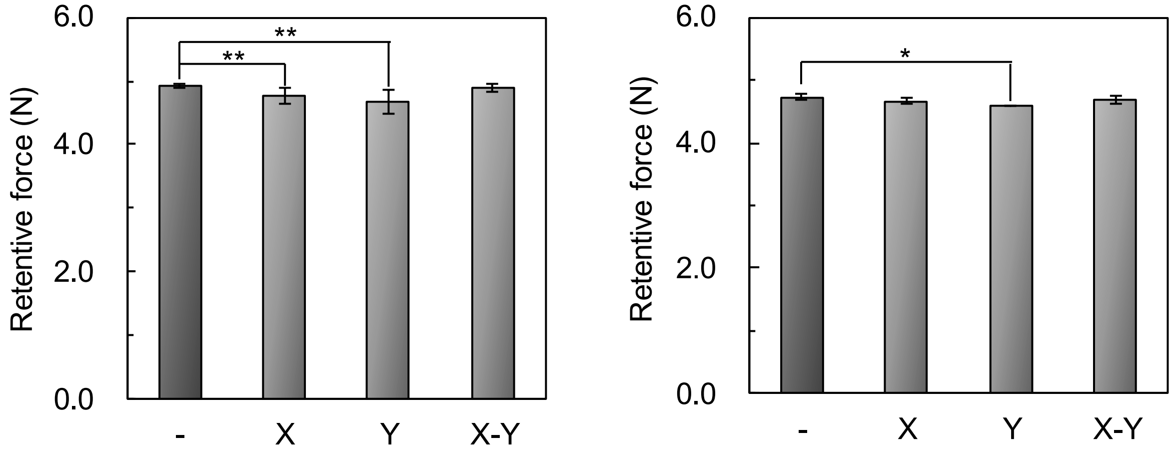


(a) GIGAUSS (b) HYPER SLIM

Fig. 4 Retentive forces according to various conditions of temporary fixation

4. The influence that gross adjustments of the center of the magnetic assembly and keeper has on the retentive force

The retentive forces measured when there was initial deliberate mismatch of the center of the magnetic assembly away from that of keeper along various directions on the horizontal axis and the consequent adjustment done are shown in Fig. 5. In GIGAUSS, the values measured after displacement along the X-axis and Y-axis directions were significantly lower than the reference values ($p<0.01$). In HYPER SLIM, the values measured after displacement along the Y-axis direction were significantly lower than the reference value ($p<0.05$).



(a) GIGAUSS (b) HYPER SLIM

Fig. 5 Retentive force of magnetic attachments after adjusting for gross displacement along various axes on the horizontal plane (* and ** indicate p<0.05 and 0.01, respectively)

Discussion

1. Retentive force measured in accordance with the test procedure stipulated in ISO 13017 (reference values)

ISO 13017 prescribes that the measured figure should be of a value that is more than 85% of that quoted in the manufacturer's literature accompanying the package. The measured retentive force values of both dental attachments in this study under ISO-stipulated conditions fulfilled the requirement. Therefore, figures acquired under ISO-compliant conditions (center of the assembly placed at the center of the table, temporary stabilization achieved using thin double-sided tape, and centers of magnetic attachment congruent) were considered to be the reference values in this study.

2. Influence on retentive forces associated with the placement of the assembly at different relative locations on the table

It was demonstrated that the relative location in which a magnetic attachment is fixed on the table has no influence on the retentive force, since there was no significant difference between values representing any of the locations (B, F, L, R) and the reference value (C). The slide guide (linear motion bearing) whose inclusion in retentive force measuring devices is specified in ISO 13017 is highly efficient and contributed to this stable result.

3. Influence of intermediate fixation conditions on retentive forces

The choice to use or avoid transient stabilization of a magnetic attachment using double-sided adhesive tape did not affect the retentive force because there was no significant difference in measured values corresponding to the various temporary fixation conditions. Ordinarily, double-sided adhesive tape is used to secure the position of the magnetic assembly at the center of the table and avoid movement before further stabilization with cyanoacrylate glue. However, as the findings proved that there was no difference in the retentive force despite the placement of the magnetic attachment at various locations on the table, we consider the temporary fixation step irrelevant.

