日　磁　歯　誌
J J Mag Dent
ISSN 0918-9629

2012 Volume 21. Number 2

JJSMAD

日本磁気歯科学会雑誌

The Journal of the Japanese Society of Magnetic Applications in Dentistry

Volume 21, Number 2

Proceedings of the 11th International Conference on Magnetic Applications in Dentistry

March 5 to 23, 2012

The Japanese Society of Magnetic Applications in Dentistry

日本磁気歯科学会

JJ Mag Dent vol.21 No.2 2012

The Journal of the Japanese Society of Magnetic Applications in Dentistry

Volume 21, Number 2

Proceedings of the 11th International Conference on Magnetic Applications in Dentistry

March 5 to 23, 2012

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

The Japanese Society of Magnetic applications in Dentistry

The 11th International Conference on Magnetic Applications in Dentistry

The 11th International Conference on The Japanese Society of Magnetic Applications in Dentistry organized by JSMAD was held on the Internet as follows;

Meeting Dates:

March 5 to March 23, 2012

Location:

JSMAD web site

http://wwwsoc.nii.ac.jp/jmd/index-e.shtml

http://www.jsmad.jp/international-e.shtml (New)

General Chair:

Prof. Yoshimasa Igarashi, Tokyo Medical and Dental University

Conference Secretariat:

Masayuki Sato, 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

Conference Committee

The Japanese Society of Magnetic applications in Dentistry

President of the Japanese Society of Magnetic applications in Dentistry

Dr. Tomohiko Ishigami, Nihon University

Vice-President of the Japanese Society of Magnetic applications in Dentistry

Dr. Shinichi Masumi, Kyusyu Dental Collage

Conference Secretary

Dr. Masatake Akutagawa, The University of Tokushima

Conference Organizing Committee

Dr. Kanji Ishibashi, Iwate Medical University
Dr. Igarashi Yoshimasa, Tokyo Medical and Dental University
Dr. Tetsuo Ichikawa, The University of Tokushima
Dr. Syuji Okawa, Meikai University
Dr. Osamu Okuno, Tohoku University
Dr. Yosuke Kinouchi, The University of Tokushima
Dr. Hisashi Koshino, Health Science University of Hokkaido
Dr. Kochi Takumi, Kochi Dental Clinic
Dr. Yoshinobu Tanaka, Aichi-Gakuin University
Dr. Joji Tanaka, Tanaka Dental Clinic
Dr. Kazuo Nakamura, International University of Health and Welfare
Dr. Yoshinori Nakamura, Aichi-Gakuin University
Dr. Masayuki Hideshima, Tokyo Medical and Dental University
Dr. Hiroshi Mizutani, Tokyo Medical and Dental University
Dr. Toshio Hosoi, Tsurumi University
Dr. Yuji Homada, Homada Shika Daiichi Shinryoujo

Conference Arrangements Committee

Dr. Masatake Akutagawa, The University of Tokushima
Dr. Sozo Ito, Iwate Medical University
Dr. Tetsuo Ohyama, Nihon University
Dr. Masafumi Kikuchi, Tohoku University
Dr. Hisashi Koshino, Health Science University of Hokkaido
Dr. Toshiaki Hasuike, Meikai University
Dr. Masayuki Hideshima, Tokyo Medical and Dental University

Proceeding Committee

Dr. Tomohiko Ishigami, Nihon University
Dr. Yosuke Kinouchi, The University of Tokushima
Dr. Yukyo Takada, Tohoku University
Dr. Kazuo Nakamura, International University of Health and Welfare
Dr. Shinichi Masumi, Kyusyu Dental Collage
Dr. Yoshinori Nakamura, Aichi-gakuin University

Published by the Japanese Society of Magnetic applications in Dentistry

c/o Division of Occlusion & Maxillofacial Reconstruction,

Department of Oral Functional Reconstruction, Kyushu Dental College
2-6-1, Manazuru, Kokura-kita, Kitakyushu, Fukuoka 803-8580 JAPAN

B&W: PRINT COOP Tohoku University Coop
Kogakubu Chuo Kosei Kaikan, 6-6 Aramaki-Aza-Aoba, Aoba-ku, Sendai, Miyagi 980-8579 JAPAN

The 12th International Conference on Magnetic Applications in Dentistry General Information

General Information

The Japanese Society of Magnetic Applications in Dentistry (President: Tomohiko Ishigami, Nihon University) is a scientific association founded in 1991 and is devoted to furthering the application of magnetism in dentistry. The 12th International Conference on Magnetic Applications in Dentistry organized by JSMAD will take place on the Internet as follows.

Meeting Dates:
Monday, March 4 to Friday, March 22, 2013

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

General Chair:
Prof. Tetsuo Ichikawa, The University of Tokushima

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 9th 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 8,000 yen per page. (No charge for invited paper.)

Guidelines for Presentation

Deadlines:
Entry: February 4, 2013
Poster submission: February 28, 2013

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 md24_tokushima@dent.tokushima-u.ac.jp

Conference Secretariat

Kan Nagao, The University of Tokushima
E-mail: md24_tokushima@dent.tokushima-u.ac.jp
Tel: +81-88-633-7347
Fax: +81-88-633-7461

Visit JSDMD Home Page for updates!
http://www.jsmad.jp/

Contents

Session 1 *Chair: Kan Nagao (The University of Tokushima)*

1. Observation of Blood Flow on Palatal Mucosa using an Improved Probe ··········· 1

T. Kawaguchi, K. Hoshiai, R. Ito, W. Fujinami, A. Otoda, Y. Tanaka, H. Nagai, M. Mitsui, Y. Tanaka

2. Pressure distribution of implant-supported removable partial dentures with stress-breaking attachments ··········· 5

K.Kono, Y. Suzuki, M. Sato, C. Ohkubo, M. Takahashi

3. Stress Analysis of Implant Keepers with Different Retaining Methods ··········· 9

K. Hayashi, R. Kanbara, Y. Nakamura, Yo. Ohno, K. Shiraishi, K. Shoji, K. Yoshihara, H. Kumano, Y. Takada, Yu. Ohno, Y. Tanaka

Session 2 *Chair: Chikahiro Ohkubo (Tsurumi University)*

4. Influence of the Axial Surface of Keeper Coping on the Circumferential Tissue Using Three-Dimensional Finite Element ··········· 15

N. Shibuya1, D. Yamanaka1, T. Uchida1, T. Ohyama, S. Nakabayashi, S. Tadokoro1, H.Toyoma, K. Ohtani, T. Fujimoto, M. Ishijima1, T. Ishigami

5. Observation of abutment tooth cementum and root cap margin– ··········· 20

A. Sugita, S. Endo, E. Nagai, N. Tsukimura, H. Saito1, M. Morokuma, N. Suzuki1, D. Akita1, T. Ishigami

6. Influence of the surface condition of used keepers to retentive force ··········· 24

T. Shionome1, Y. Ogawa1, S. Endo, M. Kiuchi, Y. Umekawa, M. Hasegawa, K. Miyata1, Y. Abe, T. Ishigami

Session 3 *Chair: Masatake Akutagawa (The University of Tokushima)*

7. Mechanical Analysis of Extracoronal Magnetic Attachment using Three-dimensional Finite Element Method ··········· 29

Yo. Ohno, R. Kanbara, Y. Nakamura, T. Masuda, H. Kumano, K. Hayashi, H. Nakamura, T. Iwai, Yu. Ohno, Y. Takada[1], Y. Tanaka

8. A change in attractive force of a keeper fabricated using a reuse metal of castable magnetic alloy ··········· 36

K. Yoshihara, T. Iwai, Y. Nakamura, H. Konno, T. Kogiso, K. Shoji, K. Okamoto, T. Masuda, Yu. Ohno, Y. Takada, Y. Tanaka

9. Working toward the international standardization of dental magnetic attachments - Commission report of the ISO Corresponding Committee in 2011 - ·········· 42

Y. Takada

Session 4 ***Chair: Yoshinori Nakamura (Aichi-Gakuin University)***

10. Comparison of the swallowing mensuration using MI sensor with swallowing soundusing the pharynx microphone– ··· 46

K. Hamaguchi, M. Akutagawa, Y. Tegawa, T. Ichikawa, S. Hongama,Y. Kinouchi

11. A Case Report of a Removable Denture Using Magnetic Attachments for Mandibular Molar Missing with a decreased occlusal vertical dimension ····· 50

R. Negoro, M. Sone, F. Okutsu, T. Kusano, T. Matsukawa, Y. Toyota, S. Yorichika, K. Okamoto, S. Ohkawa

12. A case report of a free-end-saddle telescopic denture using a magnetic attachment for maxilla molars ·· 53

M. Sato, M. Hideshima, J. Wada, T. Ando, J. Wadachi, M. Tsurumi, Y. Tsubota, Y. Odaka, Y. Igarashi

13. Development of Cement-bonded Keeper Used with Carbon Lead ? Part 3 A Trial for Ready-made Pattern ··· 56

H. Matsubara, H. Mizutani, H. Hideshima, T. Ando, K. Nakamura, H. Sasaki and Y, Igarashi

Appendix

How to Write the Proceedings for International Conference on Magnetic Applications in Dentistry ··········· 59

Observation of Blood Flow on Palatal Mucosa using an Improved Probe

T.Kawaguchi, K.Hoshiai ,R.Ito, W.Fujinami,A.Otoda,Y.Tanaka,H.Nagai,M.Mitsui,Y.Tanaka
Department of Removable Prosthodontics, School of Dentistry, Aichi-Gakuin University

Introduction

In order to evaluate oral health and the function of prostheses, it is important to clarify the movement of blood flow on the palatal mucosa and in the cervical region around abutment teeth. In the past, we have observed blood flow on the palatal mucosa;[1),2)] ,however, the probe used to measuring blood flow has a number of limitations and restrictions. In the present study we make use of a newly-developed and more advanced miniature probe which can take more detailed measurements, and we present measurements of blood-flow volume in the palate and near the cervical region of the teeth areas in which we had difficulty in measuring in the past.

Materials and Methods

The improved probe, which was used for blood-flow-volume measurement, is about 1/10 the diameter of the previous model, and it is more flexible. (Fig1)

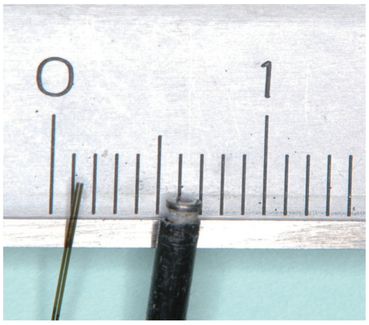


Fig1: Comparison of improved model(φ0.17mm) with previous model(φ1.8mm)

By comparing measurements of the same part of a palate using both models, we determined that there was no difference in the measurement accuracy.

Experiment①: To clarify blood flow volume of in the cervical region of teeth.

Subject: 8persons(3 men, 5 women) average age is 28.9 years old(±3.3y)

Points of Measurement: Three points separated by 1mm intervals, in the cervical region of the first molar 1 mm (Fig 2)

Experiment②: To measure the blood-flow under a denture base at the time of load.

We created a model of a denture which covers occlusal surface of the maxillary molars and palate. (Fig3)

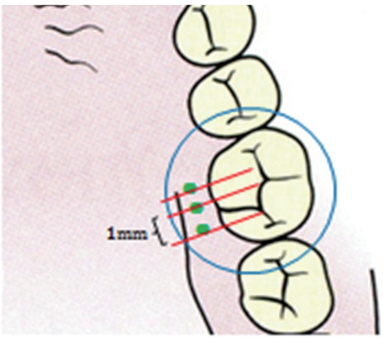


Fig 2: Points of Measurement

Fig 3: model of a denture

Blood flow volume was measured at the time of load. The maximum occlusal pressure measurement was performed simultaneously.

・The right-and-left first molar and second molar section of the model was occluded.

・The thickness of the model was about 1.5mm

・The point of measurement was the mesial point, which was separated from the cervical region of right-and-left first molars by 1 mm.

・Load was measured in terms of continuous load and intermittent load.

Continuous load involved a maximum occlusal pressure of about 400N, on average, Whereas intermittent load involved tapping at the rate of three times per second.

・On the right side, the denture model and mucosa became stuck, and on the left side, the denture model and mucosa had about 1mm of relief. (Fig4)

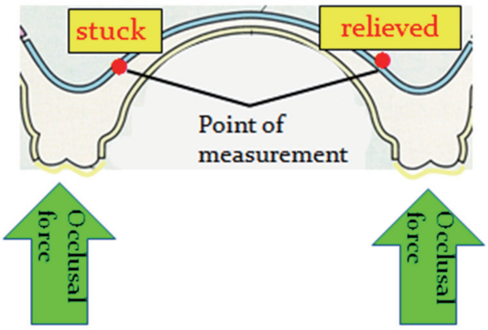


Fig 4: The difference in how to give occlusal force

Results

In experiment①,a significant difference in the blood flow volume among the three Measuring points was not seen. (Fig 5)

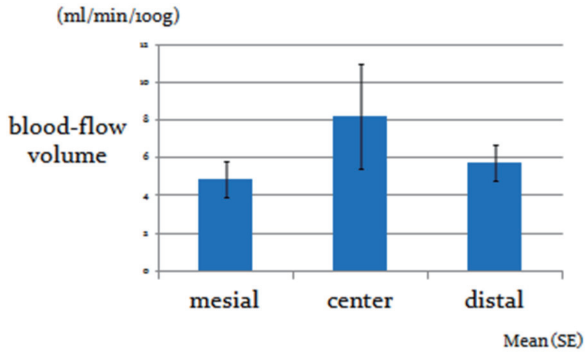


Fig 5: Blood flow volume among the three measuring points

In experiment②, in case of relieved, rate with decreasing a blood flow volume becomes small clearly rather than in case of stuck. (Fig6)

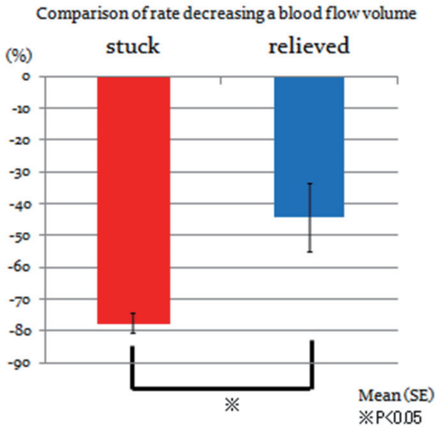


Fig 6: Comparison of rate with decreasing a blood flow volume(continuous load)

In case of relieved, rate with increasing a blood flow volume becomes small clear rather than in case of stuck. (Fig7)

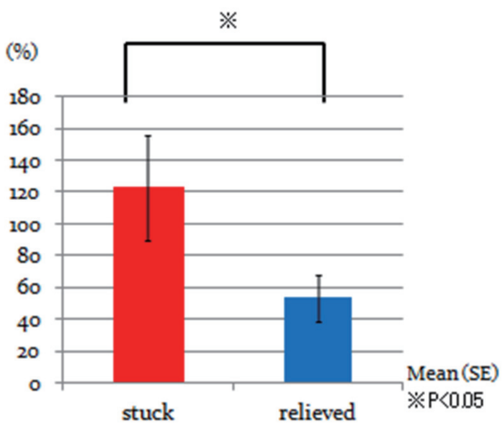


Fig 7: Comparison of rate increasing a blood flow volume(intermittent load)

Discussion

In experiment①,a clear difference in three measured regions was not seen,and the Mesial point of measurement was the most stable. The mesial point of measurement was considered to be the optimal measurement point in the cervical region of the teeth.

Therefore, the mesial point of measurement was applied in the second experiment.

In experiment②, the aspect of blood-flow-volume change in the case of intermittent load and continuous load which were measured under the conditions of occlusal pressure, showed the same tendency as the result of the past experiments under pressure.

Moreover, blood-flow-volume change in case of intermittent load and continuous load under the conditions with relief were clearly smaller than those under the conditions of being stuck. This was the same result seen in past experiments under similar pressure conditions.

Conclusion

The measurement of blood-flow-volume change under the conditions of occlusal pressure, which were difficult to perform until now, have become possible due to the use of the improved probe. Under various conditions, our results were similar to those seen in past experiments[1)-4)] under similar conditions of pressure.

Based on our findings, we believed that the improved probe is sufficiently reliable for use under clinical conditions. We intend to conduct further investigations into detailed blood-flow-volume measurements under clinical conditions.

References

1. Hasegawa,N.: Studies of Dynamic Properties of the Blood Flow of the Human Palatal Mucosa ,The journal of the Japan Prosthodontic Society 45(1), 117-128, 2001
2. Okazaki,S.: Studies on the Dynamic Properties of Blood Flow in Denture-bearing Palatal Mucosa,The journal of the Japan Prosthodontic Society 47(1), 125-134, 2003
3. Hoshiai,K. Tanaka,Y. Hasegawa,N. et al, Experimental Observations of the Blood Flow of the Mandibular Frontal-lingual Alveolar Mucosa,The journal of the Japan Prosthodontic Society 47(5), 797-806, 2003
4. Okada,C. Ueda, T. Sakurai, K.: Blood flow in denture-supporting maxillary mucosa in response to simulated mastication by loading, Journal of prosthodontic research 54(4), 159-163, 2010

Pressure distribution of implant-supported removable partial dentures with stress-breaking attachments

K.Kono[1], Y. Suzuki[2], M. Sato[1], C. Ohkubo[1], M. Takahashi[3]

[1]Department of Removable Prosthodontics, Tsurumi University
[2]Division of Oral and Maxillofacial Implantlogy, Tsurumi University
[3]GC Corp

Introduction

The implant has been placed in the edentulous ridge to support and stabilize the removable partial denture (RPD) and minimize the rotational movement[1,2] (Fig.1). As a result, less bone resorption, fewer numbers of relining and minimum decrease of retentive force of precision attachments would be expected. There are remarkable differences between implant mobility and soft tissue displacement under occlusal force. Therefore, the implant might undergo excessive pressure with a conventional RPD during masticatory function. The stress-breaking attachment for implant has been developed to prevent the excessive and harmful occlusal forces.

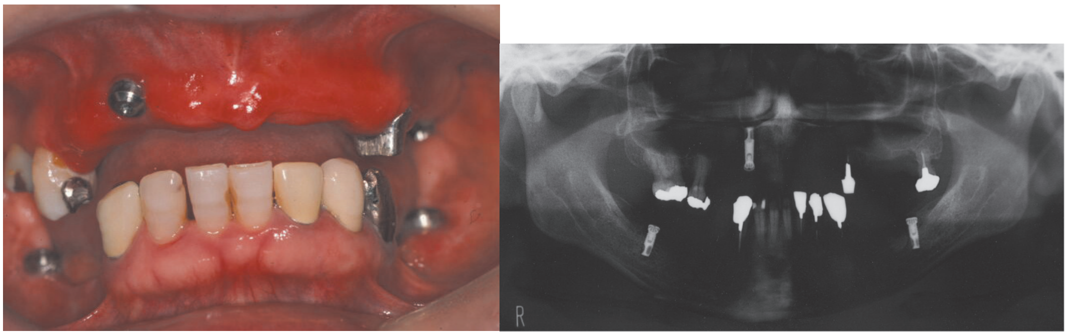


Fig.1 The implant has been placed in the edentulous ridge to support and stabilize the removable partial denture (RPD) and minimize the rotational movement

Objective

This study investigated the pressure distribution of the implant-supported RPDs with the stress breaking attachment under the occlusal force.

Materials and Methods

A model simulating a mandibular bilateral distal extension missing (#34 to #37 and #44 to #47) was fabricated using silicone impression material (FIT CHECKER® GC CORPORATION, Tokyo, Japan) as soft tissue (2.0 mm thick) on an epoxy resin bone model (Fig. 2). Five small pressure sensors (4.2mm diameter, PS-10KA, PS-10KB, Kyowa, Tokyo, Japan) were attached near the left and right first molars, first premolars and medio-lingual alveolar crest. The sensor at the median was positioned beneath the lingual bar when the RPD was set on the modified models. Five bilateral distal extension RPDs with a lingual bar and Akers clasps on both canines were designed and formed like an occlusion rim without any denture teeth. Co-Cr frameworks were conventionally cast, and then heat-cured denture base resin was packed and polymerized (Fig. 3). Two implants (Strauman, RP 10 mm) were placed at the bilateral second molar regions (#37 and #47). Implant-supported RPDs, with the non stress-breaking connection (healing cap: Hc) and the two stress-breaking connection (SBB attachment, GC, Tokyo: SBB, Magfit IPS, Aichi Steel Corp, Aichi: Mg) were fabricated. For a conventional RPD (CRPD), healing screws were placed without being connected to the implants (Fig. 4,5). Loads up to 5kg were applied, and the pressure and displacement of the RPDs were simultaneously measured and analyzed using the Wilcoxen test (α=0.05).

