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原著

Analysis of Occlusal Contacts on Dental Casts in the Intercuspal Position -Comparison between Dual-arch and Conventional Impressions-

Akiko HAYASHI, Junko TANAKA, Norio MUKAI, Masahiro TANAKA

Abstract : The purpose of this study was to pursue the impression method with favorable occlusal contact reproducibility in the intercuspal position.

Twenty subjects with individual normal occlusion were selected. Impressions of both upper and lower jaws were taken using stock trays and alginate impression material as conventional impression method 1, impression of upper jaw was taken using a custom tray and the silicone impression material and impression of lower jaw using a stock tray and the alginate impression material as conventional impression method 2, and conventional impression method 3 used contrary trays and impression materials of conventional impression method 2. Dental casts were produced with each method and mounted on articulators using the cast method. Dual-arch impression method was taken using a plastic tray and the silicone impression material, and occlusal relationship was reproduced on the articulator. Occlusal records of intraoral and dental casts were prepared using occlusal contact checking material, and add-pictures were produced from these records. We collated the classifications of Nakao occlusal facets with the occlusal surface of upper dentition model, occlusal records and add-pictures, and the occlusal contact regions were identified. The total number of reproducible regions and the numbers of reproducible regions of ABC contacts in the frontal plane, and equalizers and closure stoppers in the sagittal plane were counted from the comparison of the occlusal contact regions of intraoral and casts. For statistical analysis, the Friedman and Wilcoxon signed-rank tests were performed.

The reproducibility of the total number of reproducible regions and the numbers of reproducible regions of ABC contacts, equalizers and closure stoppers were significantly higher in the dual-arch impression method than in the 3 types of conventional method.

The results showed that the reproducibility of occlusal contacts was high in the dental cast fabricated by the dual-arch impression method, and the reproducibility of occlusal contacts on the frontal and sagittal planes was also high.

Key words : ABC contact, equalizer, closure stopper

Introduction

Crown restorations are produced by indirect techniques. In most cases, crown restorations that are tried-in are too high. In these cases, since the occlusal relationship in the working cast is different from that in the mouth, the occlusal adjustment depends on trials in the mouth, and addition of appropriate occlusal contact points to crown restoration is difficult and results in disappearance of the cusps and ridges of the occlusal surface created on the

大阪歯科大学有歯補綴咬合学講座
Department of Fixed Prosthodontics and Occlusion, Osaka Dental University
〒540−0008 大阪市中央区大手前1丁目5番17号
1−5−17, Ohtemae, Chuo-ku, Osaka 540−0008, Japan

working cast. The problem is thought to arise with the conventional impression methods where impressions are taken of the upper and lower dentitions separately. In addition, there is a need for the occlusal registration (Matsushita 1982, Matsushita et al. 1985) .

With the dual-arch impression method, the impression and occlusal registration of the upper and lower dentitions can be obtained simultaneously with the mouth closed. Therefore, there is no distortion in the lower jaw (Matsushita et al. 1985) . As a result, the occlusal relationship in the intercuspal position (ICP) can be more accurately reproduced in the working cast compared to the conventional impression method, and, as a result, impression taking and laboratory work are easier (Terada 1988, Parker et al. 1997, Arai 2000, Kubo et al. 2013, Kubo et al. 2013) . We previously compared dental casts fabricated by the dual-arch and conventional impression methods and investigated the reproducibility of occlusal contacts on the dental casts, and reported that the dual-arch impression method was useful to fabricate dental casts with high reproducibility of occlusal contacts similar to those in the mouth (Hayashi et al. 2013) . However, no study has quantitatively compared the reproducibility of occlusal contacts in the ICP, in which the occlusal contacts are functionally stabilized, on dental casts fabricated by the dual-arch impression method.

With the aim of pursuing the impression method with favorable reproducibility of occlusal contacts in the ICP, we compared the occlusal records taken from dental casts fabricated by the conventional and dual-arch impression methods with those taken from the mouth, and investigated occlusal contacts in the frontal and sagittal planes among the impression methods.

Materials and Methods

1. Subejects and teeth

We selected 20 subjects with complete dentition (13 males and 7 females) with a mean age of 25.0 ± 2.5 years who had no cuspid covering crown restoration, no experience of orthodontic treatment and no clinical abnormalities in stomatognathic function. Subjects who matched the following conditions were selected: Occlusal contacts were observed in all bilateral molars in occlusal contact images fabricated from add-picture method taken during weak and strong clenching, and the contact positions were the same even when the clenching force is changed.

The subject teeth were 8 teeth from the upper bilateral first premolars to the second molars.

This study was approved by the Osaka Dental University Ethics Committee (approval No. 100713) . Subjects understood the purpose of the study and gave consent to participate.