Although not shown in the results above, some of the values of retentive forces attained when either thick tape or no tape was used were lower (statistically insignificant) than the reference values. This is because the process of dislodging the attachments from the tables, which is done several times as in this experiment, may leave the surface of the assembly and the keeper that are fixed to the tables by the use of glue slightly damaged. Damages on the bottom surface of the assembly may have a negative effect on the precise alignment of the mating surfaces that interferes with the accuracy. However, ISO 13017 does not deal with scenarios of multiple use of a magnetic attachment. This observation does not have a direct impact on the usage of dental magnetic attachments but serves as a caution when conducting repetitive measurements as for experimental or research purposes.

4. The effect of gross displacement and consequent adjustment involving the center of the magnetic attachment on the retentive force

When a deliberate shift to mismatch the center of the magnetic assembly from that of keeper and consequent readjustment was done, some of the retentive forces measured were statistically significantly lower than the reference values for both GIGAUSS and HYPERSLIM. Ideally, when the X-Y stage is moved along the horizontal plane, to correct minor displacements after the fixation of the magnetic assembly set with centers matching as much as visibly possible, there should be no effect on the retentive forces. However, in situations of gross displacement resulting in overlap, lateral movements on the table could result in tipping or movement of the magnetic attachment elements at an inclined angle, which may negatively interfere with the adhesion, leading to weak results. Therefore, although the center of the elements of the magnetic attachment (assembly and keeper) can be adjusted to correspond by using the X-Y stage after fixation to the tables, it is highly advisable to align the setup correctly as much as possible at the fixation stage.

5. New proposal for the fixation method

The test procedure in the current standard specifies that a magnetic assembly or magnet is first fixed on the upper table, and then a keeper or a magnet is fixed on the lower table. We propose that the reverse procedure could be more useful. It involves fixing a keeper or magnet to the lower table first and then a magnetic assembly or magnet to the upper table. The proposed method would eliminate the need for using double-sided adhesive tape and would make easier the process that involves matching the center of a magnetic assembly to that of keeper before fixation.

Conclusion

Retentive forces can be measured almost accurately using the ISO 13017 test procedure, as long as the magnetic attachment is not fixed in a position where the center of the magnetic assembly is grossly displaced from that of the keeper.

Acknowledgments

The authors gratefully acknowledge contributions from the following individuals of Tohoku University School of Dentistry: Mr. Yuki SUGAI, Mr. Akitsuna TAKAHASHI, Mr. Isao TOYA, and Mr. Motoaki NAGAHAMA.

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Working toward the international standardization of dental magnetic attachments
—Commission report of the ISO Corresponding Committee in 2017—

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Abstract

The international standardization of dental magnetic attachments has continued for more than ten years since applying for NP (New work item proposal) at ISO/ TC 106 (Berlin meeting) in 2007. Finally, an international standard, which can perfectly bring out the best of magnetic attachments made in Japan, has been completed in 2015 because of additional establishment of ISO 13017: 2012/ Amd.1 at the same year. The completion of the standard gave a halt of holding the SC 2/ WG 22 meeting at the ISO/ TC 106 (Tromsø meeting) in 2016. Meanwhile, the ISO Corresponding Committee has formulated a revised version of the standard which is composed of the integration of ISO 13017 and ISO 13017: 2012/ Amd.1. The revised version was sent to SC 2 secretariat at early April, and the revised version was subjected to NP voting at end of June in 2017. As a result, it was passed as a new business, and some members of the ISO Corresponding Committee attended ISO/ TC 106 (Hong-Kong meeting) held at August in 2017. The brief summary of the revised version, and the state of the SC 2/ WG 22 meeting at ISO/ TC 106 (Hong-Kong meeting) were informed in this review.

Introduction

The international standardization of dental magnetic attachments started by submitting NP (New Business Item Proposal) at the ISO/TC 106 (Berlin meeting) in 2007 and proceeded officially from the ISO/TC 106 (Gothenburg meeting) in 2008.[1] Four years later, the international standard ISO 13017 for dental magnetic attachments was established in July 2012.[2]

Since ISO 13017 standard included some insufficient parts, such as retentive force because of its short-term formulation, the necessity of an amendment for ISO 13017 was suggested by Japanese members at the ISO/TC 106 (Paris meeting) held in September 2012.