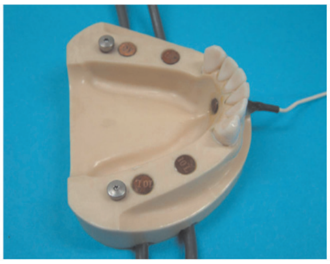
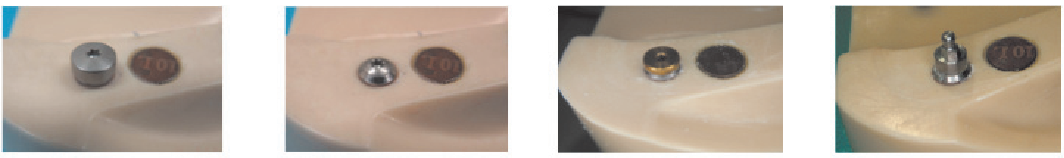


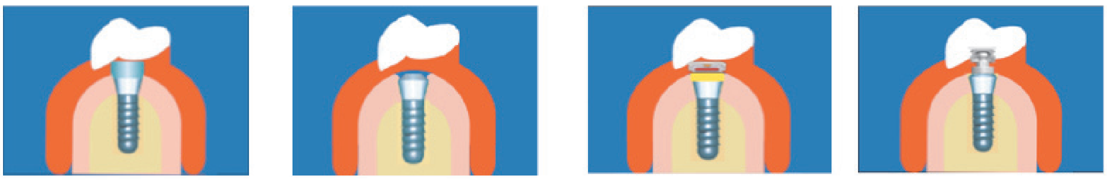
Fig. 2 Simulation model

Fig . 3 Simulation denture



ISRPD-H (Healing cap) CRPD (Healing screw) Magnetic attachment SBB attachment

Fig. 4 Implant supported situation



Healing cap (Ha) Healing screw (CRPD) Magnetic attachment (Mg) Ball attachment (SBB)

Fig. 5 Schematic of implant supported RPD

Results

The pressure on #36 and #46 of HC and MG was significantly less than SBB and CRPD ($p<0.05$). In contrast, the pressure on #34 and #44 of SBB and the MG were slightly greater than HC and CRPD. The pressure of CRPD indicated approximately one half times to three times at medio-lingual alveolar crest, compared with HC and MG, SBB (Fig.6). The amount of total pressure of HC and MG was significantly less than for SBB and CRPD ($p<0.05$) (Fig.7). The denture displacement of Hc and Mg tended to be less than for CRPD and SBB. There were approximately 20-40µm differences among Hc, Mg and CRPD ($p<0.05$) (Fig.8).

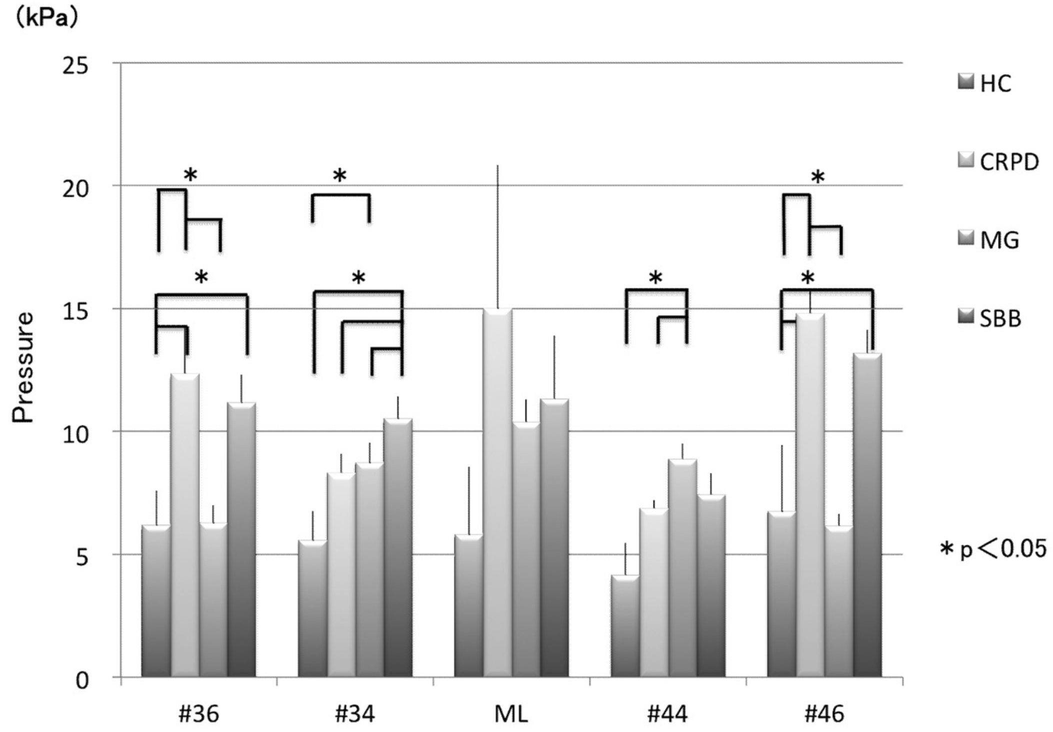


Fig. 6 Pressure distribution

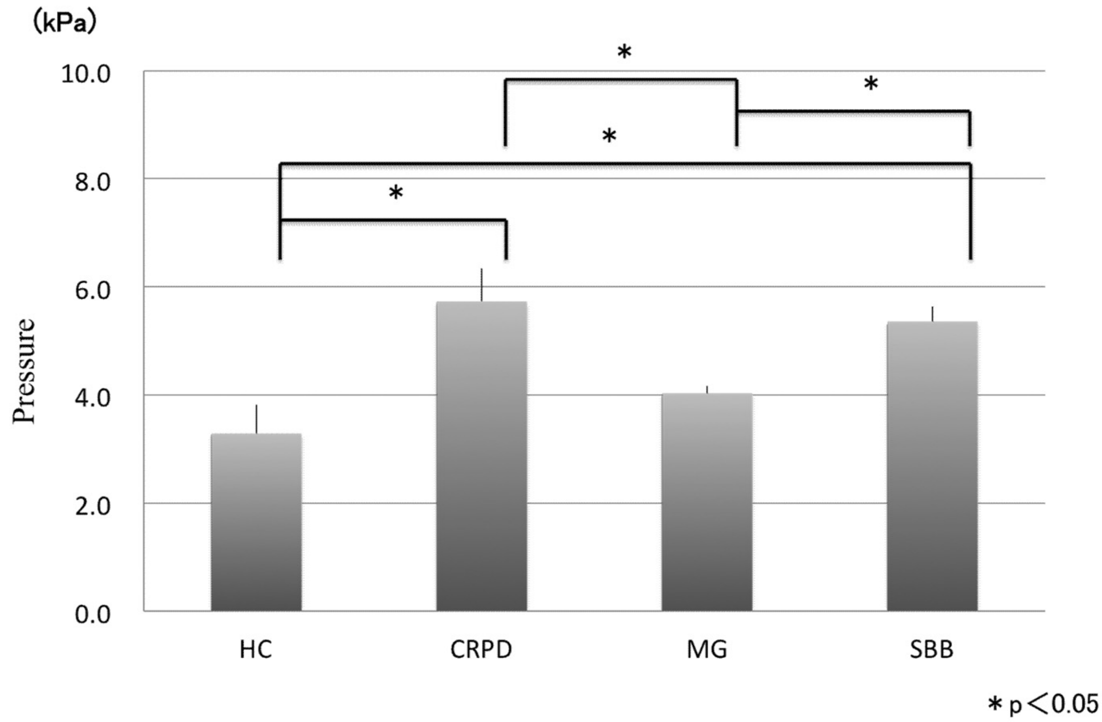


Fig.7 Amount of total pressure

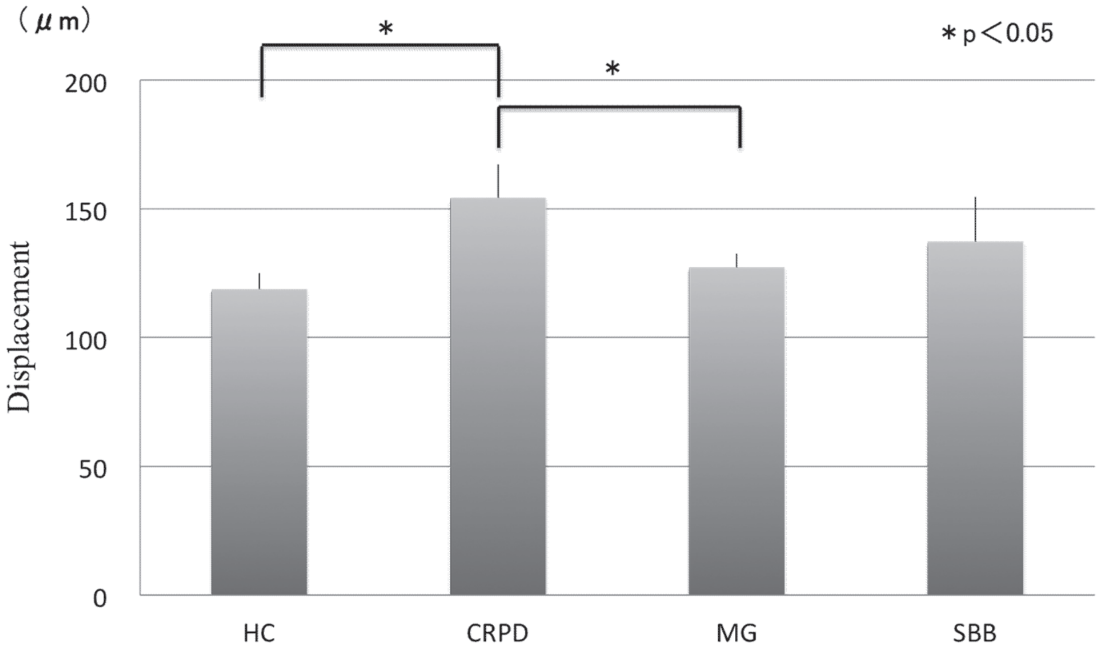


Fig. 8 Denture displacement

Discussion

The results of this study indicated that implant placement at the distal edentulous ridge can prevent the denture displacement of the distal extension bases. Note that the pressure at the distal regions (#36 and #46) decreased compared with the mesial regions (#34 and #44) by implant support. The pressure differences of the alveolar ridge, the SBB attachment tended to be greater than Healing cap and magnet attachment. The buffer action of magnet attachment was less than SBB attachment in vertical direction. Because the SBB attachment is stress breaking attachment until the denture displacement was 0.3mm. The selection of SBB attachment should be considered so that the occlusal force can be equally distributed between alveolar ridge and implants.

Conclusion

Within the in vitro limitations, precise denture settlements and pressure distribution under the denture base could be controlled using a SBB attachment. SBB attachment might be able to protect the implant from harmful force.

References

1. Ohkubo C, Effect of implant support on distal extension removable partial dentures: in vitro assessment, J Oral Rehabili 34(1):52-56, 2007.
2. Ohkubo C, Effect of implant support on distal-extension removable partial dentures: in vivo assessment, Int J Oral Maxillofac Implants 23(6):1095-1101, 2008.

Stress Analysis of Implant Keepers with Different Retaining Methods

K. Hayashi, R. Kanbara, Y. Nakamura, Yo. Ohno, K. Shiraishi, K. Shoji, K. Yoshihara, H. Kumano, Y. Takada[1], Yu. Ohno, Y. Tanaka

Department of Removable Prosthodontics, School of Dentistry, Aichi-Gakuin University
[1]Division of Dental Biomaterials, Tohoku University Graduate School of Dentistry

Introduction

Restorative implant materials and technique have continued to evolve and improve. Implant overdentures with magnetic attachment are drawing attention due to their excellent retentive mechanism.

A keeper corresponding a magnetic assembly is secured to the implant to exert the function of an attachment.

In the screw-retaining method, a keeper is mechanically secured to an implant using a retaining screw. The benefit of this method is that a keeper can be removed by operators, and, therefore, suitable for the maintenance. However, since a keeper is mechanically fixed using a screw, safety should be considered in the long-term intraoral performance of this implant. There have been several reports on clinical problems such as a fracture of an abutment screw. It is extremely important to understand mechanical influence of keeper fixture methods on implants to investigate the optimal retaining method.

Objective

The purpose of the present study was to investigate mechanical influence of keeper retaining method with screws using the three-dimensional finite element method.

Analysis methods

1. Analysis model

Figure 1 shows the keeper retaining methods of 2 types of keepers. The methods include "fixation structure A" in which a fixture and an abutment are fixed with abutment screw and keeper unit, and "fixation structure B" in which a fixture and an abutment are fixed with abutment screw, and a keeper is separately fixed with an abutment on top.

Finite element models of "fixation structure A" (Model A) and "fixation structure B" (Model B) were constructed using a general purpose finite element pre-post processor (Patran 2010, MSC software). These FEM models are shown in Fig. 2. The detailed size of each model is shown in Figures 3 and 4. The screw structure followed the same standard, and the pitch of the screw was 2 mm.The element type designation was three-dimensional tetrahedral primary element. A total nodal point and total element count of Model A were 36,931 and 211,512, respectively, and those of Model B were 38,759 and 222,615, respectively.

The cortical bone surrounding a fixture was constructed for the convenience of analysis.

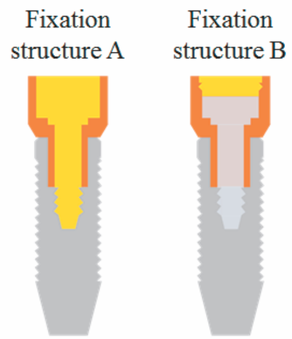


Fig. 1. The keeper retaining methods of 2 types of keepers.

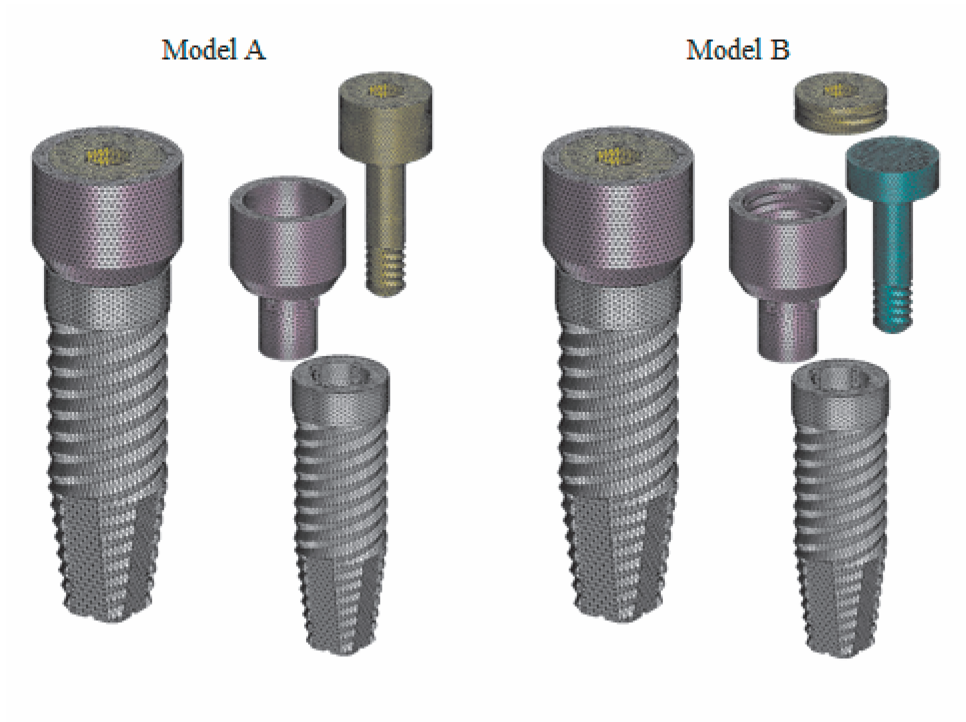


Fig. 2. Finite element models

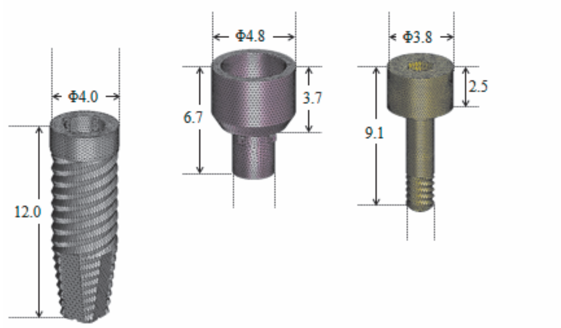


Fig. 3. The detailed size（Model A）

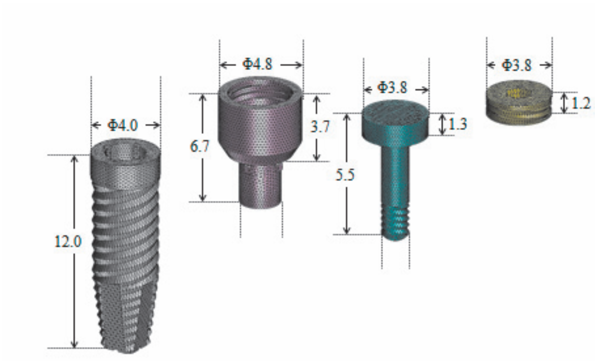


Fig. 4. The detailed size（Model B）

2. Analysis condition

An elastic stress analysis was performed using a general purpose finite element program (Marc 2010, MSC software). A workstation DELL PRECISION T 7400 (DELL) was used throughout the study.

1) Boundary condition

A complete constraint was applied to the inferior and lateral surfaces of the cortical bone in the X, Y, and Z directions (Fig. 5).

Two loading conditions (LC 1 and 2) were applied. A 800 N load was applied to the upper surface of a keeper in the vertical direction of the implant long axis in LC 1. A 800 N load was applied to the upper surface of a keeper in the 45 °direction of the implant body long axis in LC 2.

A contact condition was applied between each structure except for a fixture and the cortical bone.

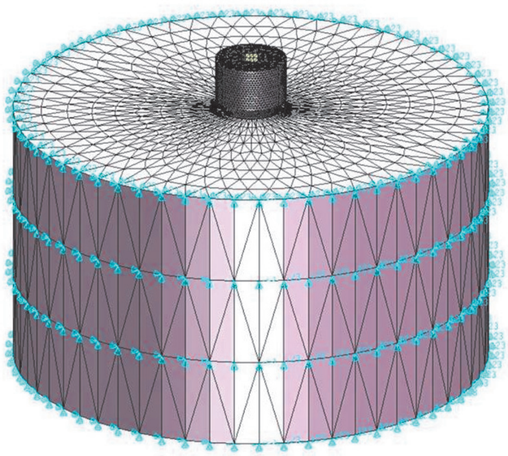


Fig. 5. Fix condition

2) Mechanical properties

Table 1 shows material constants used in the present study. Soft magnetic stainless steel SUSXM 27 was used as a keeper material of a magnetic attachment, and the abutment screw of Model B was made of Ti-6AL-4V. Material constants of a fixture and abutment were set according to the previous references.

	Young's Modulus (MPa)	Poisson's ratio
Ti (JIS The 4th sort)	104,100	0.34
Ti-6Al-4V	113,800	0.34
SUS XM27	200,000	0.30
Cortical bone	11,760	0.25

Table. 1. Mechanical Properties

Analysis results

1. Stress distribution

Stress evaluation of LC1 and 2 was performed using Von-Mises stress. The evaluation was conducted for the surface and longitudinal plane of an abutment screw.Stress evaluation of LC2 was performed using principal stress. The evaluation was conducted for the surface of an abutment screw.

1)Von-Mises stress

Figure 6 shows the overview of LC1. Although there was no significant mechanical difference in an abutment screw between Models A and B, a minor stress relaxation was observed in Model B.

Figure 7 shows the overview of LC2. A larger stress concentration in the neck and center parts of an abutment screw was observed in Model A compared with Model B.