2. Fabrication of the dental casts

The protocol of the experimental method is shown in **Fig.1**. Four impression methods were performed: 3 conventional impression methods taking impressions of the upper and lower dentitions separately and a dual-arch impression

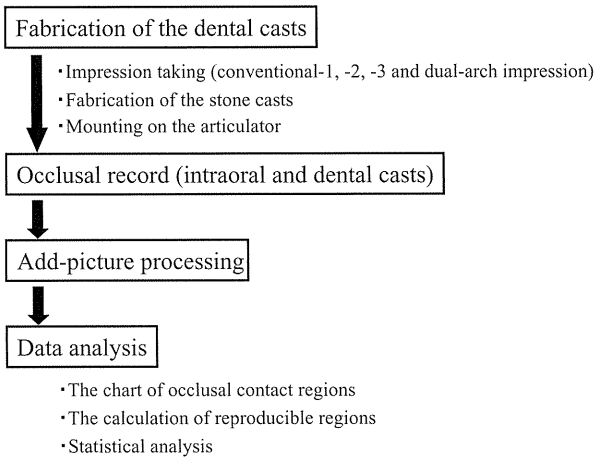

Fig. 1 The protocol of the experimental method

method. Five dental casts were fabricated from the impressions in each subject: one cast each from the impressions taken by the 3 conventional methods and bilateral impressions taken by the dual-arch impression method.

1) Conventional impression method 1

(1) Impression taking

Impressions were taken using a full-arch stock metal tray (Net Premium Tray, YDM Co., Japan) and alginate impression material (Aroma Fine Plus Normal Set, GC Co., Japan) for both upper and lower dentitions.

(2) Fabrication of the stone casts

Immediately after taking an impression from the mouth, a type Ⅲ dental stone (New Plastone II, GC Co., Japan) was flowed into the impression. The impression was stored in a container with 100% humidity during setting of the stone, and the dental cast was removed from the impression after 60 minutes. The prepared dental cast was trimmed to make the basal surface and occlusal plane generally parallel.

(3) Mounting on the articulator

The dental cast was mounted to an average value articulator (Articulator Handy, Shofu Inc., Japan) using the type Ⅲ dental stone. The upper dental cast was attached to the upper bow of the articulator using an occlusal plane table. After setting the stone, the lower dental cast was fit in the most stable position and fixed at 4 lateral sites of the cast with sticky wax (Model Cement, Dentsply-Sankin Co., Japan) to mount it on the lower bow of the articulator.

2) Conventional impression method 2

(1) Impression taking

For the upper dentition, a full-arch custom tray and a hydrophilic vinyl polysiloxane impression material (Examixfine regular type, GC Co., Japan) were used.

The full-arch custom tray was fabricated with an autopolymerizing resin (Tray Resin II, Shofu Inc., Japan) using a study cast prepared beforehand, and spacer for 2 sheets of 1.45-mm plate wax (Paraffin wax, GC Co., Japan) was set on the dentition, and the margin was set up to the tooth neck. The stoppers were set on the inner surface of the tray at 4 sites: the bilateral canine cuspids and bilateral nonfunctional cusps of the first molars. The custom tray was tried in the mouth, and an impression was taken by the tray, after a tray adhesive (Adhesive, GC Co., Japan) was applied to the tray and sufficiently dried.

For the lower dentition, a full-arch stock metal tray and the alginate impression material were used.

(2) Fabrication of the stone casts and mounting on the articulator

In fabrication of the dental cast of the upper dentition, the impression tray was removed from the mouth after setting, and left at room temperature for 60 minutes. Surfactant (Surcast Spray, GC Co., Japan) was applied to the impression, a type Ⅳ dental stone (Moderock II, Shofu Inc., Japan) was flowed into the mold, and the dental cast was removed from the impression after 60 minutes.

The dental cast of the lower dentition was fabricated following conventional impression method 1. The prepared upper and lower dental casts were trimmed to make the basal surface and occlusal plane generally parallel. The dental casts were mounted on the articulator following conventional impression method 1.

3) Conventional impression method 3

(1) Impression taking

For the upper dentition, a full-arch stock metal tray and the alginate impression material were used. For the lower dentition, a full-arch custom tray and the hydropilic vinyl polysiloxane impression material were used.

(2) Fabrication of the stone casts and mounting on the articulator

The dental cast of the upper dentition was fabricated following conventional impression method 1. The dental cast of the lower dentition was fabricated following conventional impression method 2. The dental casts were

mounted on the articulator following conventional impression method 1.

4) Dual-arch impression method

(1) Impression taking

An impression was taken using a dispotable plastic dual-arch tray (Triple Tray®, Premier Dental Co., USA) and the hydrophilic vinyl polysiloxane impression material. After the tray was tried in the mouth, the tray adhesive was applied to the tray and sufficiently dried, and the impression of the upper and lower dentitions from the canine to the second or third molar was taken. The subject was instructed to occlude gently in the ICP. Impression taking was performed once each for the left and right sides. The impression tray was removed from the mouth after setting, and left at room temperature for 60 minutes.

(2) Fabrication of the stone casts and mounting on the articulator

A free joint articulator (V2 Quadrant Articulator®, Monotrac Articulation Inc., USA) was used. In the mounting procedure (Rosenstiel et al. 2006) , excess impression material was trimmed so that the impression was parallel to the occlusal plane. The surfactant was applied to the impression, and the type Ⅳ dental stone was injected into the lower dentition of the impression and base area of the articulator. The impression and articulator were flipped after setting, and the type Ⅳ dental stone was injected on the upper dentition of the impression and base area of the articulator for mounting. The impression was removed from the articulator after setting of the stone.