The suggestion was passed by NP voting in the following year, and a draft of the amendment for ISO 13017 was formulated.[3] After three years of discussion, international standardization of the retentive force measurement method was established as ISO 13017: 2012/Amd. 1 (Amendment of ISO 13017) in November 2015.[4]

It took over nine years to the finally complete ISO standards that can unfailingly demonstrate the merits of Japanese dental magnetic attachments that are compact, lightweight, and have strong retentive force. Although the completion of the standards halted the SC 2/WG 22 meeting at the ISO/TC 106 (Tromsø meeting) held in 2016, the WG 22 meeting in Hong Kong took place for the periodic revision of ISO 13017 in 2017.

This article outlines the state of the Hong Kong meeting in 2017 and the concept of ISO 13017 integrated with its amendment.

Activities

The completion of the standard halted the SC 2/WG 22 meeting at the ISO/TC 106 (Tromsø meeting) held in 2016. Meanwhile, the ISO Corresponding Committee has formulated a revised version of the standard, which is composed of the integration of ISO 13017 and ISO 13017: 2012/Amd. 1. The revised version was sent to SC 2 secretariat in early April, and the revised version was subjected to NP voting at the end of June 2017.

As a result, it was passed as a new business (Approval number: 14), the number of P member countries who agreed with the deliberation from the DIS stage (Draft of International Standard: stage 40.00) was 5. However, the SC 2 secretariat recommended deliberation from WD (stage 20.00) because nine P member countries agreed with deliberations from WD (stage 20.00 to 20.20) (Table 1).

Table 1 Result of the NP voting at the end of June 2017

Member responses - Votes by members																		
Country (Member body)	Status*	1a. Agree to add to work programme								Market relevance	1b.Stakeholders consultation		2. Relevant documents		3. Comments		4. Participation	
		Yes				No		Abs*										
		20.00	20.20	30.00	40.00	PWI: Yes	PWI: No	NC	Exp		Yes	No	Yes	No	Yes	No	Yes	No
United States (ANSI)	S				X						X			X		X	X	
Sub-Total Question 1a		7	2	0	5	0	0	0	7									
Totals		14				0		7		1	17	4	2	19	2	19	9	12

* Status P for P-Member, O for O-Member and S for Secretariat * Abs: NC for lack of National Consensus, Exp for lack of Expert Input

As the comments of each country were submitted at the time of NP voting, the answers were prepared, and the modified WD was submitted to the SC2 secretariat in early August. The secretariat officially announced that it would formulate standards from a WD (stage 20.00) over a three-year period (Fig. 1). Since the standard has to be published (stage 60.60) in three years, we decided to aim for the passing of DIS entry (stage 40.00) at this Hong Kong meeting.

In light of results, the proposal is therefore:

☒ Approved (all approval criteria met) and the project will be registered:

- ☒ as new project in the committee's work programme (stage 20.00)
- ☐ as a Working Draft (WD – stage 20.20)
- ☐ as a Committee Draft (CD – stage 30.00)
- ☐ as a Draft International Standard (DIS – stage 40.00)

Stage
- **NP (20.00)**
- **WD (20.20)**
- **CD (30.00)**
- **DIS (40.00)**
- **FDIS (50.00)**

Entry.00, Start.20, Finish.60

☐ Disapproved (one or more approval criteria not met)

(note that if no option is selected, the default will be abandoned)

- ☐ The draft will be registered as a preliminary work item (stage 00.60)
- ☐ Abandoned.

Fig. 1 Results instructed by the SC2 Secretariat

Working goal in 2017

The chosen aim is to pass DIS entry (stage 40.00) at this Hong Kong meeting.

ISO/TC 106 Hong Kong meeting

Six members of the ISO Corresponding Committee, Dr. S. Masumi (convener),Dr. T. Ishigami (expert), Dr. Y. Takada (expert assistant), Dr. M. Takahashi (observer), Dr. E. Makihara (observer), Dr. H. Sasaki (observer), and Dr. Kent T. Ochiai (convener assistant), an American member, attended the ISO/TC 106 Hong Kong meeting held at Hong Kong University on August 20–26 2017 (Fig. 2).

Fig. 2 Hong Kong University and its position indicated on the map

The SC2/WG22 meeting scheduled on August 23 was canceled on account of an unprecedented typhoon (Level 8) that was striking Hong Kong and Macau the previous day (Fig. 3).

Fig. 3 Typhoon view from the hotel window

As an emergency plan for a rescheduled WG meeting was announced at midnight on August 24, our members got the opportunity to propose deliberations from DIS entry at the SC 2/WG 22 meeting on next morning (Fig. 4).