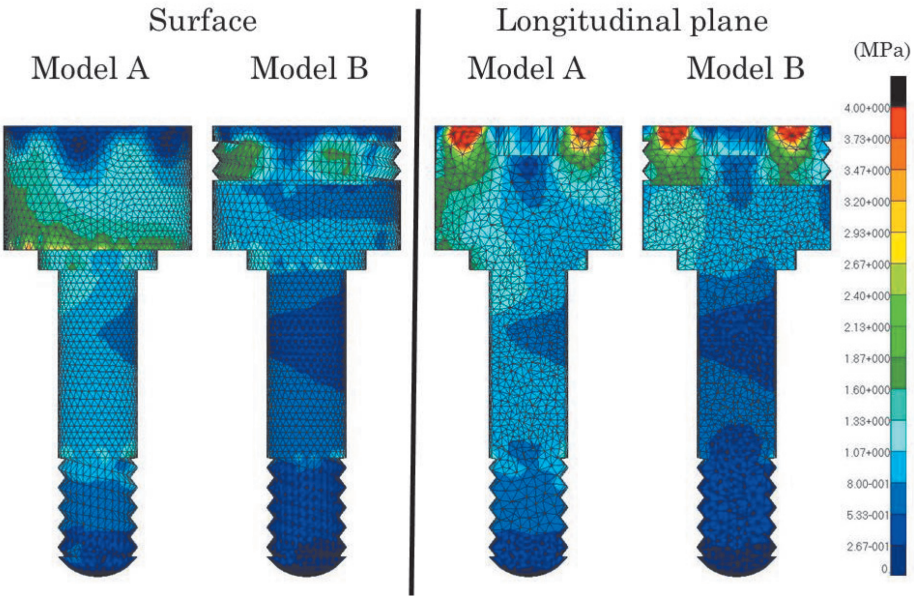


Fig. 6. Von-Mises stress (LC1)

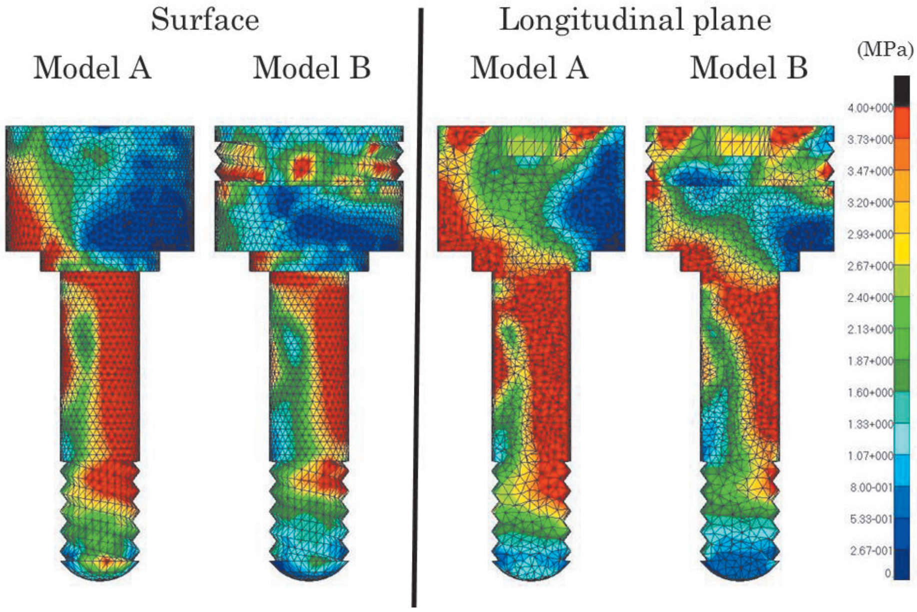


Fig. 7. Von-Mises stress (LC2)

2)Principle stress

Figure 8 shows the minimum principle stress distribution chart. The higher compressive stress concentration was observed in the corner and neck parts of an upper abutment screw in Model A compared with Model B.

Figure 9 shows the maximum principle stress distribution chart. The higher tensile stress concentration was observed in the neck part in Model A compared with Model B.

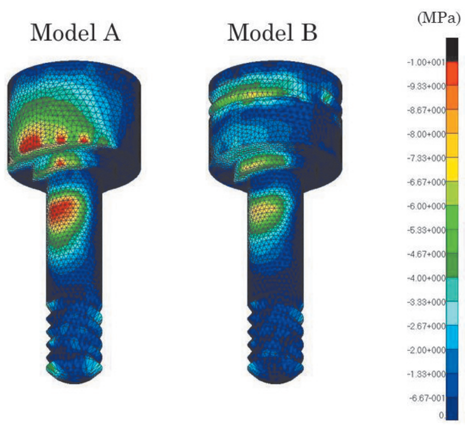


Fig. 8. The minimum principle stress

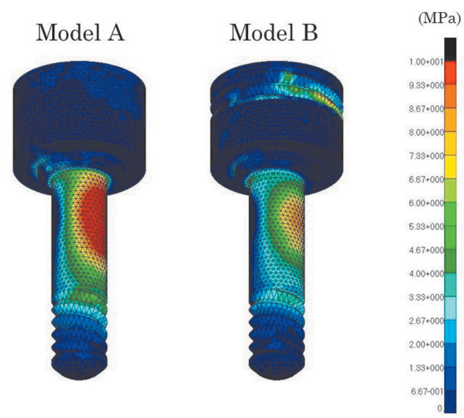


Fig. 9. The maximum principle stress

2. Stress values (maximum and minimum principle stress)

Figure 10 shows the minimum and maximum principle stress values of LC2. The measurement point excludes the point adjacent to the loading point. Minimum and maximum principle stress values were higher in Model A compared with Model B.

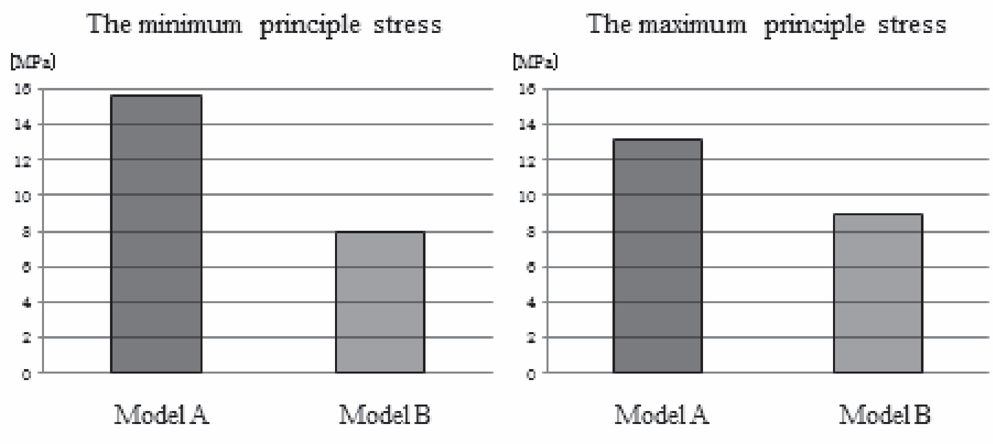


Fig. 10. The minimum and maximum principle stress values

Discussion

1. Stress distribution

The main purpose of the present study was to investigate the mechanical influence of the difference in the fixation method of a magnetic implant keeper on a load. The inner structures of two analysis models were faithfully constructed according to the size shown in Fig. 2.

Compared to “fixation structure A” in which a fixture and an abutment are directly fixed with abutment screw and keeper unit, “fixation structure B” is physical fixation of an abutment screw and a keeper using screw structure. Therefore, an appropriate setting is necessary regarding the interfacial positional relationship. An abutment screw and a keeper of “fixation structure B” were constructed on the model in the contacted position without space to evaluate the influence of the difference in the two fixation methods of a magnetic implant keeper on a load.

It is considered that the analysis model constructed in the present study can accurately evaluate the difference in keeper fixation structure.

2. Analysis condition

Boundary condition significantly affects the analysis results. The appropriate boundary condition for the present study was carefully investigated. The cortical bone was constructed around the implant body, and a complete constraint was applied around the cortical bone.

The functional force applied to the implant overdenture includes component force in different directions. Therefore, a load was applied perpendicular and 45°to the keeper adsorption face to efficiently transfer stress to an abutment screw. A load larger than estimated occlusal force was applied.

A contact element that can reproduce the contact condition between objects was applied on the interface of fixture, abutment, abutment screw and keeper.

We focused on the difference in materials of soft magnetic stainless steel (SUSXM27) used as a keeper material of magnetic attachment and titanium material (Ti-6AL-4V) used as an abutment screw material to set mechanical property value of each analysis model component. Experimental data of these materials are shown in Table 2. The mechanical influence between materials needs to be considered when these materials are used for the implant inner structure. SUSXM27 was used for a keeper and abutment screw unit in Model A, whereas SUSXM27 was used for a keeper, and Ti-6AL-4V was used for an abutment screw in Model B.

3. Analysis result

Figure 6-10 shows obtained results. A significant difference was observed in stress distribution of two keeper fixation structures during a load application in 45°compared with a load application in the vertical direction. A load was applied in the long axis direction of the implant body during a load application in the vertical direction. Since a substantial load was placed on the inner abutment, there was little influence of the difference in fixation structures and materials on abutment screws for each model. In contrast, a tilted load was applied in the long axis direction of the implant body during a load application in 45°direction. A substantial load was placed on the mutual inner screw structure of an abutment and a fixture, and bending stress was placed against an abutment screw located in the center. Therefore, there was a significant influence of the difference in fixation structures and materials on abutment screws for each model.

For stress evaluation during a load application in 45°direction, Stress evaluation of was performed using principle stress that evaluates compressive and tensile stress, and Von-Mises stress that indicates various stress as scalar. A significant influence of the difference in fixation structures and materials was observed between Model A and Model B regarding the principle stress evaluation (Fig. 8 – 10). Regarding abutment screw materials (Tables 1 and 2), SUSXM27 has lower yield stress compared with Ti-6Al-4V, and principle stress has a significant influence during fracture and deformation of objects. These results suggest that Model B has a higher safety against fracture and deformation compared with Model B considering the repetitive stress application in the mouth.

	Yield stress (MPa)	Growth (%)
Ti (JIS The 4th sort)	485	15
Ti-6Al-4V	755	10
SUS XM27	245	20

Table. 2. Experimental data

Conclusions

The mechanical evaluation was performed regarding the keeper fixation using the screw retaining method. Mechanical evaluation was conducted using three-dimensional finite element method, and the following conclusions were drawn.

1. A significant stress relaxation was observed regarding compression and tensile stress during load application in 45°direction by separating an abutment and keeper.

2. For abutment screw materials, a higher mechanical safety was suggested in Ti-6Al-4V compared with soft magnetic stainless steel (SUSXM27).

References

1. Morooka M., Ishikawa T., Ito T. and Fukuti A. : Frequent fractures of titanium root-form implant and structure and handling – case reports –, Quintessence DENTAL Implantology, 15(3), 2008.
2. Iwai T.,Yoshihara K.,NakamuraY., et al, Study of Prototype Implant Magnetic Keeper with TiN Coatings by Reactive Ion Plating, The Journal of the Japanese Society of Magnetic Applications in Dentistry. 2011
3. Japanese Industrial Standard Committee : Titanium and titanium alloys—Rods and bars, Japanese Standards Association, 2007
4. M.J.Donachie,Jr : Titanium and titanium alloys — Rods and bars, UCHIDA ROKAKUHO PUBLISHING CO, 1993

Influence of the Axial Surface of Keeper Coping on the Circumferential Tissue Using a Three-Dimensional Finite Element

N. Shibuya,[1] D. Yamanaka,[1] T. Uchida,[1] T. Ohyama,[1,2] S. Nakabayashi,[1,2] S. Tadokoro,[1] H. Toyoma,[1,2] K. Ohtani,[1,2] T. Fujimoto,[1] M. Ishijima,[1] and T. Ishigami[1,2]

[1]Department of Partial Denture Prosthodontics, Nihon University School of Dentistry
[2]Division of Clinical Research, Dental Research Center, Nihon University School of Dentistry

Introduction

When the keeper coping is applied to the abutment tooth for an overdenture, the shape of the axial surface of the keeper coping may affect the stress distribution to the abutment tooth and the circumferential tissue. The aim of this study was to evaluate the influence of the axial surface shape of the keeper coping on the circumferential tissue and to analyze the biomechanical behavior of the cortical bone under the denture base during three different loading conditions using a three-dimensional finite element method.

Materials and Methods

A complete overdenture model with a keeper coping delivered on the mandibular right canine was evaluated. The outline of the abutment tooth and mandible were modeled on the basis of three-dimentions data from a multi-detector CT (Asteion Super 4 Edition, Toshiba, Japan). The periodontal ligament, cortical bone, cancellous bone, and alveolar mucosa shapes were modeled with reference to anatomical measurements. The analysis models constructed were tooth, cortical bone, cancellous bone, denture base, keeper coping, periodontal ligament, and alveolar mucosa. For this study, Rhinoceros (Version 1.0, Robert McNeil & Associates, U.S.A) and ANSYS (Version 12.1, Ansys, Inc., U.S.A.) were used. Table 1 shows the Young's modulus and Poisson's ratio.

Material	Young's modulus (MPa)	Poisson's ratio
Dentin	11721.1	0.30
Cortical bone	10414.7	0.30
Cancellous bone	88.3	0.30
Denture base	1960	0.30
Au-Ag-Pd alloy	110800	0.30
Periodontal ligament (First load)	0.049	0.49
Periodontal ligament (Second load)	0.7	0.49
Alveolar mucosa	0.045	0.49

Table 1: Material properties

Figure 1 shows the design of keeper coping and analysis models. The height of the keeper coping was 2.5mm from the lingual alveolar crest. The abutment tooth was set to incline 15 degrees for the occlusal plane, and the top surface of the keeper coping was set perpendicularly to the tooth axis.

In Model A, the inclination angle on the axial surface is 0 degree.

In Model B, the inclination angle on the axial surface is 30 degrees.

In Model C, the form of axial surface was curved.

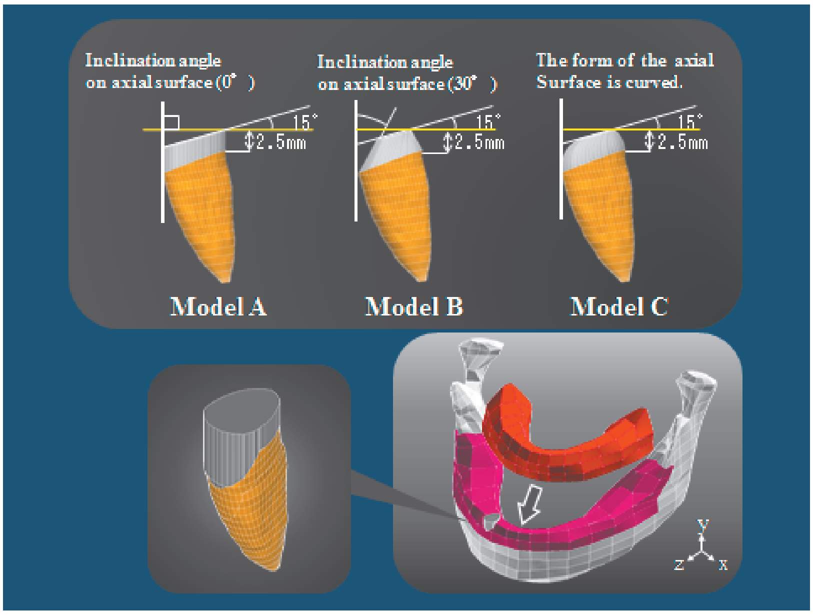


Fig.1: The design of keeper coping and analysis model

Three different loading simulations (clenching in bilateral occlusion, left lateral occlusion, and right lateral occlusion) were set up with the vector of masficatory muscles.

Table 2 shows the loading conditions.

	Node number	Load				
		Bilateral Occlusion	Left Lateral Occlusion		Right Lateral Occlusion	
			R	L	R	L
Superficial Masseter	14	190.4	114.2	137.1	137.1	114.2
Deep Masseter	5	81.6	49.0	58.8	58.8	49.0
Medial Pterygoid	11	132.8	104.9	146.8	146.8	104.9
Anterior Temporalis	9	154.8	91.6	115.3	115.3	91.6
Middle Temporalis	12	91.8	64.1	63.1	63.1	64.1
Posterior Temporalis	9	72.6	29.5	44.6	44.6	29.5
Inferior Lateral Pterygoid	3	18.1	0	0	0	0
Superior Lateral Pterygoid	3	16.9	0	0	0	0
Anterior Digastric	1	11.2	0	0	0	0

Table 2: Loading conditions

The paths of each mandibular condyle were constrained. Guidance by the articular eminence was simulated with a planar constraint. It permitted rotations and translations in the specified plane. The constraining plane was angled 30 degrees forward and downward relative to the occlusal plane, and it was canted 5 degrees medially. The inclination angle of the buccal cusp of artificial teeth was set 30 degrees, and the lingual cusp of the artificial tooth was 20 degrees. The balanced occlusion was simulated by 10 occlusal stops on a complete overdenture (Fig.2).

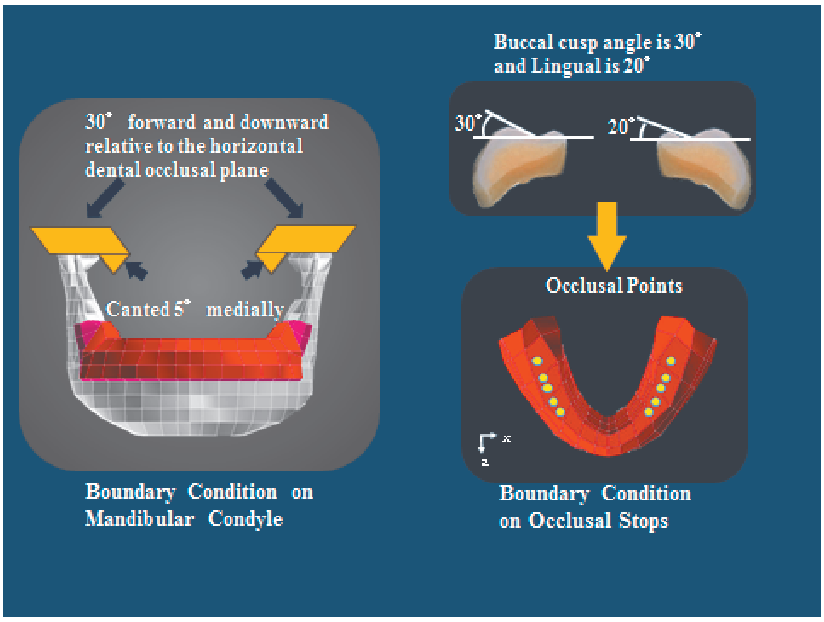


Fig.2: Constraint conditions

Results

Figures 3-5 show the stress distribution of the abutment tooth clenching in bilateral occlusion, left lateral occlusion, and right lateral occlusion. There were no differences in the stress distribution of the abutment tooth among three kinds of analysis models under three different loading conditions. The stress concentration was detected on the labial and lingual side of the abutment tooth and the center of the mandible. Figures 6-8 show the stress distribution graph of the top surface of cortical bone clenching under three different loading conditions. The 13 analysis points were set on the top surface of cortical bone (analysis points: a-m). There were no significant differences with all models in bilateral and right lateral occlusion. A difference in the stress distribution around the abutment tooth in the left lateral occlusion is shown. The stress concentration around the abutment tooth (mesial side and distal side) was decreased in model C.

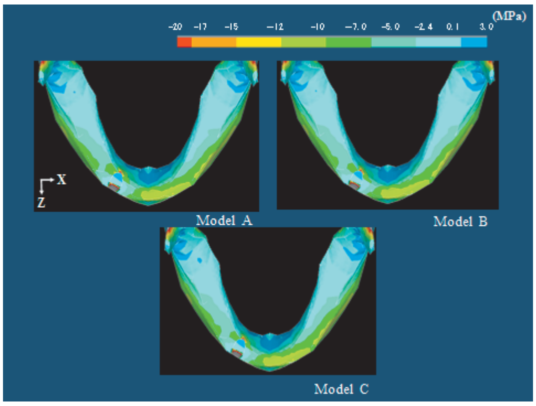


Fig.3: Bilateral occlusion

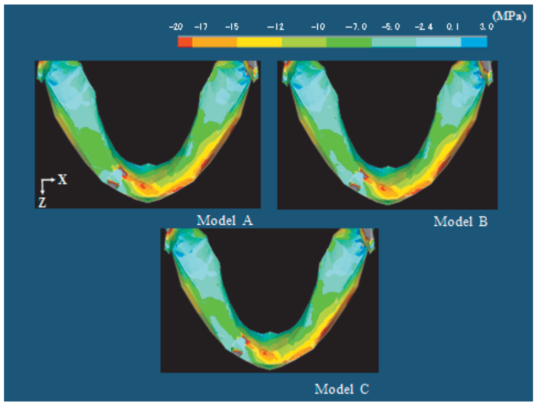


Fig.4: Left lateral occlusion

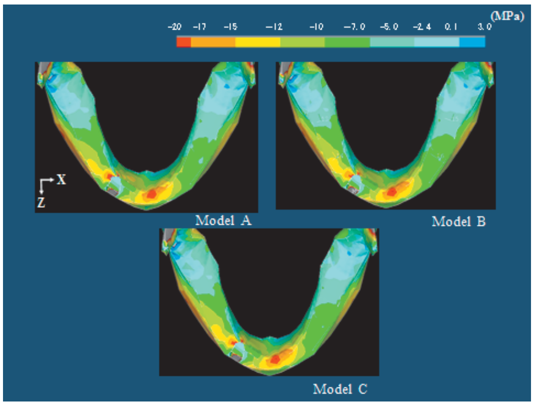


Fig.5: Right lateral occlusion

Stress distribution

(Minimum principal stress)

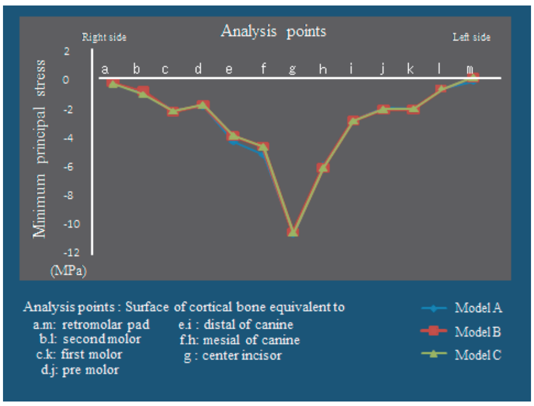


Fig.6: Bilateral occlusion

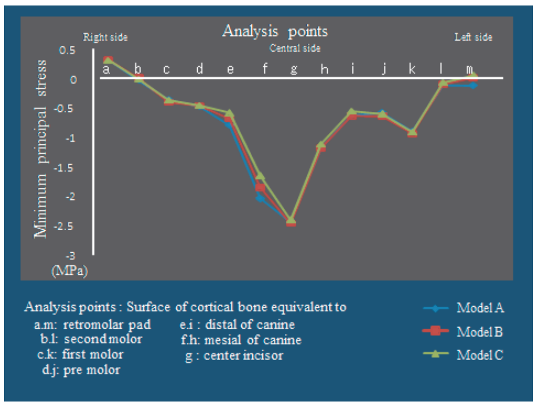


Fig.7: Left lateral occlusion

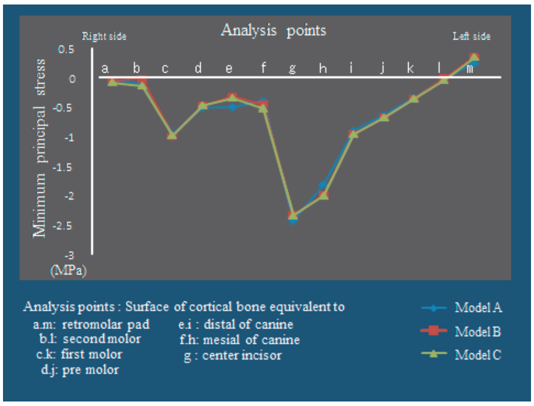


Fig.8: Right lateral occlusion

Stress distribution graph of the top surface of cortical bone

Discussion

In model A during left lateral occlusion, the lowest stress concentration was found around the abutment tooth. It could be thought that the axial surface of keeper coping curved was available to reduce the force loading on the abutment tooth.