3. Occlusal contact taking

The occlusal contact checking material (Bite-Checker, GC Co., Japan) was used.

1) Intraoral occlusal record

The head position was set so that the FH plane was parallel to the floor in a sitting position. The subject was instructed to occlude gently in ICP, and the full-arch occlusal record was taken. The occlusal record was removed from the mouth after setting, and excess regions were trimmed using scissors.

2) Occlusal records of the dental casts

For separation between the occlusal contact checking material and the stone, a wax separator (GC-sep, GC Co., Japan) was used. The wax separator was applied to the dentition of the dental cast and sufficiently dried. Occlusal contact checking material was placed on the lower dental cast of the articulator, followed by an immediate matching of the upper dental cast by finger pressure. A load of 1 kg was added on the upper bow of an articulator. The occlusal record was removed from the cast after setting, and the excess region was trimmed using scissors.

4. add-picture process for occlusal record

An add-picture of the occlusal contact area where the distance between the upper and lower teeth of less than 30 μm was produced using the add-picture method from occlusal records obtained from the mouth and dental casts (Tosa et al. 1987) .

5. Chart of occlusal contact regions (Fig.2)

Fossae and grooves were clarified with a pencil on the upper dental casts. Occlusal contact regions were collated with the classifications of Nakao occlusal facets (Nakao 1970) by observing the occlusal surface of the upper dental cast, the occlusal record and the add-picture to prepare charts of occlusal contacts. The measurement sites were 104 occlusal contact regions of the upper bilateral molars.

6. Reproducible region

Reproducible regions were identified based on the occlusal contact charts of the mouth and dental casts. The occlusal contact regions were compared between those in the mouth and dental casts, and consistent regions were regarded as

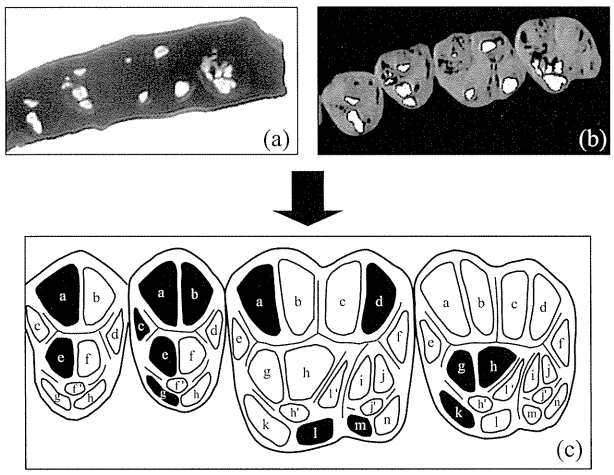

Fig. 2 The chart of occlusal contact regions (modified from Nakao(1970))
a: Occlusal record, b: Add-picture,
c: The chart of occlusal contact

reproducible regions. The number of reproducible regions in the 8 teeth from the bilateral upper first premolars to the second molars were counted in each of the 4 impression methods. For the dual-arch impression method, the number of reproducible regions was determined regarding the right and left upper dental casts as the entire upper dentition.

1) Total number of reproducible regions

The total number of reproducible regions was counted in each of the dental casts fabricated by the dual-arch and the 3 conventional impression methods.

2) Number of reproducible regions in the frontal plane

ABC contacts were selected to investigate reproducible regions in the frontal plane. Occlusal facets corresponding to the internal facets of the upper buccal cusps of the classifications of Nakao occlusal facets (Nakao 1970) were regarded as A contact, those corresponding to the internal facets of the upper lingual cusps were regarded as B contact, and those corresponding to the external facets of the upper lingual cusps were regarded as C contact (**Fig. 3a**). The numbers of reproducible regions of ABC contacts were counted in each of the dental casts fabricated by the dual-arch and the 3 conventional impression methods.

3) Number of reproducible regions in the sagittal plane

Equalizers and closure stoppers were selected to investigate reproducible regions in the sagittal plane. Occlusal facets corresponding to the upper mesial and distal slopes of the classifications of Nakao occlusal facets (Nakao 1970) were regarded as equalizers and closure stoppers, respectively (**Fig. 3b**). The numbers of reproducible regions of equalizers and closure stoppers were counted in each of the dental casts fabricated by the dual-arch and the 3 conventional impression methods.

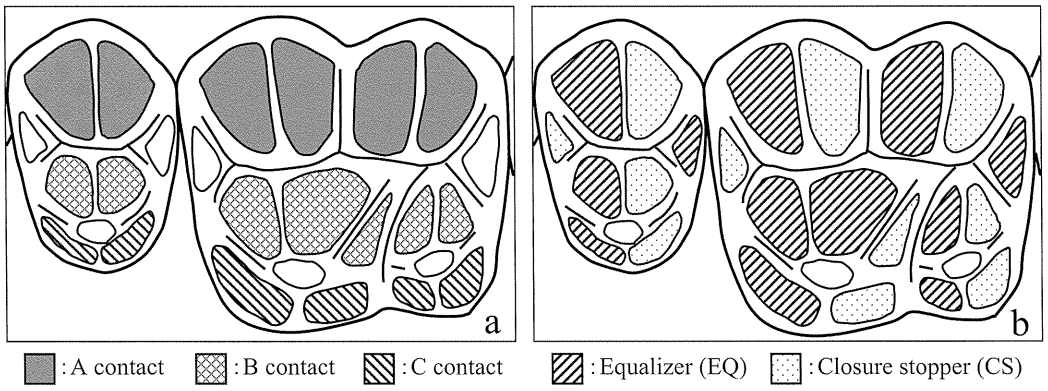

Fig. 3 Each reproducible region on the classifications of Nakao occlusal facets
a: Frontal plane, b: Sagittal plane