Venue / Time	P1	P2	P3	P4	MB 141	MB142	MB121	MB122	MB151
8:00-9:00	SC8 plenary	SC1 plenary	SC3 WG5	SC7 WG 9	SC2 WG 20	SC7 WG 4	SC9 WG4	SC6 WG 1	
9:00-10:00									
10:00-11:00		SC4 plenary (10:30-12:30)	SC9 plenary (10:30-12:30)	SC3 plenary (10:30-12:30)	SC2 WG 7 (Convenor not available)	SC2 WG 22	SC2 WG 14	SC6 WG 9	
11:00-12:00	TC 106 WG 10 with SC8 WG2								
12:00-13:00									
13:00-14:00		SC2 plenary (13:30-16:30)	SC6 plenary (13:30-16:30)	SC7 plenary (13:30-16:30)					
14:00-15:00									
15:00-16:00									
16:00-17:00									
17:00-18:00									

Emergency Plan for rescheduled WG meetings.rev3

8/24/2017 3:12 a.m.

Fig. 4 Emergency plan for rescheduled WG meetings at 3:12 a.m. on Aug. 24

Although the meeting from 10 a.m. was as chaotic as the weather, a gentle wind seemed to blow to the Japanese side. We were able to obtain nearly the meeting approval of our proposal with a few minor modifications. The deliberation from the DIS stage was also passed by the WG 22 and SC 2 plenaries (Fig. 5).

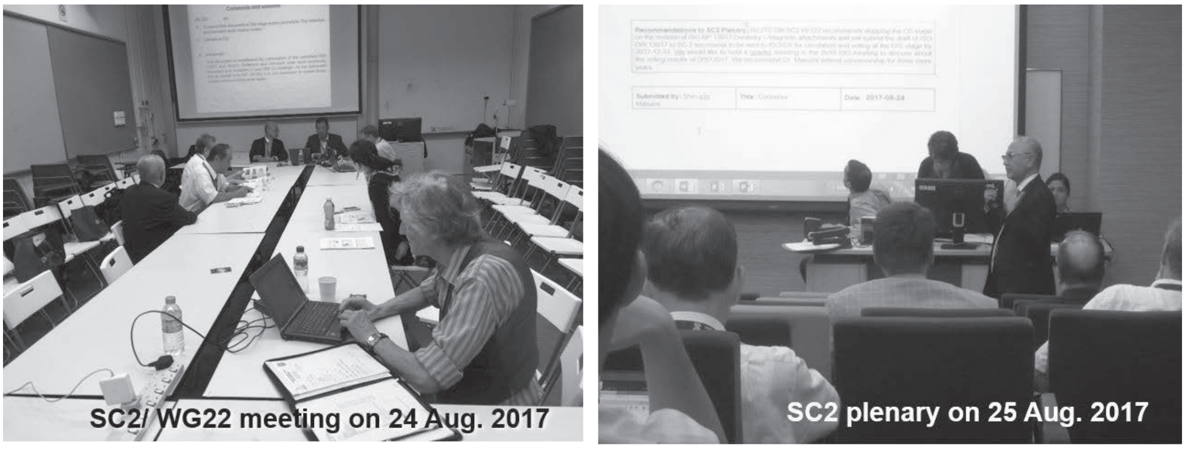


Fig. 5 SC2/WG 22 meeting and the SC2 plenary

Currently, the revised draft was accepted by SC2 Secretariat on October 24, 2017, and it is scheduled to be subject to DIS voting early next year.

Pleasures in Hong Kong, such as a dinner party of ISO/TC 106 and excellent night life, are shown in Fig. 6.

Fig. 6 Pleasures in Hong Kong

Overview of ISO 13017 integrated with ISO 13017: 2012/Amd. 1

An overview of ISO 13017 integrated with ISO 13017: 2012/Amd. 1 is shown in Table 2. ISO 13017 consists of clauses 1 to 8, and it is reinforced by the addition and revision of clause 5 (5.1 Retentive force) and clause 6 (6.3 Retentive force, 6.4 Corrosion resistance), in accordance with the amendment (Amd. 1) (See underlines in Table 2.).

The pretreatment of specimens was specified in clause 5. Concretely, the “cleaning protocol” for specimens to measure the retentive force was added to sub-clause 5.1.