Conclusions

Within the limitations of this study- it was thought the curved form of the axial surface reduced the biomechanical risks of the circumferential tissue around the abutment tooth in an overdenture.

References

1. Korioth TW, Hannam AG, Deformation of the Human Mandible During Simulated Tooth Clenching, J Dent Res 73:56-66, 1994.
2. Langenbach GEJ, Hannam AG, The Role of Passive Muscle Tensions in a Three-dimensional Dynamic Model of the Human Jaw, Arch Oral Biol 44:557-573, 1999.

Observation of abutment tooth cementum and coping margin

A Sugita,[1] S Endo,[1] E Nagai,[1,2] N Tsukimura,[1,2] H Saito,[1] M Morokuma,[1] N Suzuki,[1]
D Akita,[1] and T Ishigami[1,2]

[1]Department of Partial Denture Prosthodontics, Nihon University School of Dentistry
[2]Division of Clinical Research, Dental Research Center, Nihon University School of Dentistry

Introduction

It is ideal for placing finishing line of crown restoration prosthesis at enamel, however root cap placed finishing line at cementum surface. There are few studies on the cementum margins of prostheses. In this study, we investigate the cementum coping margin and scaling and root planning (SRP) of the cementum surfaces of extracted teeth.

Materials and Methods

1. Use of hand and ultrasonic scalars for SRP of extracted teeth

After extracted teeth, the subject of this observation is no cervical cavity in a upper caspid which fixed with 10% formalin. It is set in the gypsum which the periapical side is being under 5 mm from the labial cement-enamel-junction (CEJ) on the edge and cut off crown using the diamond disk. For extraction, root preparation was completed with a diamond point (Sho-fu, Tokyo, Japan) in Test 1 and an SRP and a hand scaler (Gracy-curet 5.6, Hu-Friedy) or an ultrasonic scaler (A-chip, Yoshida, Tokyo, Japan) in Test 2. For these samples, after decalcification with 5% formic acid, the procedure was carried out with paraffin embedding, which required hematoxyline-eosin (H.E.) staining, as can be observed microscopically (Fig.1).

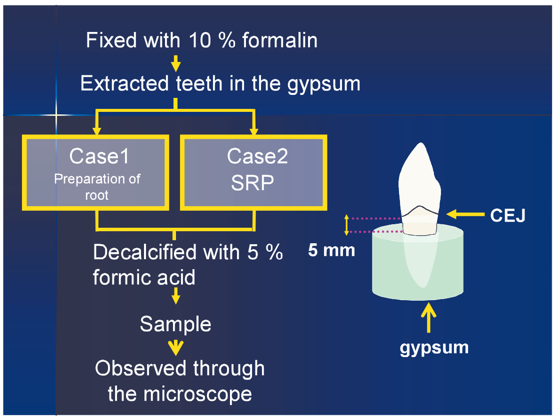


Fig.1

2. A laser microscope was used to observe the extracted teeth with the coping margin

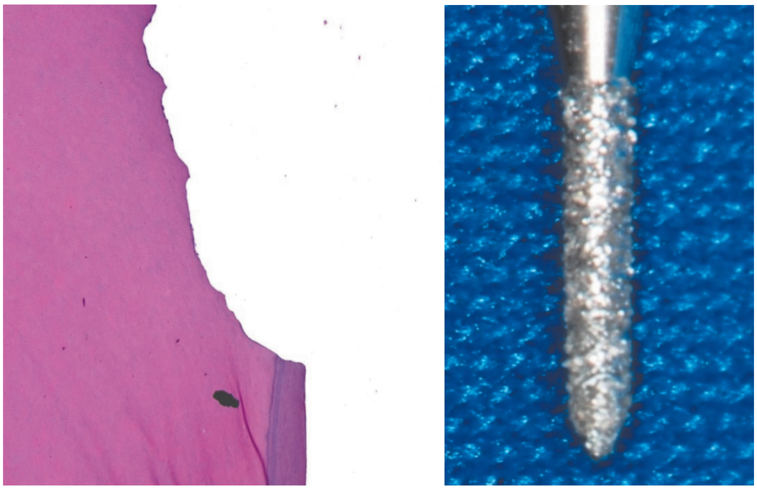
Ten extracted teeth with the coping margin were observed with a laser microscope (VHX-1000, KEYENCE, Tokyo, Japan) (Fig.2).

Fig.2 Microscope

Results

1. As the result of this study, for the observation of after preparation of root surface. The cementum is less susceptible to chipping when a diamond point is used (Fig.3).

Without a diamond point, cracking and exfoliation of the cementum occur on the root surface (Fig.4).

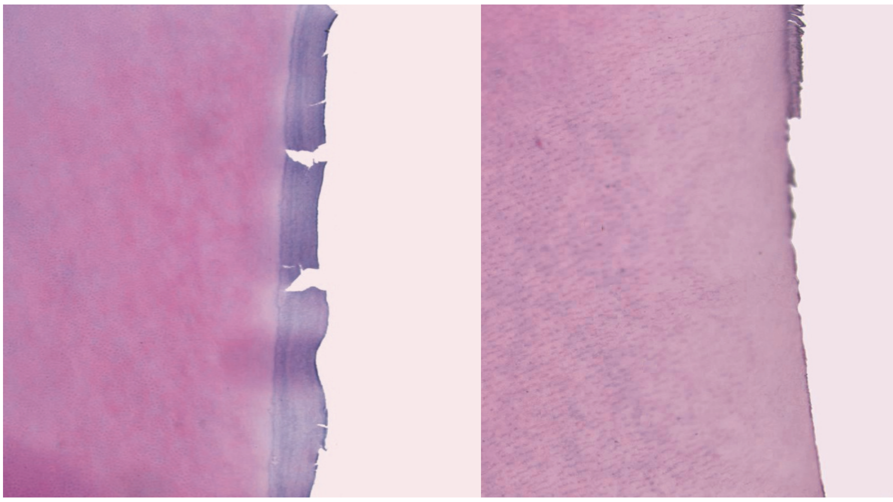


(a) 106RD ×10 (b) 106RD

(a) SF106RD ×10 (d) SF106RD

Fig.3

Showing the Figure3 by using 106RD or SF106RD and preparation of root. Forming surface shows the serrate, and the marginal types was chamfer. The coping margin place on cementum. Chipping and cracking were not observed on the cementum. It was smooth surface formation of SF106RD from 106RD better.



(a) Ultrasonic scaler (b) Hand scaler

Fig.4

SRP using a hand scaler is found most cementum had been removed from SRP using an ultrasonic scaler.Margin was seen in 8 of 10 non-conforming to these samples.

2. Observations were conducted at magnification of 100 around the coping margin (Fig.5).

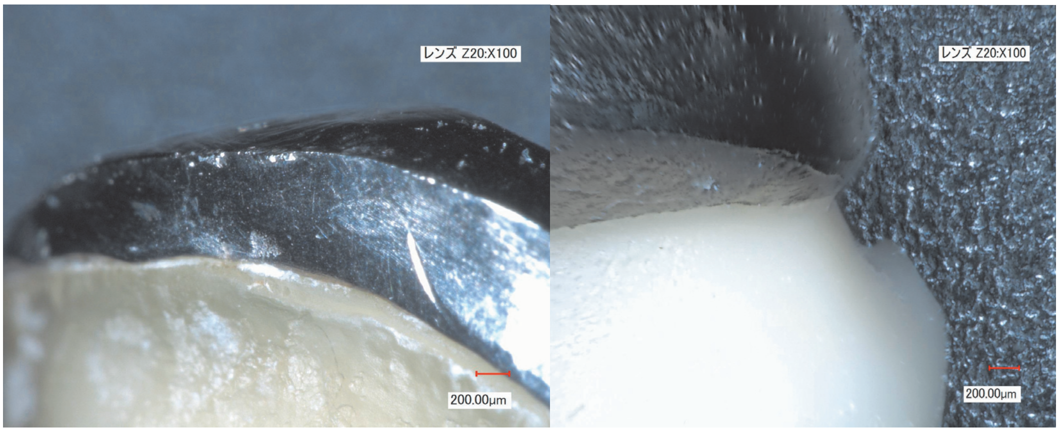


Fig.5

Discussion and Conclusions

The results of this study indicate that preparation of the cementum of the root surface with a diamond point has little influence on the root surfaces. However, chipping and cracking of the cementum were observed following the use of an ultrasonic scaler. This crack is because the abundance of sharp fiber in cervical tooth cementum, prom to cracking along this fiber. Base upon the results of this study, the coping margin place on cementum, it may be caused by non-conforming margin by SRP.

The results of this study indicate that the preparation of cementum of root surfaces with a diamond point has little influence on the root surface. Many of the extracted teeth with the margin of the coping, There are steps between the coping and the root surface, non-conforming margin was observed.

References

1. T. Ishigami, Observation on Cervical Enamel Margins studied by Scanning Electron Microscopy, The Journal the Stomatological Society, Japan 50 (2) : 299-337,1983.

Influence of the Surface Condition of Used Keepers on the Retentive Force

T. Shionome,[1] Y. Ogawa,[1] S. Endo,[1] M. Kiuchi,[1] Y. Umekawa,[1,2] M. Hasegawa,[1] K. Miyata,[1] Y. Abe,[1] and T. Ishigami,[1,2]

[1]Department of Partial Denture Prosthodontics, School of Dentistry, Nihon University
[2]Division of Clinical Research, Dental Research Center, School of Dentistry, Nihon University

Introduction

It has been reported that retentive force with a magnet declines as the surface condition of the keeper of a magnetic attachment becomes rough. As a major factor for be a roughness, it was thought that denture attached and removed, abrasion and brushing. However, it is no report of the surface condition and changes in retentive force of the used keepers in clinical. The keeper were fitted in the oral cavity have being possibilities to make waviness and decline.

Therefore, that is intended to explore the polishing methods for restore of retentive force in clinical.

Materials and Methods

1. Analysis of the surface condition of used Keepers

The surface condition of the five keepers (GIGAUSS D600, C600, GC, Tokyo, Japan) (D600, n=4) (C600, n=1) used in the oral cavity was analyzed the surface condition. Five untreated keepers were used as a control. The surface condition was measured with a laser microscope (KEYENCE CORPORATION, Osaka, Japan), and the surface roughness (Ra) and weviness (Wz) were calculated. The cut off value for the Ra set at λc0.8 mm, the cut off value for the Wz was set up at λf8 mm and λc0.8 mm followed. The rest is too unclear to offer a suggestion. Please check and change or clarify as appropriate.)

2. Comparison of the surface quality and retentive force caused by polishing

At first, untreated keeper D600 was analyzed Ra and Wz. The retentive force of the D600 keeper and D600 magnetic assembly was measured (EZ-Test, Shimadzu, Kyoto, Japan) using a crosshead speed of 5 mm/min in a universal testing machine. After that, the surface of keepers was roughened used Alumina breasting on the assumption that used keepers Ra in the oral cavity, and the roughed keepers was calculated retentive force after roughed keepers analyzed. Next, the surface of the roughened keeper was polished with a silicone point or waterproof abrasive paper, and the retentive force was measured after analyzing the respective surface condition. The untreated keeper was used as a control (Fig.1).

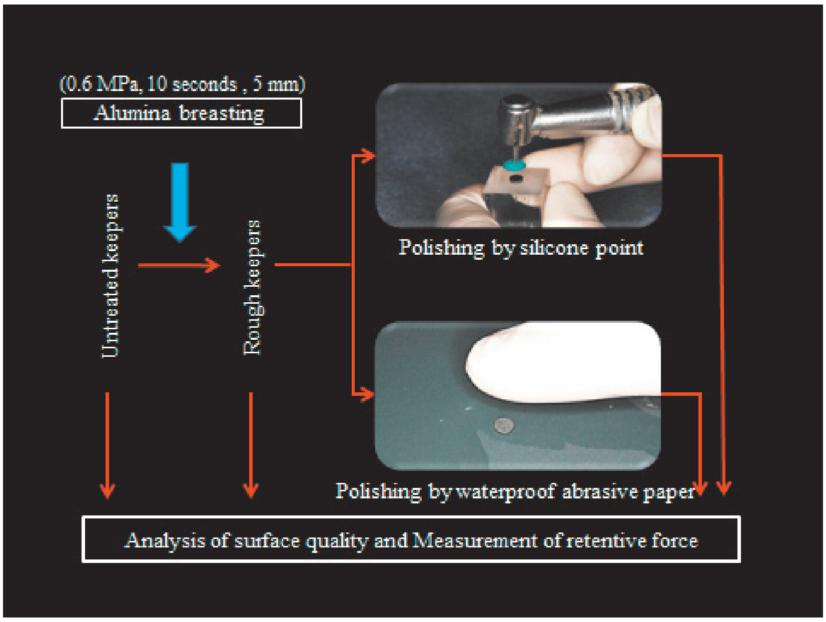


Fig.1

3. Measurement of the retentive force after polishing the used keeper

The apparatus to polish in a parallel fashion to upper surface of the keeper was made. Using D600 and C600 keepers in the oral cavity were polished on the waterproof abrasive paper was place at the apical end of the poling apparatus used by retentive force measurement. Untreated keepers were used as a control (Fig.2).

4. Data were statistically analyzed

The keepers used in the oral cavity were statistically analyzed using the Mann-Whitney U test (α=.01), and between-group polishing differences were analyzed with the Steel-Dwass test (α=.01).

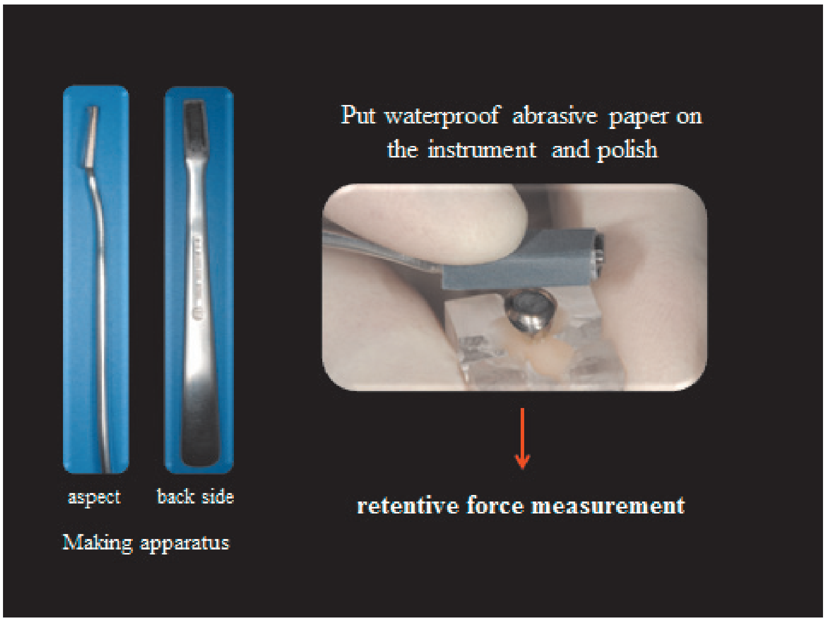


Fig.2

Results

The Ra of untreated keepers was 0.31 µm on average, and that of used keepers was 1.01 µm on average. In analogy with Ra, Wz of used keepers showed significantly high value as compared to that of untreated keepers. Next, the used keepers exhibited various Wz curves, and the degree varied. However, the curves declined in the marginal part near the mesodistal, lingual, or buccal side (Fig.3).

In the case of the comparison of Ra, the untreated Ra was 0.31 µm on averaged and that of the used waterproof abrasive paper was on averaged 0.42 µm on averaged. There was no significant difference between them. In the case of Wz, the Wz of used sandblast keepers averaged 4.97 µm, and that of used silicone point averaged 3.46 µm. There was no significant difference between them. Regarding the retentive force, the retentive force of untreated keepers averaged 4.93 N, while that of waterproof abrasive paper averaged 4.82 N. As is evident in the comparison in Ra and Wz, there was no significant difference between them.

We compared the polishing with waterproof abrasive paper to that with silicone point, and both Ra and retentive force exhibited restore as seen in the untreated keepers. (Fig.4)

As compared to untreated Wz curve, waterproof abrasive paper, sandblast and silicone point showed significant difference. (Fig.5)

By Comparison, before and after polished the keepers of the retentive force that untreated, used and polished D600 were 4.93 N, 4.47 N and 4.63 N respectively.

In addition, the retentive force of untreated, used, and polished C600 averaged 5.47, 4.63, and 4.7 N, respectively.

Both retentive force of polished D600 and C600 shows restore. (Fig.6)

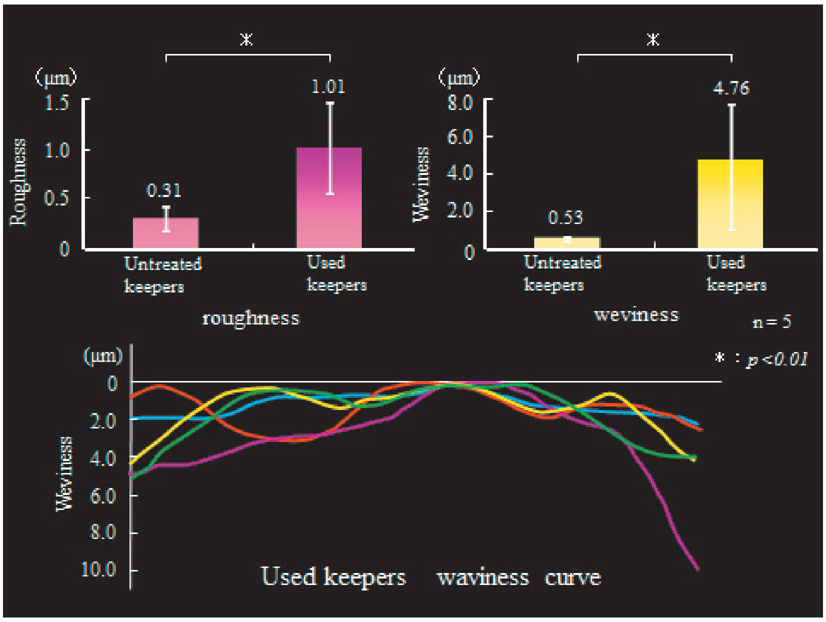


Fig.3

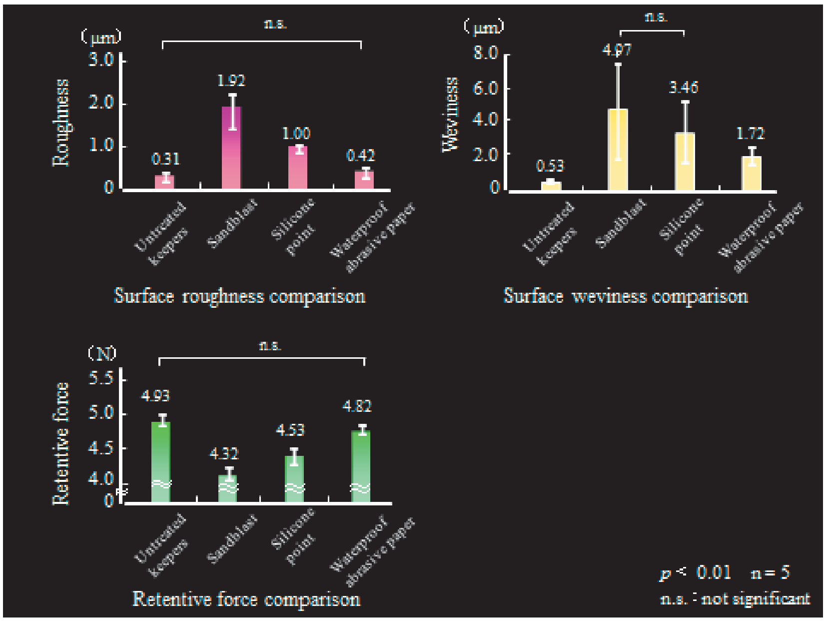

(μm)
n.s.
Roughness
3.0
2.0
1.0
0
0.31
1.92
1.00
0.42
Untreated keepers
Sandblast
Silicone point
Waterproof abrasive paper
Surface roughness comparison
(μm)
n.s.
Weviness
8.0
6.0
4.0
2.0
0
0.53
4.97
3.46
1.72
Untreated keepers
Sandblast
Silicone point
Waterproof abrasive paper
Surface weviness comparison
(N)
n.s.
Retentive force
5.5
5.0
4.5
4.0
0
4.93
4.32
4.53
4.82
Untreated keepers
Sandblast
Silicone point
Waterproof abrasive paper
Retentive force comparison
p < 0.01 n = 5
n.s. : not significant