7. Examination items

1) Comparison of the number of reproducible regions among the impression methods

The total number of reproducible regions and the numbers of reproducible regions of A, B, and C contacts, equalizers and closure stoppers were compared among the impression methods. Statistical analysis employed the Friedman and Wilcoxon signed-rank tests. The level of significance was set at 5%.

2) Comparison of the number of intraoral occlusal contact regions and the number of reproducible regions obtained by each impression method

The total number of reproducible regions and the numbers of reproducible regions of A, B, and C contacts, equalizers and closure stoppers were compared with the numbers of the intraoral occlusal contact regions .

Results

1. Total number of reproducible regions

1) Comparison of the number of reproducible regions among the impression methods

The total numbers of reproducible regions obtained by the impression methods are shown in **Figure 4**. The median numbers of reproducible

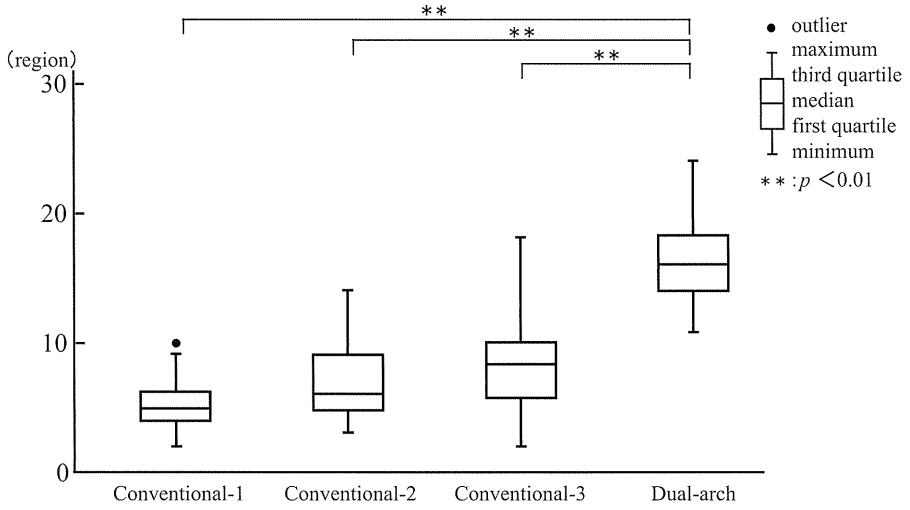

Fig. 4 The total number of reproducible regions in each impression method

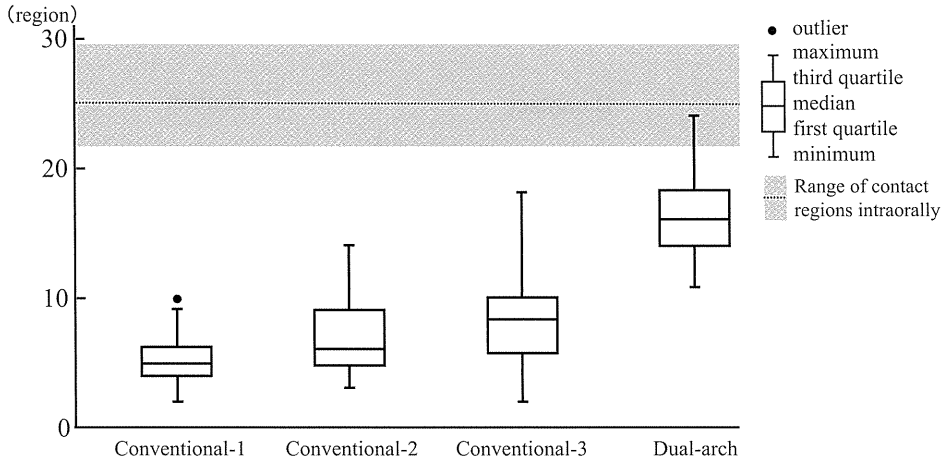

Fig. 5 Number of intraoral occlusal contact regions and total number of reproducible regions in each impression method

regions in the conventional impression method 1, 2, 3 and the dual-arch impression method were 5, 6, 8.5, and 16. Statistical analysis revealed significant differences between the dual-arch impression method and conventional impression method 1, 2, and 3.

2) Comparison of the number of intraoral occlusal contact regions and the number of reproducible regions obtained by each impression method

The number of intraoral occlusal contact regions and total numbers of reproducible regions obtained by the impression methods are shown in **Figure 5**. The ranges of the number of intraoral occlusal contact regions are presented as the first quartile, median and third quartile. The median number of reproducible regions in the dual-arch impression method was 16, which was the closest to the median number (25.5) of intraoral occlusal contact regions.