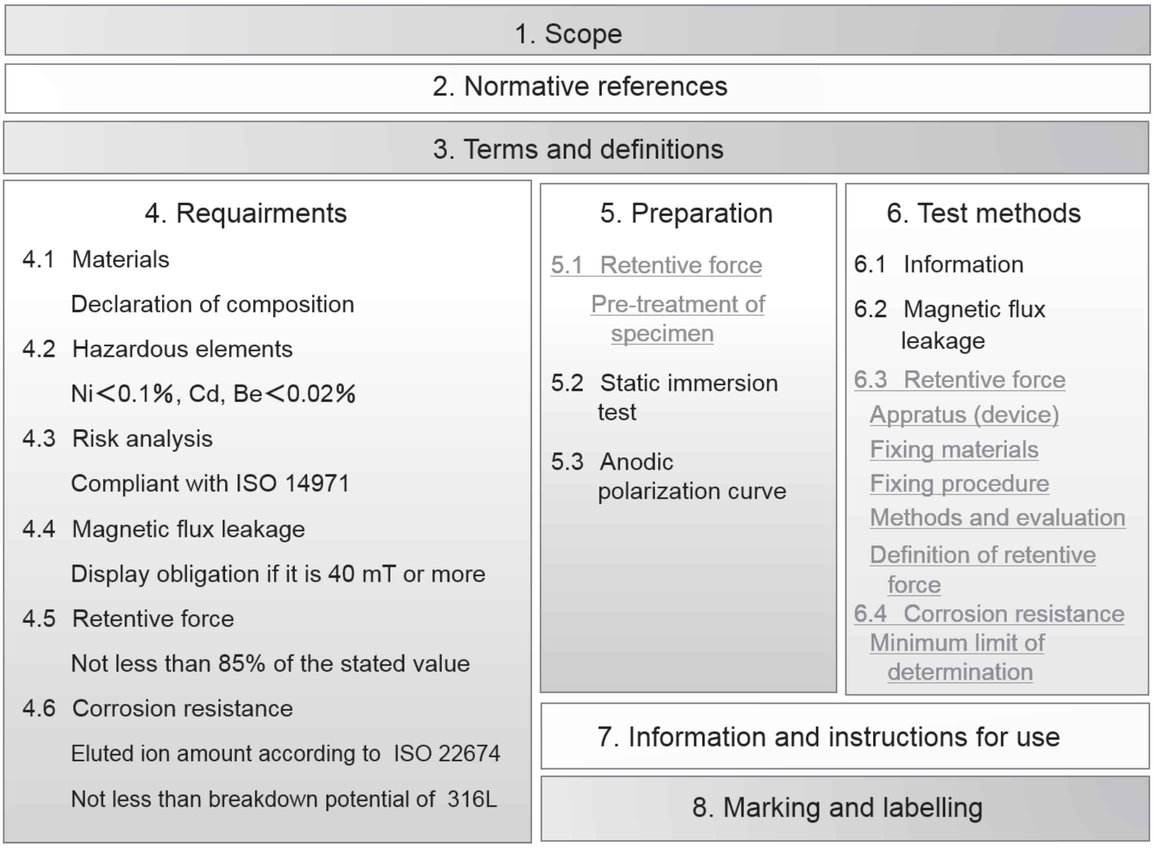
Clause 6 specified the test methods for evaluating whether the magnetic attachment shall satisfy the requirements stated in clause 4, mainly, specifying methods for measuring magnetic flux leakage, retentive force, and corrosion resistance.

The amendment (Amd. 1) enhanced the method for measuring retentive force in detail, making it possible to perform accurate and reproducible measurements. In particular, the measurement assisting device was specified to move vertically to the mating face, regulating the dynamic friction force within 0.01 N (1 g).

Furthermore, the retentive force curve obtained by the attractive force measurement is specified in order to clarify how to obtain the retentive force, and the difference between the measurement value and the baseline was defined as the true maintenance force.

Corrosion resistance in clause 6.1 introduced the determination limit and the detection limit used in the chemical analysis method in order to clarify the quantitative analysis of impurity element ions in the static immersion test.

Table 2 Overview of ISO 13017 integrated with ISO 13017: 2012/ Amd. 1



Finally

The international standardization of dental magnetic attachments, which started in 2005, took 12 years to establish international standards, including preparations. As we succeeded in establishing a couple of international standards, ISO 13017 and ISO 13017: 2012/Amd. 1 (Amendment edition), within the scheduled term, we were able to realize an exemplary formulation. We would like to ask for your continued support and cooperation in the future.

To readers,

Thank you very much.

From all members of the ISO Corresponding Committee in JSMAD

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