Fig.4

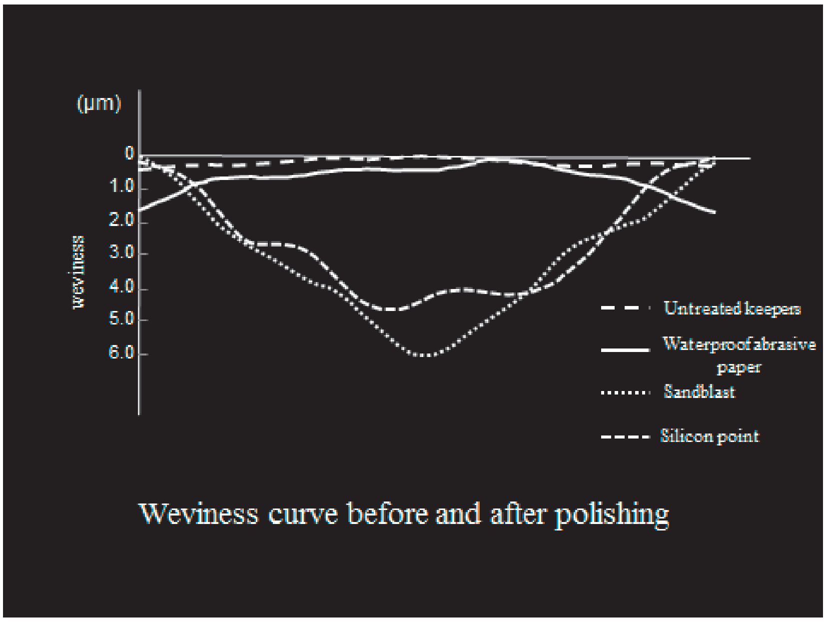

(μm)
weviness
0
1.0
2.0
3.0
4.0
5.0
6.0
Untreated keepers
Waterproof abrasive paper
Sandblast
Silicon point
Weviness curve before and after polishing

Fig.5

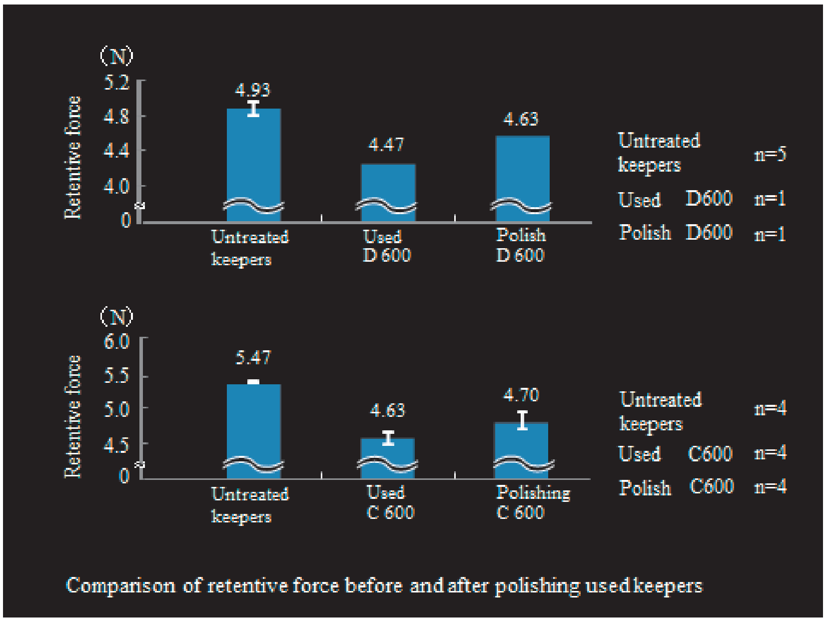


Fig.6

Conclusions

The surface of keepers used in the oral cavity exhibited Ra and Wz. The findings suggested that the retentive force decreases with the increasing degree of Ra and Wz. In addition, polishing with waterproof abrasive paper was more effective for restoring Ra, Wz, and retentive force than was polishing with a silicone point.

This result indicates that the use of waterproof abrasive paper was more effective for polishing keepers with decreased retentive force and roughened surface in the oral cavity.

Acknowledgment

This study was supported in part by a Grant from Dental Research Center, Nihon University School of Dentistry.

References

Y. Ogawa, Effect of Crosshead Speed on Magnetic Retentive Force. JJ Mag Dent 18(2):39-41, 2009.

Mechanical Analysis of Extracoronal Magnetic Attachment using Three-dimensional Finite Element Method

Yo. Ohno, R. Kanbara, Y. Nakamura, T. Masuda, H. Kumano, K. Hayashi, H. Nakamura, T. Iwai,

Yu. Ohno, Y. Takada[1], Y. Tanaka

Department of Removable Proshodontics, School of Dentistry Aichi-Gakuin University
[1]Division of Dental Biomaterials, Tohoku University Graduate School of Dentistry

Introduction

Magnetic attachments were originally developed to apply for non-vital teeth. Plastic patterns for extracoronal attachments were developed to expand clinical applications including vital teeth. In clinical setting, a load is indirectly transmitted to the inferior part of extracoronal magnetic attachments through housings with groove joints. Therefore, a load is applied not only to the neck of extracoronal magnetic attachments, but also to grooves and housing joints. Although Shoji from the Department of Removable Prosthodontics, School of Dentistry, Aichi-Gakuin University, reported the results of strength test of extracoronal attachments with housings in 20th Japanese Society of Magnetic Applications in Dentistry, there is no theoretical validation. Our department has performed the elastic stress analysis of extracoronal magnetic attachments. However, the mechanism of plastic deformation remains to be elucidated.

Objective

The purpose of the present study was to investigate the mechanical strength of extracoronal magnetic attachments using a three-dimensional finite element method to compare the results with the actual measurement data. The housing with joints was attached to extracoronal magnetic attachments.

Materials and Methods

Preliminary experiment to verify elastoplastic analysis and main experiment to verify extracoronal magnetic attachment were performed. Analysis models were fabricated for each experiment, and boundary condition and material constant were determined. The procedure is shown below. Patran was used for model fabrication and result display, and a general purpose nonlinear structure analysis solver program (Marc 2008, MSC software) was used for the analysis.

1. Analysis model

1) Preliminary experiment

The simple cubic model with a cross-section area of 1.73 x 1.73 mm and 6.11 mm on a side was constructed for the preliminary experiment using Patran. The design and analysis model are shown in Fig. 1.

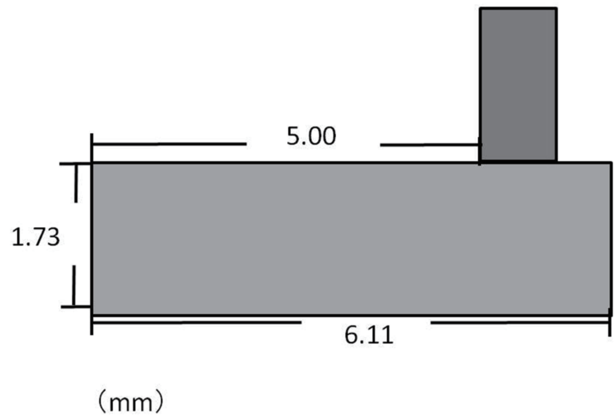


Fig. 1. Preliminary experiment model

2) Main experiment

The 12-mm-high and 9-mm-wide foundation replaced by a natural tooth and an extracoronal magnetic attachment produced from CAD data of the GIGAUSS EC keeper tray were fabricated as a unit, and 2.0-mm-high and 8.6-mm-wide housing was attached on the top. After constructing the foundation and extracoronal magnetic model as a unit, a keeper was cemented, followed by housing placement. Figure 2 shows the design and analysis model.

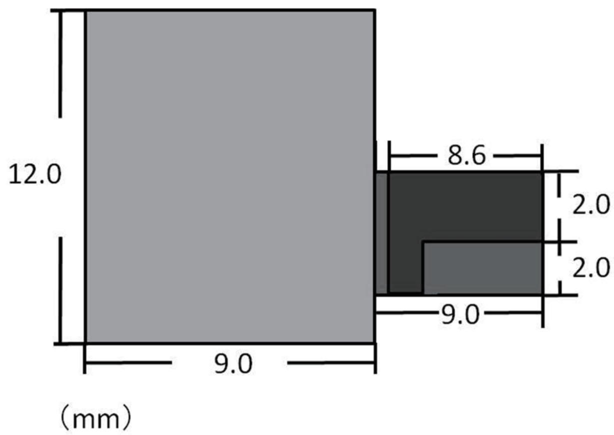


Fig .2. Main experiment model

2. Boundary condition

A complete constraint was applied to the left surface in the X, Y, and Z directions for both preliminary and main experiments as is shown in the figure. For loading condition, a column with 1 mm in diameter was placed on the center of an extracoronal magnetic attachment at 0.5 mm / mm for 15 seconds to apply a load more than 1000 N (Fig. 3)

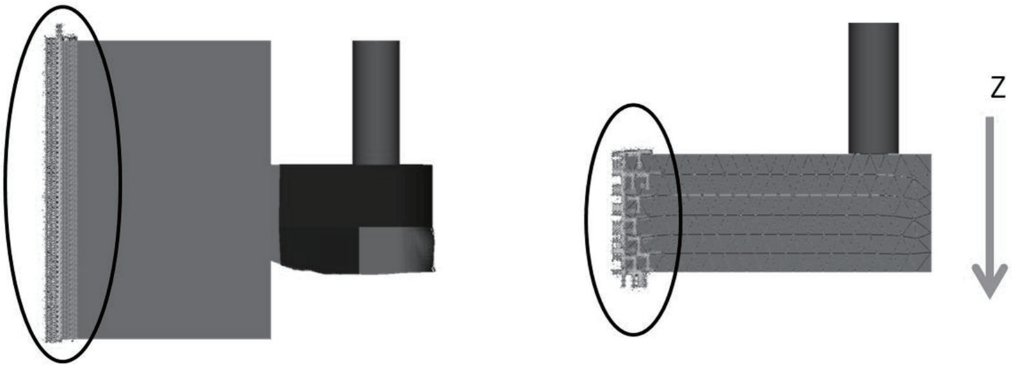
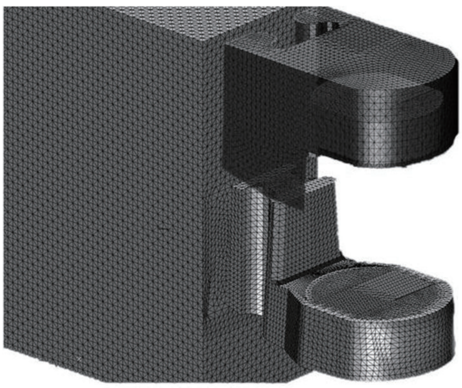


Fig .3. Boundary condition

3. Material constant

The Young's modulus and Poisson's ratio were introduced to SUSXM 27, a material of a keeper and a magnet, and cementum. The analysis model of a preliminary experiment, the foundation of the main experiment, and 12Wt% Au-Ag-Pt alloy, a material of an extracoronal magnetic attachment were determined by the stress-strain curve (Fig. 4). Since the material constant of 12Wt% Au-Ag-Pt alloy is unknown in the actual measurement data, hardening and softening heat treatment stress-strain curves were introduced to reproduce elasto-plasticity.

Elastic deformation after each heat treatment was calculated from the linear part of the graph, and Young's modulus 12,987 was introduced. An arbitrary figure in the graph was introduced after plastic deformation for reproduction (Fig. 5).



	Young's modulus (MPa)	Poisson's ratio
12Wt% Au-Ag-Pt alloy	determined by the stress-strain curve	
SUSXM27	196,000	0 . 30
cementum	8,820	0 . 30

Fig .4. Material Properties

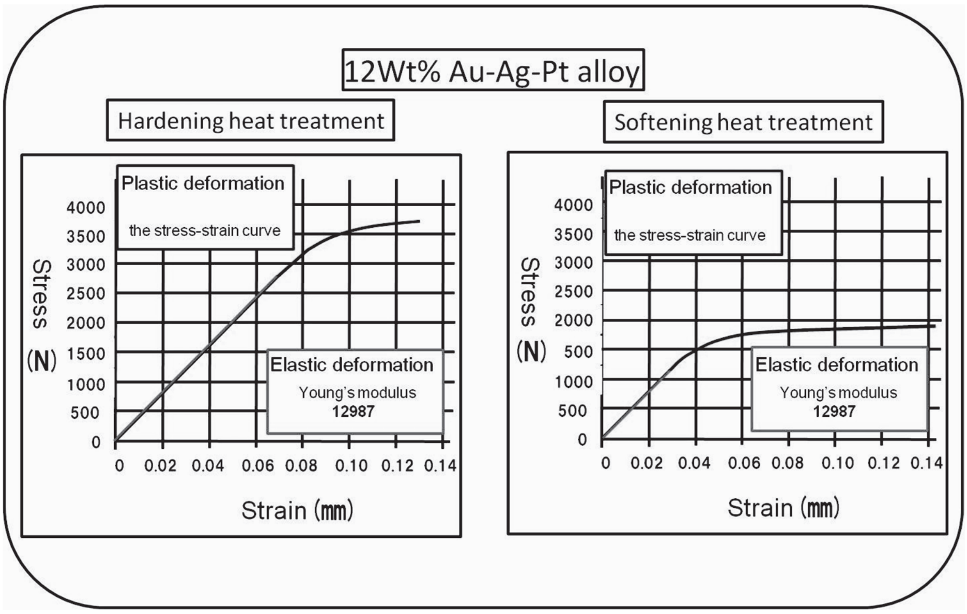


Fig .5. Hardening and softening heat treatment stress-strain curves (12Wt% Au-Ag-Pt alloy)

Results

1. Preliminary experiment

Verification of elasto-plastic analysis was performed by actual measurement and load displacement curve. The figure shows a load displacement curve. The X axis stands for the z axis displacement of the preliminary experiment analysis model, and the Y axis stands for the stress value applied on the test sample of the preliminary experiment. Values in the load displacement curve after hardening and softening heat treatment of the metal were approximated the actual measurements (Fig. 6).

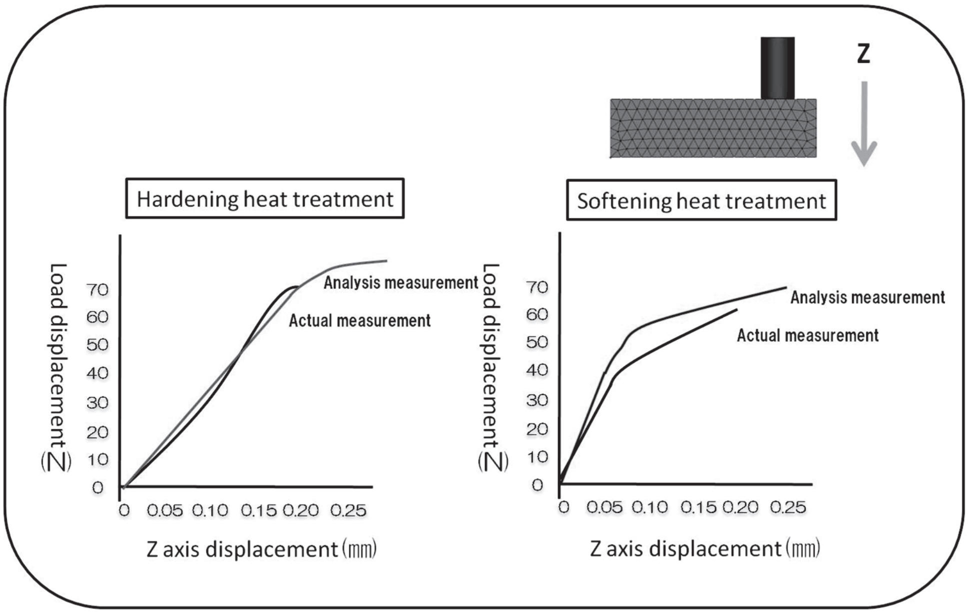


Fig .6. Actual measurement and load displacement curve

2. Main experiment

1) Stress distribution

Stress distribution was evaluated using von Mises stress. Stress concentration was observed in the upper margin of the extracoronal attachment groove. The result confirmed that stress is transmitted to the upper and lower margins of foundation (Fig. 7).

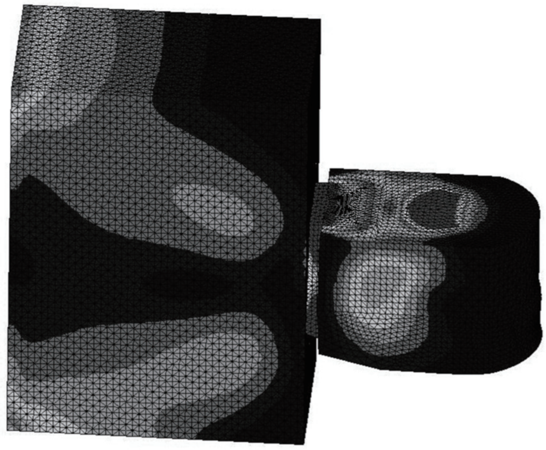


Fig .7. Stress distribution

2) Load displacement curve

The horizontal axis of the load displacement curve shows z axis displacement of an extracoronal magnetic attachment, and the vertical axis shows a load in the measurement point shown in the slide. The result confirmed that plastic deformation occurs over 733 N in the hardening heat treatment and over 390 N in the softening heat treatment (Fig. 8).

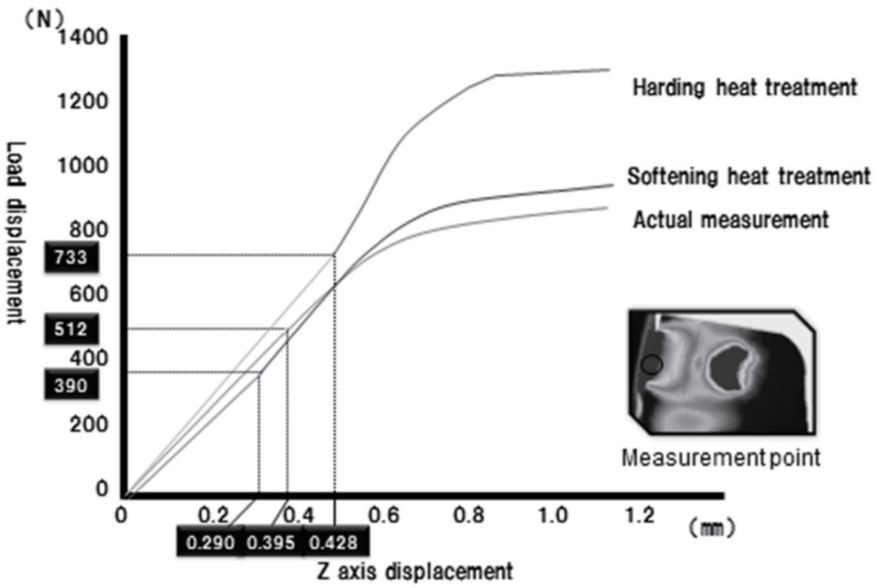


Fig .8. Load displacement curve

Discussions

1. Analysis model

The finite element model used in the main experiment was fabricated by constructing extracoronal attachment model based on the practically-used and normalized CAD data, and a housing and foundation were fabricated to fit the model. Since the size of the model is accurately reproduced, problems are unlikely to happen.

The model was fabricated using tetrahedral element. Although the calculation accuracy of the tetrahedral element is considered to be not as good as hexahedral element, the fabricated model in the present study was segmentalized so that the element figure is approximated as hexahedral element. Therefore, inaccurate stress concentration and reaction force due to insufficient element could be avoided.

2. Boundary conditions

The same boundary conditions as the strength test of the 20th Conference of Japanese Society of Magnetic Applications in Dentistry were used in the present study. A load up to 1000 N was applied at 0.1 mm / sec. The results approximated the actual measurement were obtained by specifically setting the speed and acceleration. However, there was a difference in the metering rod between actual measurement and the analysis. This is considered to be due to the fact that the tip of the metering rod is round in the actual measurement and flat in the analysis. Further discussion is necessary to understand the influence of this difference.

3. Elasto-plastic analysis

Although elasto-plastic analysis is barely used in dentistry, it is widely introduced in the industrial field and gains credibility. In the present study, a preliminary experiment was performed to reconfirm the credibility.

4. Metal treatment

Mechanical properties of the hardening and softening heat treatments were used for 12Wt% Au-Ag-Pt alloy. Although cast strength was measured in the actual measurement, normalized mechanical properties were applied in the present study. This is due to the fact that cast strength is not consistent, and, therefore it was considered inappropriate to use for simulation.