2. A, B, and C contacts

1) Comparison of the number of reproducible regions among the impression methods

The numbers of reproducible regions of A, B, and C contacts obtained by the impression methods are shown in **Figure 6**. The median numbers of reproducible regions of A contact in the conventional impression method 1, 2, 3 and the dual-arch impression method were 0, 0, 1, and 2.5, those of B contact were 3, 4, 3.5, and 6.5, and those of C contact were 0, 1, 1, and 3, respectively. In the A, B, and C contacts, statistical analysis revealed significant

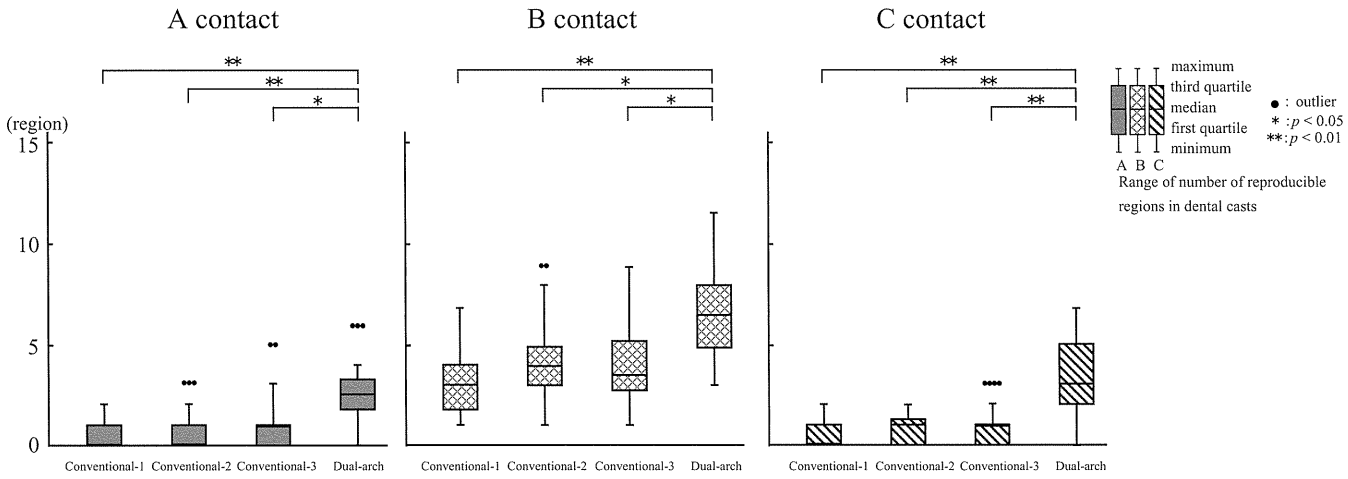

Fig. 6 Numbers of reproducible regions of A, B, C contacts in each impression method

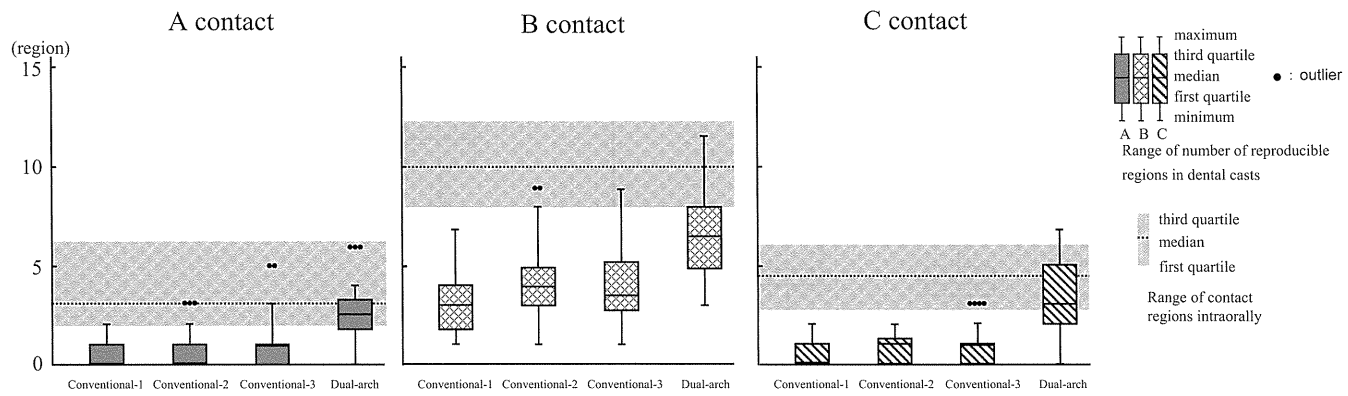

Fig. 7 Number of intraoral occlusal contact regions and reproducible regions of A, B, C contacts in each impression method

differences between the dual-arch impression method and conventional impression method 1, 2, and 3.

2) Comparison of the number of intraoral occlusal contact regions and the number of reproducible regions obtained by each impression method

The numbers of intraoral occlusal contact regions and reproducible regions of A, B, and C contacts obtained by the impression methods are shown in **Figure 7**. The median numbers of intraoral occlusal contact regions of A, B, and C contacts were 3, 10, and 4.5, and the median numbers of reproducible regions in the dual-arch impression method were 2.5, 6.5, and 3, respectively. The median numbers obtained by the dual-arch impression method were the closest to the median numbers of intraoral occlusal contacts.

3. Equalizer and closure stopper

1) Comparison of the number of reproducible regions among the impression methods

The numbers of reproducible regions of

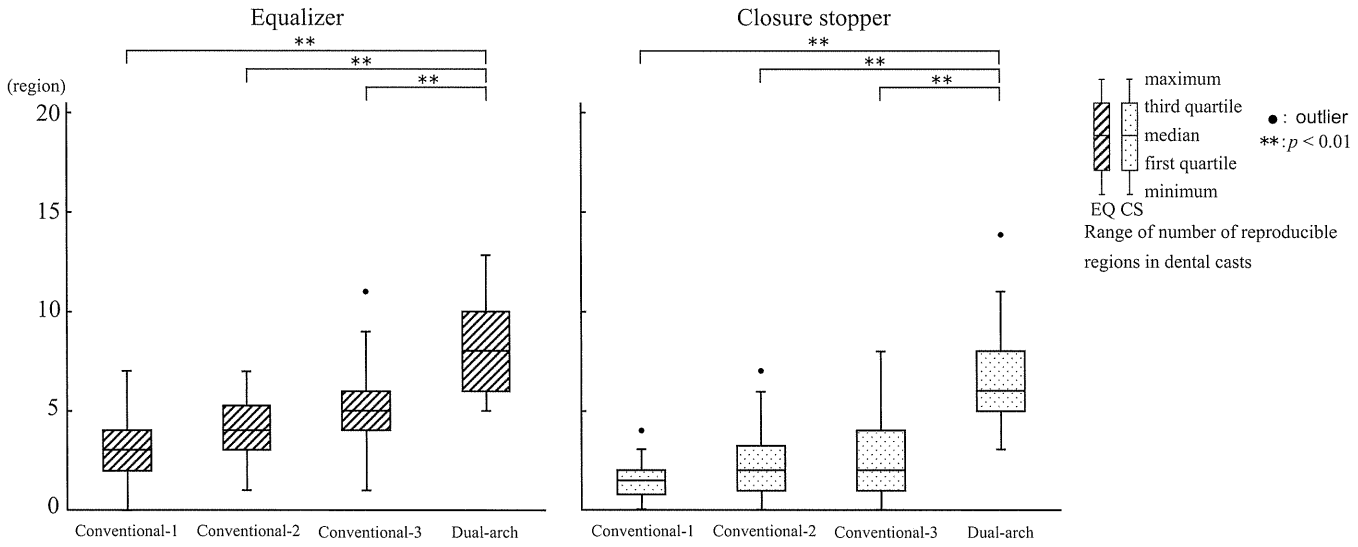

Fig. 8 Numbers of reproducible regions of equalizers and closure stoppers in each impression method

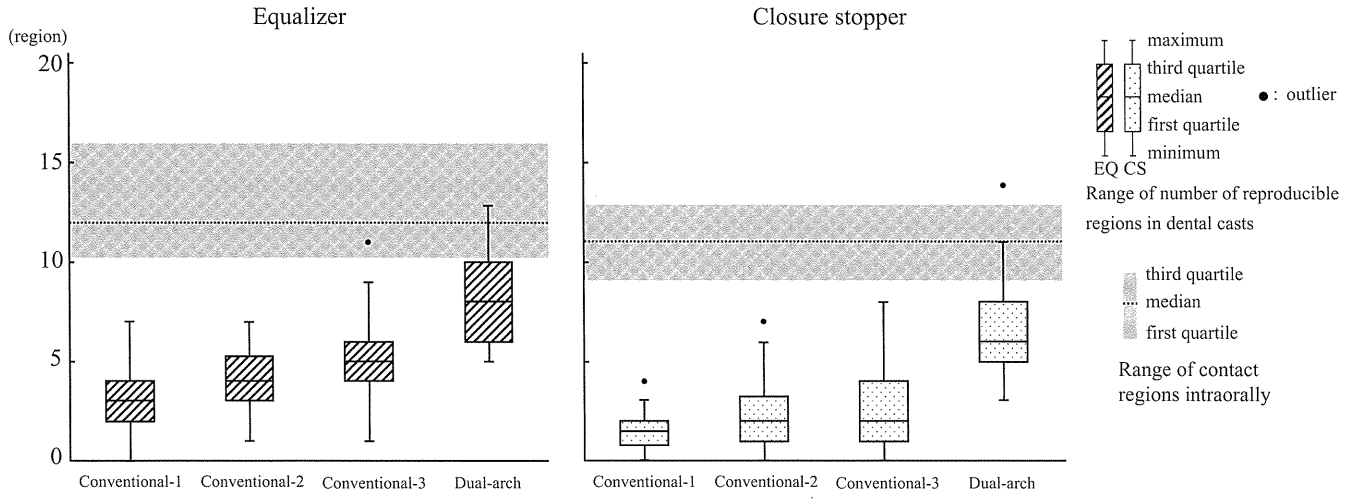

Fig. 9 Number of intraoral occlusal contact regions and reproducible regions of equalizers and closure stoppers in each impression method

equalizers and closure stoppers obtained by the impression methods are shown in **Figure 8**. The median numbers of reproducible regions of equalizers in the conventional impression method 1, 2, 3 and the dual-arch impression method were 3, 4, 5, and 8, and those of closure stoppers were 1.5, 2, 2, and 6, respectively. In the equalizers and closure stoppers, statistical analysis revealed significant differences between the dual-arch impression method and conventional impression method 1, 2, and 3.