5. Analysis result

The graph obtained by the preliminary analysis approximated the actual measurement graph. The result suggested that validity of the elasto-plastic analysis using three-dimensional finite element method was confirmed. Since the main experiment introduced the same condition setting, the validity of the main experiment was also considered satisfactory. Actual measurement and analysis values did not completely agree. This was considered to be the influence of displacement in XY axis direction in actual measurement.

In the present study, evaluation was performed using stress distribution and load displacement curve.

Stress distribution was evaluated using the von Mises stress. Although the von Mises stress cannot be used for compression and tension evaluations, it indicates stress concentration easily. The results showed stress concentration in the upper margin of the extracoronal attachment groove, and stress transmission to the upper and lower margins of foundation. The similar results were obtained in the break test of actual measurement. A crown and an abutment tooth were assumed for the foundation, and high stress concentration was expected in the margin line by receiving a stress in an extracoronal magnetic attachment. The same condition setting as the preliminary experiment was applied in the load displacement curve, and the results were compared and discussed with actual measurement of the extracoronal magnetic attachment strength test by Shoji from the First Department of Prosthodontics, School of Dentistry, Aichi-Gakuin University. The actual measurement was performed during casting. The actual elastic limit was 512 N. This value was in between softening and hardening heat treatment values. The same results were reported by Hideo Nakamura, and therefore, the validity of the present analysis was confirmed. However, a load displacement curve of the softening and hardening heat treatment had multiple curves instead of two. This is considered to be due to the element influence after segmentation. It is necessary to raise the precision by using hexahedral element with multiple nodal points and increasing contact points.

Conclusions

The results of the elasto-plastic analysis confirmed that an extracoronal magnetic attachment has wide elastic area as actual measurements. Analytical values demonstrated that deformation does not occur until 733 N in the hardening heat treatment, and 390 N in the softening heat treatment.

References

1. T. Masuda, H. Kumano, Y. Nakamura et al.: Stress Analysis of Extracoronal Magnetic Attachment using Three-dimensional Finite Element Method, The Journal of the Japanese Society of Magnetic Applications in Dentistry, 16 (1), 18-22, 2007

2. H. Nakamura: An Influence of Heat Treatment on Fatigue Strength of Au-Ag-Pd Cast, Dental Materials Journal, 16 (2), 141-154, 1997

A Change in Attractive Force of a Keeper Fabricated using a Reuse Metal of Castable Magnetic Alloy

K. Yoshihara, T. Iwai, Y. Nakamura, H. Konno, T. Kogiso, K. Shoji, K. Okamoto, T. Masuda, Yu. Ohno,

Y. Takada[1], Y. Tanaka

Department of Removable Proshodontics, School of Dentistry Aichi-Gakuin University
[1]Division of Dental Biomaterials, Tohoku University Graduate School of Dentistry

Introduction

In clinical practice, a root cap with a ready-made stainless steel keeper is placed to a non-vital tooth, and a magnetic assembly is embedded in the denture base. The size of a magnetic attachment has become smaller along with a reduction of the magnet size in recent years. However, there is often a case when a commercially available magnetic attachment cannot be placed due to the limited space, inclined dental root, and the influence of adjacent teeth. A magnetic alloy root-cap was developed to be replaced by a conventional root-cap with a keeper. This root-cap was fabricated using a castable magnetic alloy, and, therefore, attachable to the magnetic assembly. The development of the root-cap expanded the application of magnetic attachments in the limited space compared with a conventional root-cap with a keeper. Hearth formed by casting using a lost-wax method is essential to prevent casting defects.

A mixture of hearth and virgin metal is used for casting in clinical practice. It is necessary to evaluate an influence of casting using hearth of dental magnetic alloy on the attachment force between a keeper and a magnetic assembly.

Objective

The present study examined attractive force of a keeper and magnetic assembly fabricated using a hearth of dental magnetic alloy, and analyzed the constituent elements for verification.

Materials and Methods

1. Materials

Castable magnetic alloy Attract P (TOKURIKI-HONTEN Co.) was used. Attract P is the only commercially available dental cast magnetic alloy. Figure 1 and Table 1 show an ingot image and properties of Attract P. The main component of the alloy is Ag-Co-Pd. It also includes Au, Zn, and In.

Table 1 Composition and Properties of Attract P

Color : silver
Melting point : 1148-1192℃
Castable temperture : 1300℃
Specific gravity : 10.5kg/cm^3
Strength : 197HV
Yeild Strength : 300MPa
Elongation : 13.5%

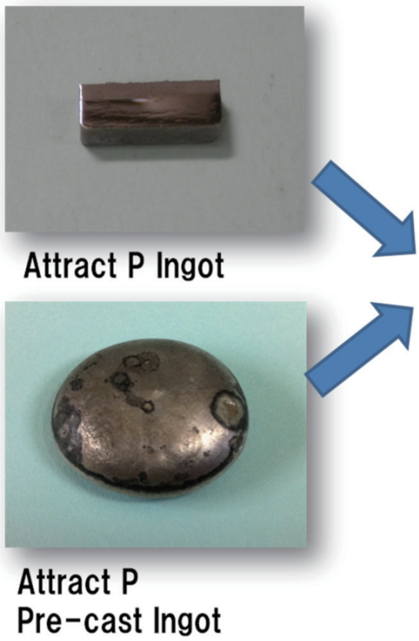
Fig. 1 Ingot of「Attract P」(TOKURIKI HONTEN)

2. Experimental method

2.1 Sample fabrication method

Two metals were used for sample fabrication, Attract P ingot and hearth formed by casting the sample using Attract P ingot. The investment material and oxidized layers on the hearth surface was removed using a carborundum point, followed by sandblasting to reuse for casting.

Five different samples including a mixture of Attract P ingot and hearth at ratio of 1 : 3 (0) , 1 : 1 (25) , and 3 : 1 (50) , ingot alone (75), and hearth alone (100) were prepared. The number of each sample was 5 (Fig. 2). Figures 3 and 4 show completed samples and their size.



Cntent of pre-cast ingot by percentage		0%	25%	50%	75%	100%
Total weight (g)	Virgin metal	10	7.5	5	2.5	0
	Pre-cast ingot	0	2.5	5	7.5	10

Fig. 2 Ratio between ingot and pre-cast ingot used for preparation of specimens.

Fig. 3 Specimen used in this study..

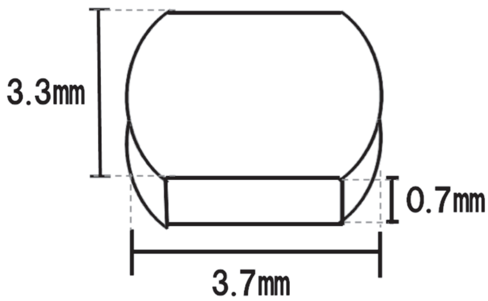


Fig. 4 Size of specimen

2.2 Attractive force measurement

Magnetic assembly GIGAUSS C600 was used, and attractive force between the samples and magnetic assembly was measured using a compact table-top universal tester machine EZ test (SHIMAZU) 10 times for each sample at 5 mm / min crosshead speed. A custom-made jog devised by Tanaka et al. (1)(2) was attached to EZ test (Fig. 5).Samples were fixed to the mold using instant adhesive so that magnetic assembly and keeper adsorption face are tightly adhered.

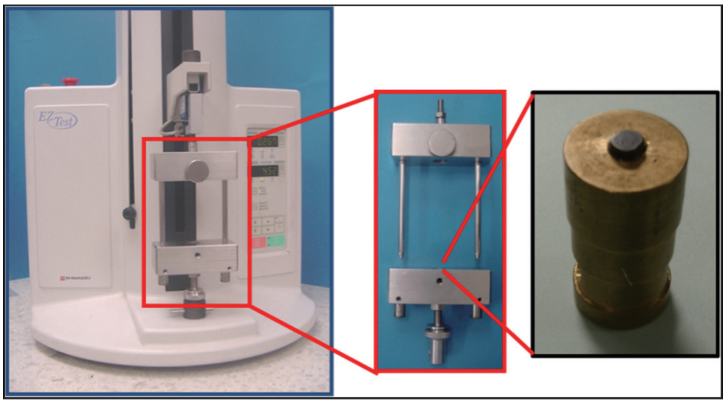


Fig. 5 Universal testing machine Ez-test (SHIMADZU) and special JIG

2.3 Constituent element analysis method

Constituent element analysis was performed using an electron probe micro analyzer JXA-8340F (JEOL). Constituent elements were identified by point analysis, followed by the surface analysis of 2 x 3 mm area using a probe with 9 μm diameter. In addition to observation of the adsorption face of each sample, arbitrary face of the ingot surface was observed as a control.

2.4 Statistical analysis

Attractive force measurement and constituent element analysis were performed for each sample. Pearson's product-moment correlation analysis was performed for each result to investigate factors affecting the change of attractive force.

Results

Attractive force decreased with an increase of hearth content. Constituent element analysis revealed that Co content in samples decreased and segregation of samples is more likely to happen with an increase of hearth content. Regarding Co content in samples, Co w% on the observation surface in sample was employed as an approximate value of Co content in samples. Since the segregation phase is rich in Ag, the area with more than 45% Ag content in the Ag mapping image was regarded as the segregation phase. Segregation phase area ratio on the adsorption face in samples was calculated based on Ag content. Statistical analysis result revealed a moderate correlation between attractive force and Co content, attractive force and area ratio of the segregation phase on adsorption face (segregation phase ratio), hearth and Co contents, and attractive force and Co at 1% significance level. There was a minor correlation between hearth content and segregation phase ratio (Fig. 6, 7, 8, 9 and 10). Constituent element analysis of an ingot confirmed the area with multiple segregations (Fig. 11). Point analysis of the segregation phase showed that the main component of the segregation phase was Ag-Pd, whereas that of base alloy was Co-Pd (Fig. 12).

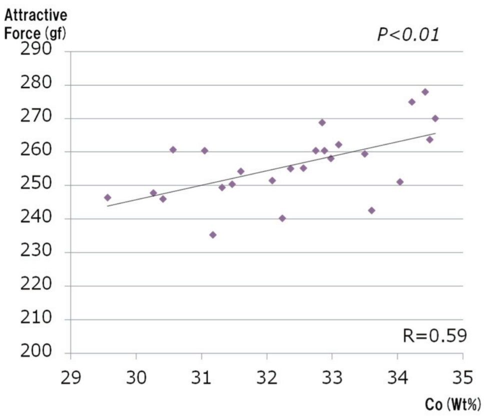


Fig. 6 Graph of Attractive force - Co contents

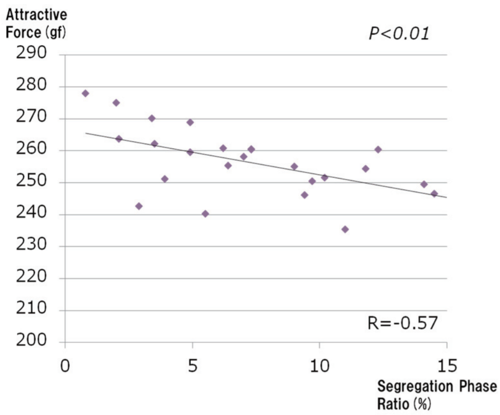


Fig. 7 Graph of Attractive force - hearth content

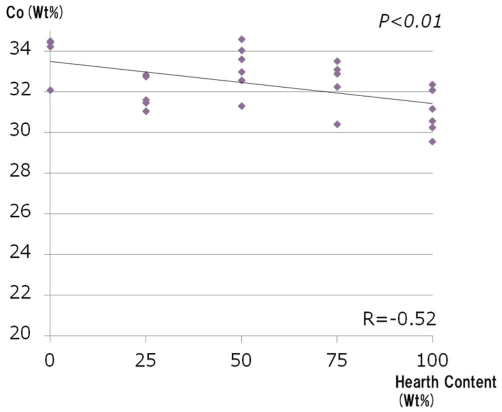


Fig. 8 Graph of Hearth content - Co contents

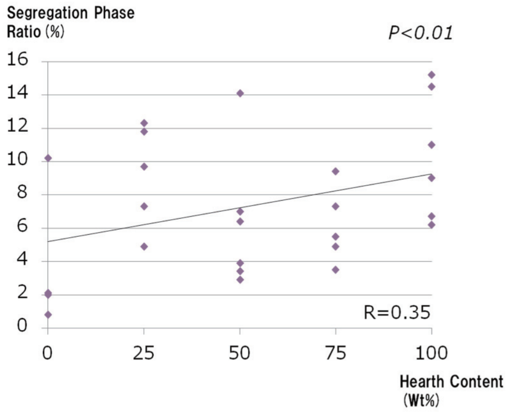


Fig. 9 Graph of Segregation phase ratio - hearth content

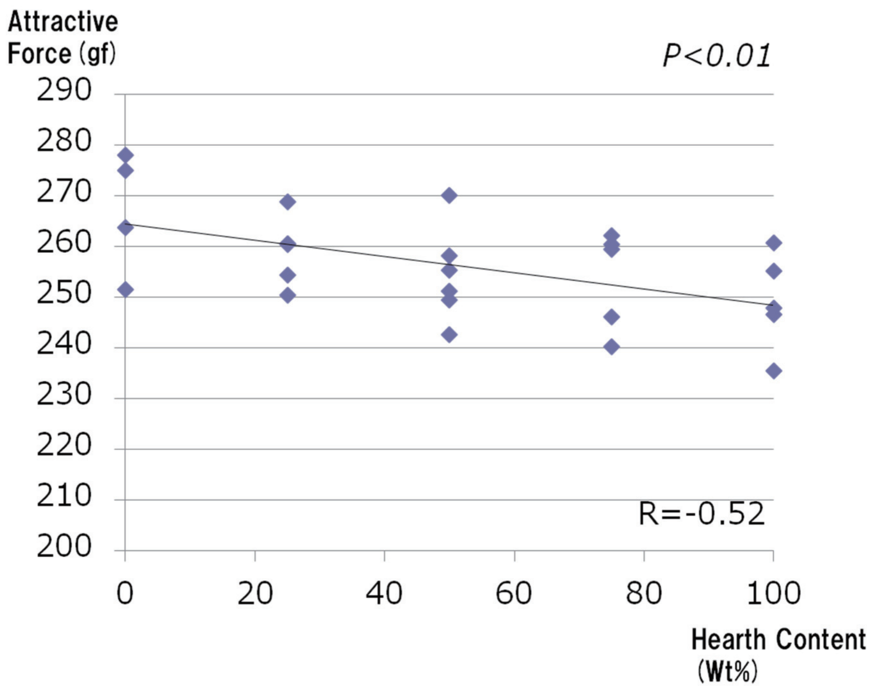


Fig. 10 Graph of Hearth content - Attractive force.

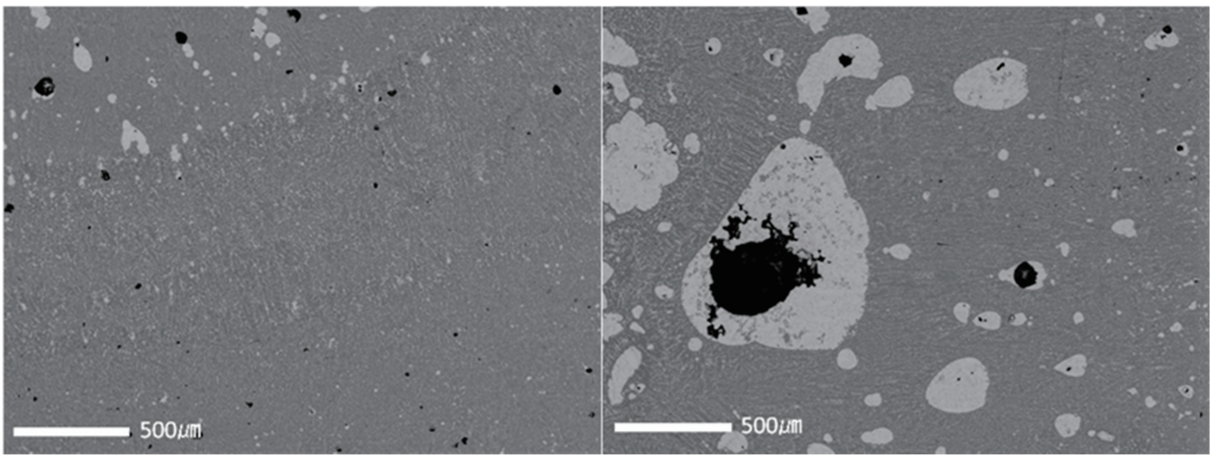


Fig. 11 SEM of another point of one ingot.

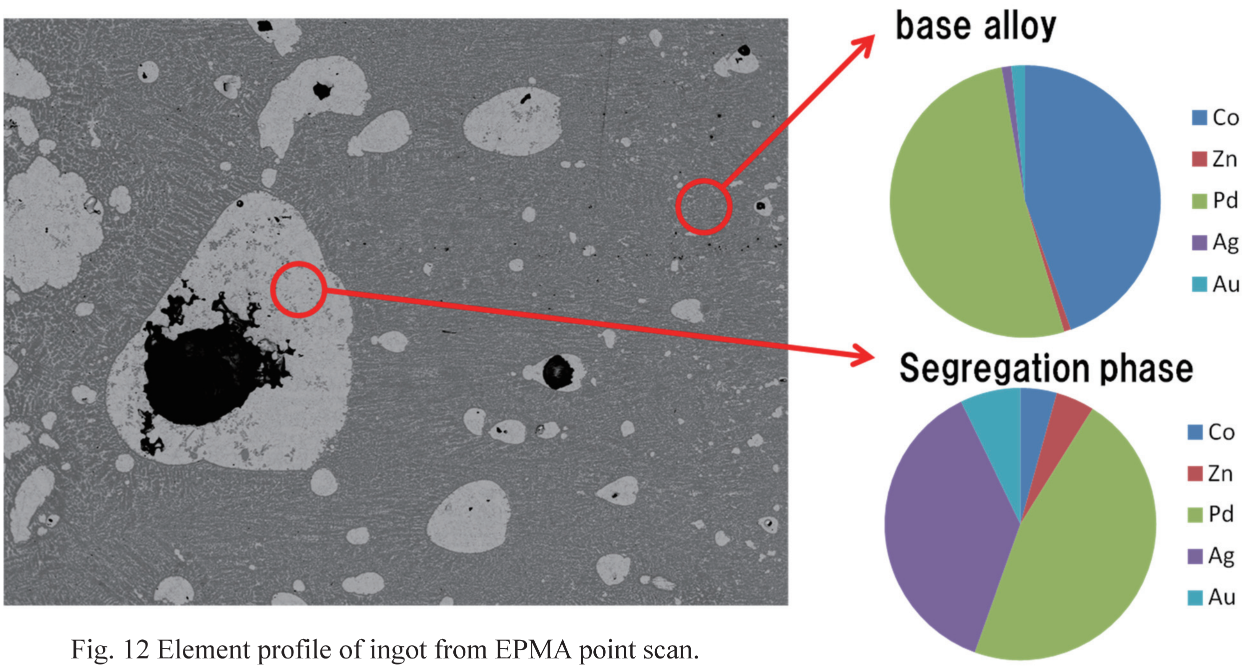


Fig. 12 Element profile of ingot from EPMA point scan.

Discussions

1. Hearth and Co contents

A moderate correlation between hearth and Co content is considered to be due to the lost Co contained in the removed oxidized layer. Oxidized layers are formed not only on the surface of the hearth but also on the contact surface with the investment material, and were observed on the surface of the cast. (Fig. 13)

It is recommended to perform the process from melting to casting in argon atmosphere to prevent oxidization of the metal.

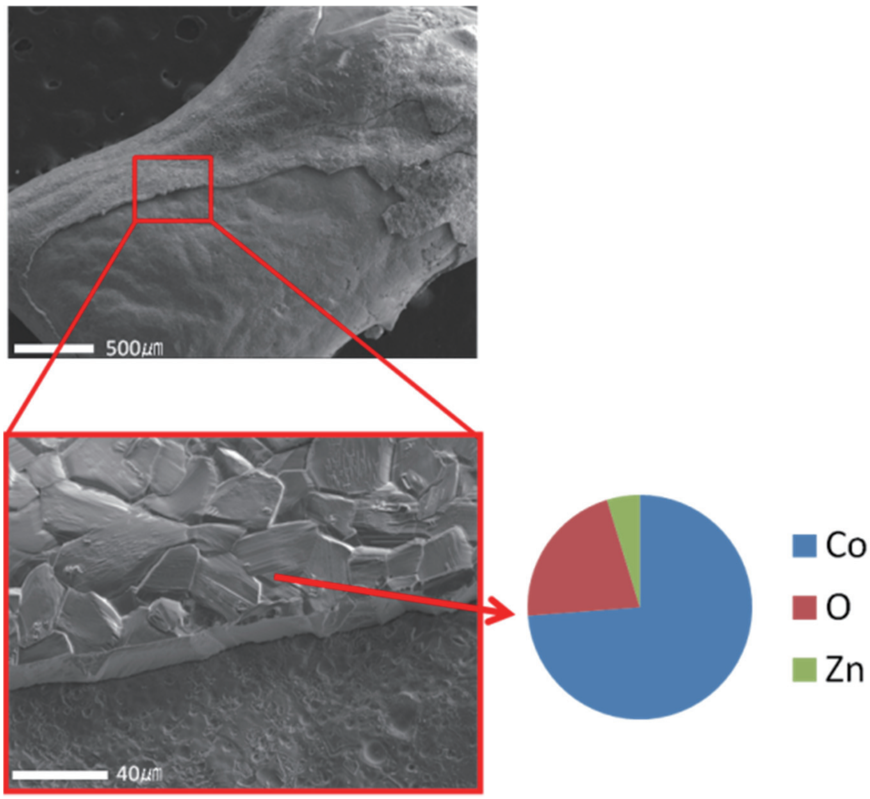


Fig. 13 SEM and element profile of oxide layer on the specimens.