2) Comparison of the number of intraoral occlusal contact regions and the number of reproducible regions obtained by each impression method

The numbers of intraoral occlusal contact regions and reproducible regions of equalizers and closure stoppers obtained by the impression methods are shown in **Figure 9**. The median numbers of intraoral occlusal contact regions of equalizers and closure stoppers were 12 and 11,and the median of numbers of reproducible regions in the dual-arch impression method were 8 and 6, respectively. The median numbers obtained by the dual-arch impression method were the closest to the median numbers of intraoral occlusal contacts.

Discussion

1. Subjects

Since the classification of occlusal facets and the accurate presentation of tooth contact regions were aims in this study, subjects at an age with minimum attrition were selected. Obana (1957) regarded wear facets as occlusal facets of natural teeth because the appearance of mild wear facets of the natural teeth in young subjects was very similar to that of functional cuspal inclined surfaces of artificial teeth. Nakao (1970) observed occlusal facets and partially modified the classification of Obana occlusal facets. The subjects of the studies performed by Obana and Nakao were in their 20s and 30s, having no missing teeth, decayed teeth, restored teeth, crown restoration, excluding of the third molars, or the abnormality of the stomatognathic system. Thus, we selected individuals aged 20 to 30 years without missing teeth or crown restoration covering the cusp, with individual normal occlusion and without subjective or objective abnormality of the stomatognathic system as the subjects.

2. Methods

1) Impression taking

Impressions of the entire dentition were taken with the 3 conventional impression methods, and those of the unilateral dentition were taken with the dual-arch impression method. For fabrication of crown restoration, stability of the occlusal relationship between the upper and lower dentitions is important, for which impression taking of the entire dentition with various impression methods may be necessary. However, the influence of mandibular distortion during mouth opening is greater in taking an impression of the entire dentition than in taking an impression of unilateral dentition (Arai 2000) . In contrast, impression and occlusal registration taking of the upper and lower dentitions can be simultaneously performed using the dual-arch impression method, which more accurately reproduces occlusal contacts in the ICP even though only a unilateral impression can be taken (Terada 1988) .

If the tray interferes with a tooth or a mucosa during impression taking using the dual-arch impression method, an impression different from ICP may result. Kaplowitz (1996) reported that a cast including a canine allows dental technicians to reproduce a patient's dentition more accurately. Mitchell et al. (2009) reported that the dual-arch impression tray in the molar region requires a sufficient length to include a canine. From these two reports, we concluded that confirming the position of the

tray and canine before the impression will help in the accurate positioning of impression taking of the canine and the anteroposterior positioning of a tray, leading to the dual-arch impression method that accurately reproduces ICP. To avoid this, we confirmed that the tray did not touch the tooth or the mucosa before using the dual-arch impression method, and that it included a canine.

2) Impression material

For the conventional impression methods, the alginate and hydrophilic vinyl polysiloxane impression materials were used in combination for the upper and lower dentitions. For the dual-arch impression method, the hydrophilic vinyl polysiloxane impression material was used. Both impression materials are frequently used in daily dental practice. However, application of the hydrophilic vinyl polysiloxane impression material on the both upper and lower dentitions was not used for the conventional impression methods. Arai (2000) reported that dental casts by the conventional impression methods and the dual-arch impression method were fabricated using a hydrophilic vinyl polysiloxane impression material and a type Ⅳ dental stone on the upper and lower dentitions, and occlusal records from these casts were compared with the intraoral occlusal record. Although the method was different from ours in some respects, the entire occlusal contact images and occlusal contact areas of the lower first molar in the cast fabricated by the dual-arch impression method were similar to the intraoral occlusal contact. In addition, the hydrophilic vinyl polysiloxane impression material for both upper and lower entire dentitions is rarely used in daily clinical practice. Thus, we did not use this condition.

3) Mounting on the articulator

To investigate the reproducibility of occlusal contacts, it was necessary to mount the upper and lower dental casts in the most stable position. When an occlusal registration material is between the upper and lower dental casts, the casts are mounted on the articulator in inconsistent states, and the occlusal height is increased by the thickness of the occlusal registration material (Terada 1988). Thus, mounting was performed using the cast method.

When dental casts were mounted on an articulator by ligation with wire, the position of casts in the ICP may be altered. Thus, we did not use this method. Accordingly, no occlusal registration material was placed between the upper and lower casts, and casts was set in the most stable position for mounting on the articulator.