2. Hearth content and segregation phase ratio

Segregation was observed on all the sample surfaces. The correlation between the size and amount of segregation and hearth content was weak. It is considered that composition of Attract P easily forms segregation regardless of the use of hearth.

Considering segregation phase was commonly observed in the ingot, the influence of biased segregation caused by coagulation condition of a cast is higher than hearth content.

3. Attractive force and Co content

Co is a strong magnetic body, and is considered to be involved in magnetic property. Okamoto et al(3) reported that Au-Co alloy shows magnetic property in 8 ? 82 wt%, and Pd-Co alloy shows magnetic property in more than 5 wt%.

Considering there was a moderate correlation between Co content and attractive force, Co content is considered to affect attractive force.

The Co amount of the adsorption face in samples was analyzed and evaluated in the present study. The overall Co content may change if larger segregation exists in the deeper area. Melting samples and measuring accurate Co content may confirm stronger correlation.

4. Attractive force and segregation phase ratio

The segregation phase was observed only on the adsorption face, and the size of segregation phase varied from 10 µ to 500 µm in diameter. Although the influence of segregation phase with a small diameter on attractive force may be small since the master alloy is situated just below the segregation phase, that with a large diameter may cause decrease in attractive force in a similar way as air gap.

A moderate correlation was observed between attractive phase and segregation phase ratio in the present study. Although the size of segregation phase was not considered, the influence on attractive force may be different between multiple segregation phases with a small diameter and a few segregation phases with a large diameter despite of the same area ratio.

The size of segregation phase affecting attractive force needs to be investigated. It is also necessary to confirm the relationship between segregation phase with a large diameter and attractive force.

Conclusions

Moderate correlation was observed between hearth and Co contents, attractive force and Co content, and hearth content and attractive force. The results suggested that Co content decreased after recasting using a hearth, resulting in a decrease in attractive force.

A hearth in the present study was formed after casting once from the virgin metal. However, a hearth is repeatedly used in clinical practice, and it is concerned that composition of the alloy significantly changes.

The composition of the base alloy after casting using a repeatedly-used hearth needs to be confirmed.

References

1. Y.Nakamura, K.syoji, R.Kanbara, et al : Influence of the Mesuring Methods on the Attractive Force of Megnetic Attachments. JJ Mag Dent 19 (2):10-15, 2010.

2. Y.Terao, Y.Nakamura, T.Isihda, et al : Mesuring Methods of the Attractive Force of Magnetic Attachment. JJ Mag Dent 16(2):14-19, 2007.

3. K. Okamoto, K. Eda, M. Miyazaki et al: Basic research regarding casting magnetic alloy. Dental Materials Journal, 17 (5) 309-314, 1998

Working toward the international standardization of dental magnetic attachments - Commission report of the ISO Corresponding Committee in 2011 -

Y. Takada

Chief member of the ISO corresponding committee in JSMAD
Division of Dental Biomaterials, Tohoku University Graduate School of Dentistry

Introduction

The international standardization of dental magnetic attachments has been continued for over six years since “Development and standardization of the dental magnetic attachment" supported by the NEDO grant was started in 2005. After NWIP (New Work Item Proposal) was presented in ISO/ TC 106/ SC2 in 2007 (Berlin meeting), a Japanese draft established by “The Magnetic attachment standardization committee (The ISO corresponding committee in JSMAD)” was approved as WD 13017 (Working draft) in 2008 (ISO/ TC 106 Goteborg meeting). WD 13017 was revised to DIS 13017 (Draft of International Standard) in Jun, 2011 through CD 13017 (Committee Draft) in ISO/ TC 106 Rio de Janeiro meeting in 2010.

Our activities in ISO/ TC 106 Phoenix meeting in 2011 are reported and you can know progress in ISO/ DIS 13017, here.

Working goal in 2011

The Magnetic attachment standardization committee set up the following targets.

1) In ISO/ TC 106 Phoenix meeting which will be held in September, 2011, we get acceptance of revised DIS 13017 and that of its FDIS voting.
2) We improve jigs used for measuring retentive force in order to standardize measurement methods and the jigs for the retentive force in detail before long.

Fig. 1 Members of the magnetic attachment standardization committee

Activities

DIS 13017 came into existence by DIS voting for CD 13017 in Jun, 2011 without a dissenting vote. (Fig.2).

Ballot Information			
Reference	ISO/DIS 13017	Committee	ISO/TC 106/SC 2
Edition number	1		
English title	Dentistry – Magnetic attachments		
French title	Médecine bucco-dentaire – Attaches dentaires magnétiques		
Start date	2011-01-20	End date	2011-06-20
Opened by ISO/CS on	2011-01-20 00:13:38	Closed by ISO/CS on	2011-06-22 00:14:54
Status	Closed		
Voting stage	Enquiry	Version number	1
Note	This DIS has become ISO VA Lead - parallel enquiry has been launched with CMC - ISO files have been corrected - ISOCS 2011-02-01		
Vienna agreement	ISO lead	CEN ballot type	CEN Enquiry Ballot
CEN reference	prEN ISO 13017	CEN committee	CEN/TC 55

Result of voting

P-Members voting: 16 in favour out of 16 = 100 % (requirement >= 66.66%)

(P-Members having abstained are not counted in this vote.)

Member bodies voting: 0 negative votes out of 19 = 0 % (requirement <= 25%)

Approved

Fig.2 The result of DIS voting in 20th Jun, 2011

The first meeting of the magnetic attachment standardization committee was held in July, 2011 in Tokyo, and we set the working goal in 2011. In order to promote DIS 13017 to FDIS 13017, we discussed answers to comments from P-member countries such as introduction, material compositions, hazardous elements, and biocompatibility. After that, we revised the DIS 13017, and convener of WG 22, Dr. H. Mizutani who was our committee member sent new revised DIS 13017 to experts of P-member countries.

After ISO/ TC 106 Phoenix meeting held in September, 2011, the second meeting of the committee was held in Tokyo in November, 2011. The chairman of the committee reported the details of SC2/ WG 22 meeting. The convener of WG 22 also revealed that the revised DIS 13017 was approved and that FDIS voting for the DIS 13017 was determined next year (in 2012) in plenary of TC 106.

We also discussed improvements of jigs used for measuring retentive force with respect to friction of a liner motion bearing and addition of an X-Y stage for specimens.

ISO/TC 106 Phoenix meeting

Five members of the magnetic attachment standardization committee, Dr. H. Mizutani (convener), Dr. Y. Takada (expert), Dr. Y. Nakamura (expert assistant), Dr. Kent T. Ochiai (convener assistant), and Dr. H. Sasaki (obsever) attended the ISO/TC 106 Phoenix meeting. Reception banquet was given on 18th September by host country (U.S.A.) in Pointe Hilton Tapatio Cliffs Resort. (Figs.3 and 4)

Fig.3 Pointe Hilton Tapatio Cliffs Resort

Fig.4 Reception banquet

The five members made an effort to success SC 2/ WG 22 meeting till all hours of the night. (Fig.5) SC 2/ WG 22 meeting was held on 19th September at the same place. (Fig.6) The revised DIS 13017 was approved and FDIS voting for the DIS 13017 was determined next year (in 2012) in the meeting.

Fig.5 Small hours on previous day of the meeting

Fig.6 SC 2/ WG 22 meeting

The short minutes of the meeting was partially shown in Fig.7.

There was discussion on the revised DIS 13017 "Dentistry – Magnetic attachments". Each of the comments that were received from the different voting countries were reviewed and accepted or modified according to the consensus of the group. The "Introduction" and "Scope" of the document were revised and accepted by the group.
It was resolved that the revised DIS be sent to the secretary of SC2 for circulation as a FDIS. It was further resolved that a half day meeting be held next year in subcommittee 2.

Fig.7 A part of the short minutes of the meeting

Improvement of the jig

The committee continuously develops a pilot model of the jig, which can measure the retentive force with excellent accuracy and reproducibility because of the preparation for ISO/ TC 106 Paris meeting in 2012. (Fig.8)

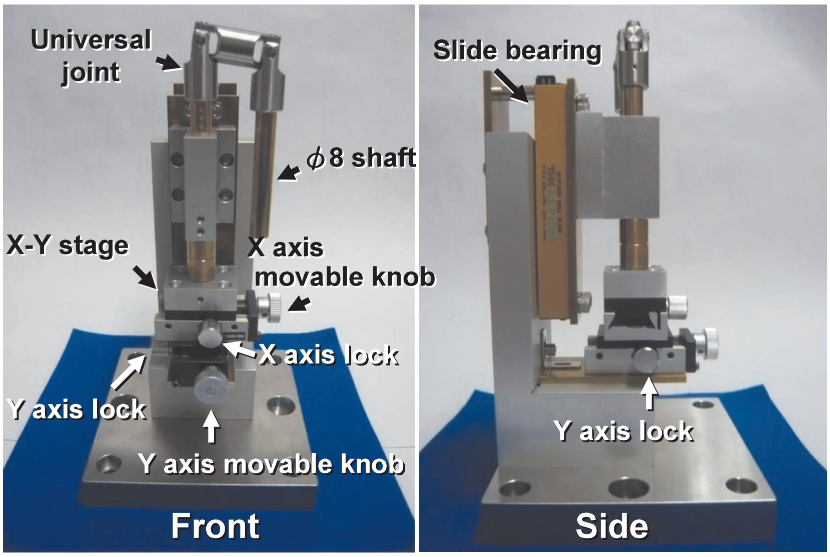


Fig.8 A pilot model of the Jig equipped with an X-Y stage and a new slide bearing

Future prospects

The members of the Magnetic Attachment Standardization Committee are looking forward to a voting result of FDIS (Final Draft of International standard) in this year. If FDIS 13017 is carried in the voting, ISO 13017 (ISO standard of "Dentistry-Magnetic attachments") will come into the world in this year. In preparation for ISO/ TC 106 Paris meeting in 2012, the members make a challenge to a new standardization of measurement methods and the jig for the retentive force in magnetic attachments, now. The members' activity already allows obtaining the souped-up jig for measuring retentive force.

To readers,

We will do our utmost to live up to your expectations!

From all members of the Magnetic Attachment Standardization Committee
(The ISO corresponding committee in JSMAD)

PS.

Congratulations!

ISO 13017 was published on 15 July, 2012.

Comparison of the swallowing mensuration using MI sensor with swallowing sound using the pharynx microphone

K. Hamaguchi[1] , M. Akutagawa[2], Y. Tegawa[3], T. Ichikawa[3], S.Hongama[3] and Y. Kinouchi

[1] Graduate School of Advanced Technology and Science, The Univ. of Tokushima
[2] Institute of Technology and Science ,The Univ. of Tokushima
[3] Institute of Health Biosciences ,The Univ. of Tokushima

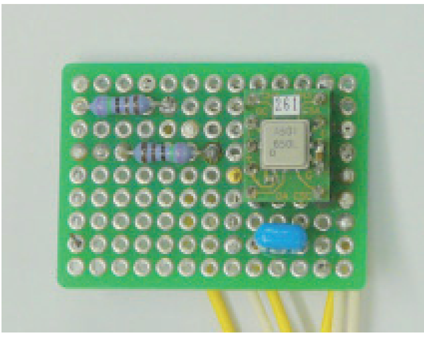
Introduction

The objective of this study is to develop a screening device for the swallowing difficulty (dysphagia) using a magneto-impedance (MI) sensor. The video fluorography (VF) or video endoscopy is used to diagnose dysphagia. In the other hand, RSST (repetitive saliva swallowing test)[1)] is widely used as a simple test in some facilities where they have no VF apparatus.

The authors have developed a device to automate the RSST using a MI sensor. Availability of proposed method is examined in previous study[2)]. As results of experiments, movement of a laryngeal prominence could be measured using a small magnet and the MI sensor. In this study, we compared the movement by the MI sensor with the other measurement method i.e. video image analysis and swallowing sound recorded by pharynx microphone.

Method

The proposed device consists of a neodymium magnet, a MI sensor (Aichi Micro Intelligent, AMI302) and a personal computer for data acquisition. The MI sensor is capable to measure three-dimensional magnetic field. The magnet is attached on the laryngeal prominence, and the MI sensor is attached on breastbone. Relative position between the magnet and the sensor changes in the subject's swallowing. The magnetic field at the sensor reflects the swallowing movement.



(a) Magnetic sensor module

(b) Pharynx microphone

Fig.1. The device of measurement.

In RSST, the subject is instructed to swallow saliva as fast as possible in 30 seconds. If the subject can swallow less than 3 times, he/she is suggested to need further investigation. In proposed system, basic procedure is same as original RSST except 10 seconds preceding measurement to obtain offset of the sensor output. The offset is subtracted from measured values. In addition, the swallowing sound and larynx movment are captured by a video camera in order to evaluate whether three-dimensional MI sensor can measure swallowing (Figure 2). The swallowing sound are obtained by the throat microphone(Fig.2). The movment of larynx is obtained by use of A metal pin (Φ1mm×30mm) is attached on the larynx by surgical tape. The movement of the pin is tracked by a video camera. We also get the swallowing sound at the same time by the throat microphone(Fig.2).

The change of sensor output ΔV(t) is described as

$$\Delta V(t) = \sqrt{(V_x(t) - V_{ox})^2 + (V_y(t) - V_{oy})^2 + (V_z(t) - V_{oz})^2} \quad (1)$$

where $V_x(t)$,$V_y(t)$,$V_z(t)$ are sensor output of each axis and V_{ox}, V_{oy}, V_{oz} are offset of them. V_{ox}, V_{oy}, V_{oz} are average during offset period. They consist of geomagnetism and sensor offset.

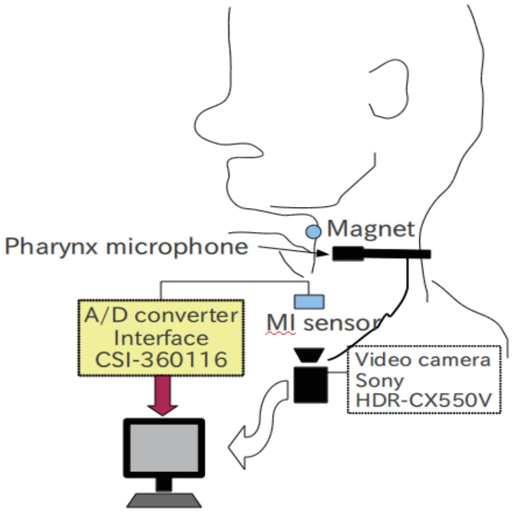
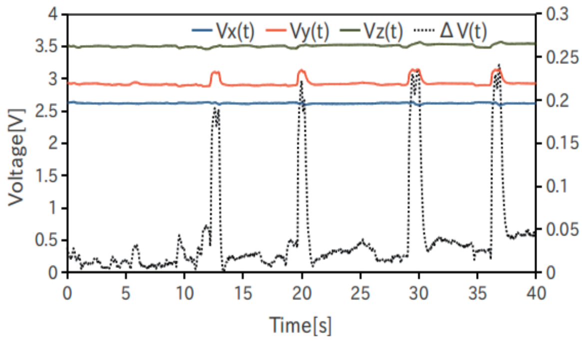
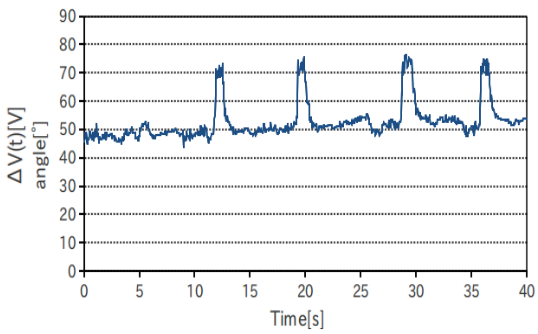


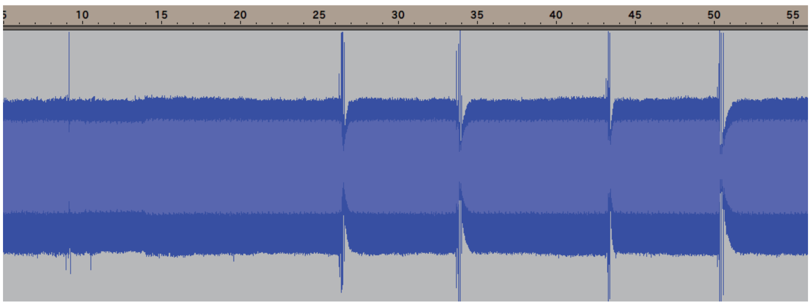
Figure 2. Placement of the measuring device



(a) Output of the MI sensor



(b) Change of the angle by the video images



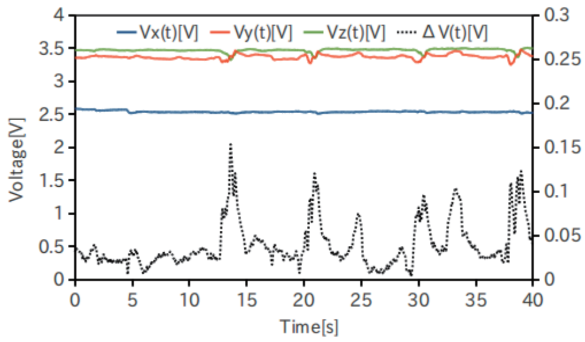
(c) Swallowing sound waveform for healthy adult(23 years old)
Fig. 3 The measurement result for healthy adult (23 years old)

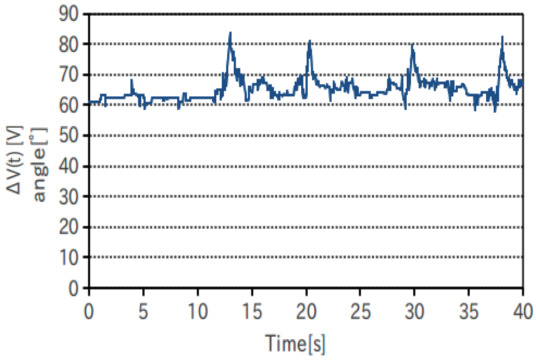
Results

Fig. 3 and Fig. 4 shows result for healthy adult (23 years old, male).

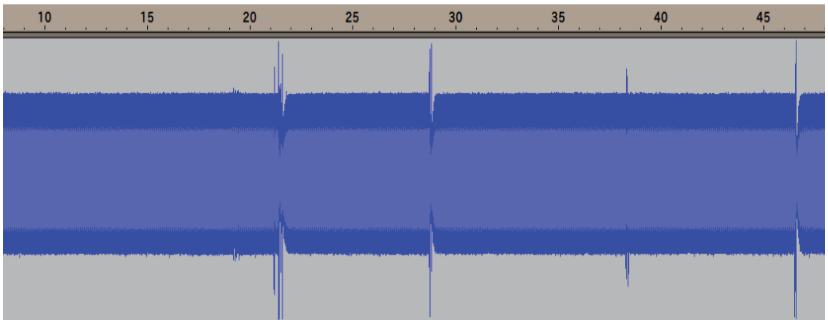
It is possible to count the swallowing movements from each Fig. 3 (a), (b) and (c). Especially, Fig. 3 (a) summarizes the variance of 3 magnetic sensors. It is convenient to count using threshold.

Fig.4 shows a result of another subject of healthy adult (24 years old, male). In this subject, waveforms during the swallowing are blurred. It is difficult to apply the threshold to count the swallowing.





(a) Output of the MI sensor (b) Change of the angle by the video images



(c) Swallowing sound waveform for healthy adult (24 years old)

Fig. 4 The measurement result of healthy adult (24 years old)

Difference between two subjects is whether it was able to detect swallowing movement. The results of the first subject, the number of swallowing can be confirmed by each measurement method, but the second results, the measurement result by the sensor can not counted the number of swallowing. However, Fig. 4 (b) and (c) is possible to count the number of swallowing.

Discussion

This result has an interesting interpretation. It could not be measured by the sensor, there is no rotational motion of the magnet, we thought the possibility was moved up and down on the surface of the skin. Figure 5 shows in order to examine this possibility, which represents the locus of the magnet by the moving image. The X-and Y-axis in Figure 5 is the axis of the moving image, when the subject was facing the front, the X-axis was from front to back, the Y-axis was from top to bottom. The video taken from the left as viewed from the subject. As an analysis of Figure 5, that there is no movement on the surface of the skin and do not found rotational motion. Based on these results it is concluded that measured the movement of the non-swallowing by sensor.

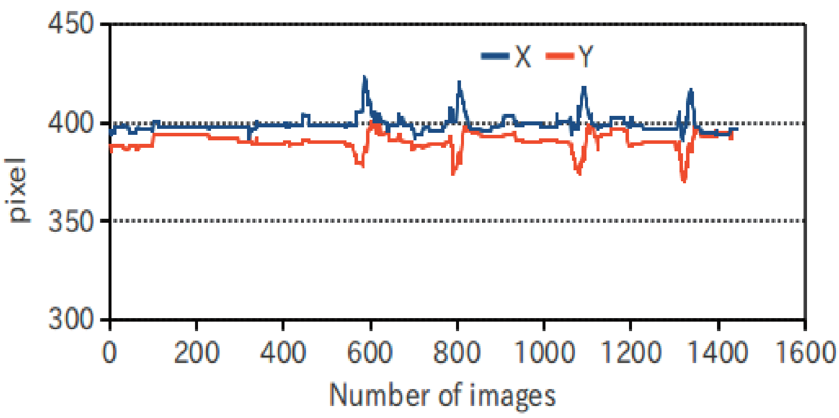


Fig. 5 Locus of movement of the magnet on the surface of the skin

Conclusion

An experimental device for automated RSST using a magnet and magnetic sensor is described. We confirm that the proposed device can measure the movement of the laryngeal prominence. However, it is difficult to count the number of swallowing for some subjects with uncertain movement of the magnet of the larynx.

References

1. K.Oguchi, E.Saitoh, M.Mizuno, M.Baba, M.Okui, M.Suzuki, The Repetitive Saliva Swallowing Test (RSST) as a Screening Test of Functional Dysphagia (1) Normal Values of RSST", The Japanese Journal of Rehabilitation Medicine Vol.37, 375-382, 2000
2. K.Tanida, M.Akutagawa, Y.Kinouchi, T.Ichikawa and S.Hongama, Evaluation of Swallowing Movement by Posture Change Using a Magneto-impedance Sensor, JJ Mag. Dent., Vol.18, No.2, 15-19, 2009
3. K.Hamaguchi, M.Akutagawa, Y.Kinouchi, Y.Tegawa, T.Ichikawa, Examination of the Sensor Placement in the Swallowing Mensuration Using a Magneto-impedance Sensor, JJ Mag. Dent., Vol.20, No.2, 28-31, 2011

A Case Report of a Removable Denture Using Magnetic Attachments for Mandibular Molar Missing with a decreased occlusal vertical dimension

R. Negoro, M. Sone, F. Okutsu, T. Kusano, T. Matsukawa, Y. Toyota, S. Yorichika, K. Okamoto and S. Ohkawa

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

Introduction

To maintain a harmonious craniofacial system, it is essential to establish an appropriate occlusal vertical dimension (OVD). This case report describes our establishment of an appropriate OVD for a patient (Eichner B3: mandibular molar missing) with a decreased OVD to restore the aesthetics and function by the use of magnetic attachments.

Clinical History

The patient, a 59-year-old female, complained of aesthetic dissatisfaction and masticatory dysfunction. The patient had a partially edentulous maxilla (Eichner B3: mandibular molar missing). All fixed prostheses were failed restorations with a marginal discrepancy and damaged by caries. The patient refused to wear a mandibular removable partial denture because of dissatisfaction with a visible metal clasp on the anterior teeth. She was diagnosed with intraocclusion by analysis of OVD (Fig.1). Finally, we suggested that a mandibular removable overlay denture with coping-type of magnetic attachments and a maxillary removable partial denture with extracoronal-type of magnetic attachments and porcelain fused to metal crowns were fabricated, which the patient found acceptable.

Fig.1 Intraoral view at the initial examination

Treatment Procedure

At first, the prostheses with the marginal discrepancy were removed (Fig.2), and temporary restorations were placed. The #3 and #12 teeth were extracted because of severe caries. After the preprosthetic treatment, the OVD was increased by the use of the treatment denture, and the patient obtained an adequate occlusal relationship (Fig.3).

Fig.2 Intraoral views of removing the prosthesis with the marginal discrepancy

Fig.3 Intraoral views of inserting temporary restorations and treatment denture

As a definitive prostheses, a maxillary removable overlay denture with coping-type of magnetic attachments and a horseshoe plate as the major connector was fabricated (Fig.4), and a mandibular removable partial denture with an extracoronal-type of magnetic attachment was also fabricated (Fig.5). The magnetic attachments in this case report were used by GIGAUSS C400® (GC, Japan). The keepers of the magnetic attachment and magnetic assemblies were fixed with adhesive resin cement (Multilink® Automix, Ivoclar Vivadent, Liechtenstein) (Figs.6 and 7). Fig. 8 is an intraoral view of the definitive prostheses.

Fig.4 Maxillary removable overlay denture

Fig.5 Mandibular removable denture

Fig.6 Keeper of a magnetic attachments

Fig.7 Extracoronal type of magnetic attachments

Fig.8 Intraoral view with definitive prostheses

Conclusions

A magnetic attachment could be provided as a means for alleviating patient concerns regarding aesthetics and functions. It is difficult to maintain an ideal combination of aesthetics and functionality because the design of a final prosthesis is complex. Therefore, continuous follow-up is necessary with occlusal adjustment and relining of the denture base to prevent any reduction of the OVD. In addition, periodontal management and force control of the remaining dentition should be evaluated during the maintenance program.

A case report of a free-end-saddle telescopic denture using a magnetic attachment for maxilla molars

M. Sato[1], M. Hideshima[2], J. Wada[1], T. Ando[1], J. Wadachi[1], M. Tsurumi[1], Y. Tsubota[1], Y. Odaka[1], and Y. Igarashi[1]

[1]Removable Partial Denture Prosthodontic, Graduate School,
[2]Clinic for Conservation of Oral and Maxillofacial Function, University Hospital,
Tokyo Medical and Dental University

Introduction

Partially edentulous patients do not favor wearing removable partial dentures (RPDs) due to their reduced comfortable wear, aesthetics, and function. For the treatment of a unilateral distal extension defect involving more than three molars (Kennedy Class II), it is common to choose a bilateral design of RPDs in consideration of the long-term preservation of the abutment teeth and residual ridge and of the movement of RPDs. However, bilateral design still presents some problems related to patient discomfort. We report a case in which patient satisfaction was improved from the viewpoints of comfortable wear, aesthetics, and function using a unilateral RPD design by applying a Konus telescopic crown and a magnetic attachment.

Case Report

The patient was a 45-year-old male. His chief complaint was malfunction of the maxillary left molar bridge. This bridge had been fabricated a few years earlier, and the patient had begun to feel uncomfortable a few months before the start of this study. As the bridge moved, he was no longer able to masticate on the left side.

Fig.1 Frontal view of remaining dentition at the initial visit

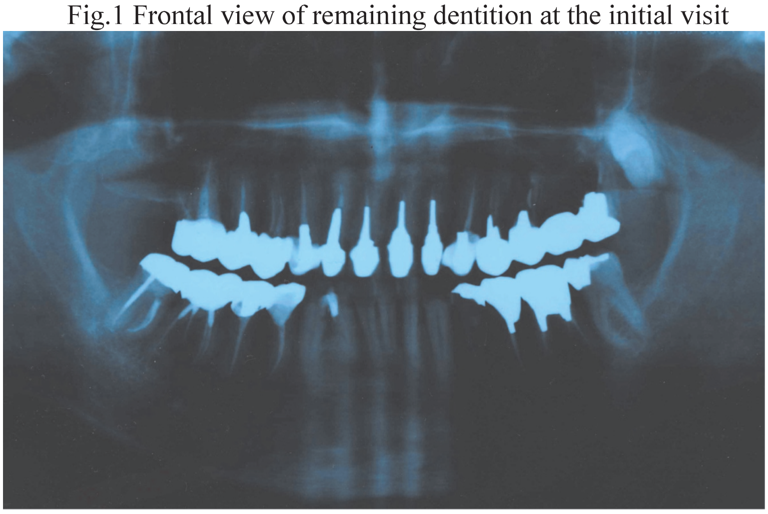


Fig.2 Panoramic radiograph at the initial visit

As shown in Fig.1, the veneering crown of the maxillary left lateral incisor (#22) was fractured. A panoramic radiograph showed a root fracture of the maxilla left second premolar (#25) and second molar (#27), cervical caries of the first premolar (#24), and a poor canal treatment of the canine (#23). The remaining teeth had been affected by mild periodontal disease as a whole.

Treatment Planning and Procedures

After removing the bridge of the left maxillary molars, the immediate resin plate denture (#24~#27) was inserted at the same time as #25 and #27 were extracted (Figs. 3 & 4). The denture was arranged into a bilateral design by setting wire clasps on #13, #16, and #23.

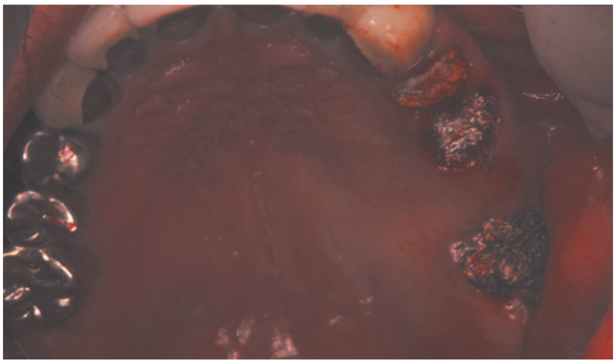


Fig.3 Occlusal view immediately after after extraction of #25 and #27

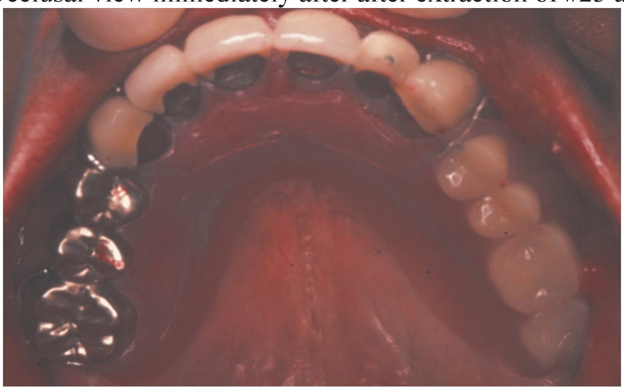


Fig.4 Occlusal view with immediate denture

A final denture was fabricated after root canal treatment of #23 and #24.

For more comfortable wear and better aesthetics, a Konus telescopic denture was selected as the final denture (Figs. 5~7). The design was as follows:

#23, #24, and #25 were selected as the abutment teeth. The Konus telescopic crown was applied to #23 and #24.

The magnetic attachment was applied to #25 because of the poor condition of this tooth.

In this case, due to the reduced inter-maxillary space at the palate side of #24, the telescopic denture was reinforced by applying metal teeth (Fig. 7).

After obtaining retentive force of the telescopic crown following delivery of the denture, the magnetic assembly was embedded in the denture with auto-polymerizing resin. The patient was satisfied from the viewpoints of comfortable wear, aesthetics, and function.

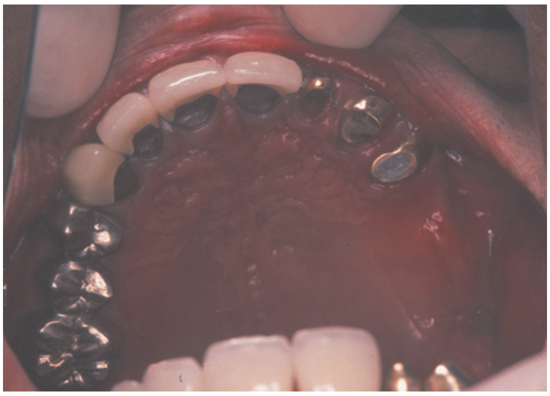


Fig.5 Occlusal view without final denture.

Fig.6 Occlusal view with final denture

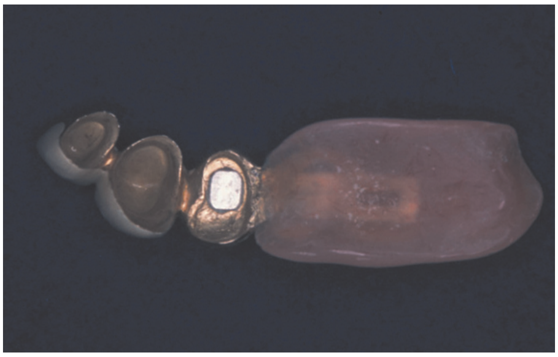


Fig.7 Final Konus telescopic denture with magnetic attachmen

Conclusions

The final denture was arranged into a unilateral design by using a magnetic attachment with a Konus telescopic denture, and the patient was satisfied with the results from the viewpoints of comfortable wear, aesthetics, and function. In addition, somewhat suggestion was provided for the indication of the unilateral denture by the combination of Konus telescope and magnetic attachment.

References

1. Nokubi T., Igarashi Y.: Contemporary removable partial denture, 102-109, Quintessence, Tokyo, 2000. (in Japanese)
2. Mizutani H.: Characteristics and clinical indication of magnetic attachment. J Jpn Prosthodont Soc, 48: 10-19, 2004. (in Japanese)
3. Mizutani H.: Selection of retainer for removable partial denture -Conic telescope or magnetic attachment?-. J Jpn Prosthodont Soc, 48: 138-141, 2004. (in Japanese)

Development of Cement-bonded Keeper Used with Carbon Lead – Part 3: A Trial for a Ready-made Pattern

H. Matsubara[1], H. Mizutani, H. Hideshima[2], T. Ando, K. Nakamura, H. Sasaki, and Y. Igarashi

Removable Partial Denture Prosthodontics, Graduate School, [1]Dental Laboratory, Clinical Facilities Dental Hospital, and [2]Clinic for Conservation of Oral and Maxillofacial Function, Dental Hospital, Tokyo Medical and Dental University

Introduction

Ready-made plastic patterns are usually used to fabricate magnetic attachment keeper housings for cementation. However, the outer diameters of the plastic patterns often limit the shape of the casting patterns of the keeper components[1]. Some problems on castability of plastic patterns were also reported[2,3].

We presented a new method for fabricating a keeper component at the 18th and 19th annual meetings of the Japanese Society of Magnetic Applications in Dentistry. In the first presentation[4], we reported a new method for fabricating keepers with trial graphite patterns made with rod-shaped graphite for writing (Fig.1).

Fig.1 Trial graphite pattern made from carbon rod

Fig.2 a carbon pattern fabricated with the carb on material (#2191)

This method was shown to be useful because of the casting performance, which is attributed to the high thermal stability and mechanical strength of the graphite material and its good compatibility with the investing materials.

In the second presentation[5], we reported on the pattern fabrication using carbon material (#2191) widely used in the industrial field to develop ready-made carbon patterns (Fig.2). However, the thermal stability of the material presented a problem. This time, we are going to present a new trial carbon pattern with improved thermal stability for casting.

Objectives

The purpose of this study was to assess the efficacy of a newly developed carbon material for developing ready-made carbon patterns for fabricating keeper housings.

Materials and Methods

1. Materials

A newly developed carbon material (Aichi Steel Co., Japan) was used in this experiment. This material has higher heat resistance property than the carbon material #2191 (Aichi Steel Co., Japan) used in the previous study. Carbon patterns for fabricating keeper housings were made with this material.

A keeper without a holder (PHYSIO MAGNET; Aichi Steel Co., Japan) was used in this study. Carbon patterns were fabricated in order to confirm the position of the carbon pattern in the investing material.

2. Experiment 1

The six carbon parts of the casting patterns were fabricated with newly developed carbon material. They were heated and stored under six heat conditions (450℃, 500℃, 550℃, 600℃, 650℃, 700℃, 30 minutes) in the furnace, respectively. After heating and storing the diameters of carbon patterns were measured to assess the thermostabilities of the pattern sizes (Fig 3). In addition, changes of their surface textures were observed visually (Figs. 4 and 5).

Fig.3 Measurement of the diameter (650℃, 30 minutes)

Fig.4 State after heating (450℃, 30 minutes)

Fig.5 State after heating (650℃, 30 minutes)

3. Experiment 2

On the basis of Experiment 1, the casting patterns of keeper components in which the carbon parts were incorporated were fabricated by the usual method under two conditions (stored 690℃ furnace for 30 minutes, stored 700℃ furnace for 20 minutes). After casting, the diameter of the keeper space was measured and evaluated (Figs 6 and 7).

Fig.6 As-cast after heating and storing (700℃, 20 minutes)

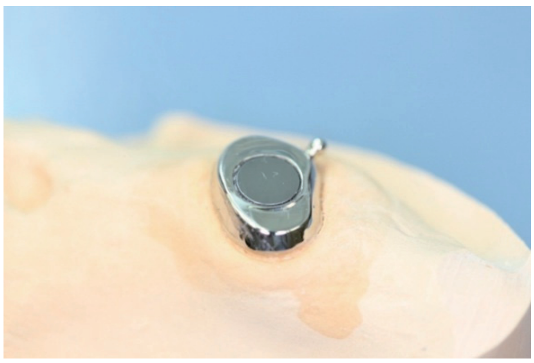


Fig.7 A keeper cemented to the root cap

Results and Discussion

There is little difference in the diameter of the keeper space among the samples derived from furnace heating conditions of 450℃ to 650℃, although the surface textures of the carbon patterns showed little change.

It is concluded that the new carbon material showed great improvement in terms of thermal stability for fabricating keeper components. However, considering the accuracy of casting or fitness, further improvement of heat resistance of the materials will be needed.

References

1. M. Hasegawa, S. Endo, K. Miyata, et al: New technique for making root copings for magnetic attachment using a keeper spacer made with refractory investment, J J Mag Dent, 19(1), 69-73, 2010.
2. T. Kogiso ,Y. Nakamura, Y. Ohno, et al: The influence of keeper-tray materials on their casting precision , J J Mag Dent, 19(1), 61-68, 2010.
3. T. Kogiso , Nakamura, R. Kanbara, et al: The effect of different keeper-tray materials burn-out incineration on casting investment during burn-out procedures, J J Mag Dent, 20(1), 61-67, 2011.
4. H. Matsubara, H, Mizutani, H. Hideshima et al: Development of cement-bonded keeper used with carbon lead – Part 1, J J Mag Dent, 18(1), 85, 2009.
5. H. Matsubara, H, Mizutani, H. Hideshima et al: Development of cement-bonded keeper used with carbon lead – Part 2: A Trial for a ready-made pattern, J J Mag Dent, 19(1), 89-90, 2010.

25 mm

25 mm 25 mm

How to Write the proceedings
TiTle including No. : Times New Roman 14pt Bold

0.5 line

Name (Initial. Family name) : Times New Roman 11 pt, (indent of a 0.5 line above and under this line)
ex. Y. Takada, N. Takahashi[1] and O. Okuno[2]

0.5 line

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

0.5pt line (Black)

One line

Manuscript Basics

0.5 line

The proceedings book will be printed directly from the manuscript provided by the author. The conference secretariat staff does not edit or proofread manuscripts, so all material should be concise and error free. The entire paper must be legible.

The components of a paper are (in order of appearance)

Introduction
Objective
Materials and Methods
Results or (Results and discussion)
Discussion
Conclusion
Acknowledgements
References

One line

Manuscripts Should

0.5 line

- be in a one-column format
- be 10.5 point type (fonts such as Times New Roman (for body text) and Arial(for Headlines) are easy to read)
- be single-spaced
- be justified within the column
- be written by the standard format of MS Word 2003 (number of characters and lines in a page)

Authors should use the page size of A4 format (210 mm × 297 mm). Four spaces (half size English character) should be inserted in the head of first line between paragraphs.

Main Headings

- bold 12 pt. Type
- 12 pts. (1 line space) before and 6 pts. (0.5 line space) after
- upper- and lower-case
- NO underline (underscore)
- NO italic
- one line of space above and below, except when the heading is at the top of a column
- left justified

Subheadings

- be bold 10.5 pt. type (font: Arial)
- upper and lowercase
- NO underline (underscore)
- NO italic
- indented and on-line with the rest of the paragraph (no extra space above and below)

25 mm

Secondary Subheadings

- italic 10.5 pt. type (font: Arial)
- upper and lowercase
- NO underline (underscore)
- NO bold
- indented and on-line with the rest of the paragraph (no extra space above and below)

Margins

- Top 25 mm
- Bottom 25 mm
- Left and right 25 mm

Figures and Tables

All figures and tables should be imported directly into the document and will be printed along with the text. Figures and tables will NOT be reduced or enlarged by the conference secretariat staff. All figures and tables will be printed in black and white, so do not refer to colors within text to describe graph lines or particular areas of photos.

However, if you will demand the PDF file of your manuscript, you may use colors because the PDF file refer to colors. Note, however, that you should use colors which can be distinguished even when they are printed in black and white.

All figures and tables should be numbered consecutively and placed in numerical order within the manuscript. For each figure, a caption should be placed directly below the figure, and should include the figure number and caption text.

References

Literature references should be listed at the end of the paper in the same order that they appear in the text, and in accordance with the following examples.

1. Journal article (example): Y. Takada, N. Takahashi and O. Okuno: Electrochemical behavior and released ions of the stainless steels used for dental magnetic attachments, J J Mag Dent, 16(2), 49-52, 2007.
2. Book (example): R. Kunin, On Exchanging Resins, pp 88, Robert E. Kreiger Publishing Company, New York, 1972.