4) Clenching force during intraoral occlusal registration

Tanioka et al. (2011) reported that, in subjects who had no subjective or objective stomatognathic abnormalities, the occlusal contact position was stable even when the clenching force is changed. The clenching force was determined to be 10% and 30%MVC of assuming the maximum voluntary clenching (MVC) of masseter muscle as 100%. In the present study, when the clenching force was changed (subjectively weak and strong clenching) and bilateral molar contacts were observed in occlusal contact images extracted from add-pictures, no difference in the contact position was noted even when the clenching force is changed. Thus, the intraoral occlusal record was obtained under a subjective weak clenching.

5) Clenching force during impression taking of the dual-arch impression method

Arai (2000) reported that impression taking and occlusal registration could be performed with relatively strong clenching because food packaging wrap film was used as the septum between upper and lower occlusal surfaces of the dual-arch impression tray. However, strong clenching would have perforated the septum of the tray in this study because nylon non woven fabric was used. It was also considered difficult

for the subjects to maintain strong clenching until setting the impression and occlusal contact checking materials in intraoral occlusal recording and impression taking by the dual-arch impression method. In addition, in a clinical setting, impression taking using the dual-arch impression method with strong clenching may cause a lower crown restoration than the actual condition in the mouth.

Thus, after confirming that the occlusal relationship had stabilized, impression taking with the dual-arch impression method was performed with subjective weak clenching.

3. Reproducible regions

1) Classification of Nakao occlusal facets and identification of reproducible regions by the add-picture method

The contact relationship of the upper and lower teeth was previously presented with the number of occlusal contact points and the occlusal contact areas. Although the method using the number of occlusal contact points is capable of presenting the occlusal contact by the individual teeth, identification of the contact regions of the teeth is difficult. The method using the occlusal contact areas is incapable of accurately evaluating contacts because the slopes of the contact facets are neglected. To compensate for the disadvantages of the methods based on the number of occlusal contact points and the occlusal contact areas, we employed the occlusal facet classification method reported by Nakao (1970), which qualitatively presents contact regions and slopes.

Methods to investigate occlusal contact included articulating paper, wax, silicone rubber impression material (black silicone) (Nakao 1970, Tosa et al. 1987), and a pressure measurement sheet (Hattori et al. 1994, Tanaka et al. 2005). Among these, the occlusal contact test using silicone rubber impression material is less affected by the surface texture of the tooth, the saliva compared with the use of articulating paper. As a result, there are no unnecessary or unclear markings (Nakao 1970). Also, silicone rubber impression material has little resistance during occlusion, and is suitable for quantitative analysis. Furthermore, using the silicone rubber impression material, occlusal contact can be judged in the closely area where the distance between the upper and lower teeth of less than 30 μm, which is considered to be the acceptable range of occlusal height in the stomatognathic system (Tanaka 1975).

Thus, we used the classification of Nakao occlusal facets and add-picture method to identify reproducible regions.

2) ABC contacts, equalizers and closure stoppers

To maintain stomatognathic system function, the addition of functionally stable occlusal contacts in fabrication of the crown restoration is necessary, for which buccolingual stability in the frontal plane and mesiodistal stability in the sagittal plane are important. These stabilities involve ABC contacts, equalizers and closure stoppers. The closure force acts in the long axial of tooth direction and on the periodontal tissue and have favorable stability in the mandibular position (Stuart 1985, Ishihara 2000). However, the previous study reported that crown restorations have fewer occlusal contacts and the location of occlusal contacts differs compared with those intended or natural teeth after occlusal adjustment (Ishihara et al. 1998). It is necessary to investigate the occlusal contact on the dental cast.

In the present study, to analyze the occlusal contact on the dental casts, ABC contacts were classified as reproducible regions on the frontal plane, and equalizers and closure stoppers were classified as reproducible regions on the sagittal plane.

4. Results

On comparison among conventional impression methods 1, 2, and 3 and the dual-arch impression

method, the total number of reproducible regions and the numbers of reproducible regions of A, B, and C contacts, equalizers and closure stoppers were significantly different between each conventional impression method and the dual-arch impression method. As reasons for the greater number of reproducible regions obtained with the dual-arch impression method, biological factors such as the jawbone and periodontal tissue, and material factors such as the impression and die materials are considered. The biological factors are reduction of the width of the mandibular bone during mouth-opening by the masticatory muscles and muscles around the floor of the mouth (McDowell 1961, Regli 1967) and displacement of the teeth by the impression pressure (Matsushiro 1978). The material factors are related to the precision of impression and die materials. Shinoda (1992) reported that the influence of biological factors on the occlusal height of the crown restration is greater than that of material factors. We considered that differences in the mandibular position had a greater influence on the reproducibility of occlusal contacts in the ICP during impression taking in our method.

Similarly, Arai (2000) reported that the occlusal contact on the casts fabricated by the dual-arch impression method were similar to that in the mouth, compared with that by the conventional impression method. In their study, the number of subjects was only 2, but there may have been no error in the material factors because hydrophilic vinyl polysiloxane impression material and a type Ⅳ dental stone were used, similarly to our study. The error of biological factor, mandibular narrowing during mouth opening, may have been large.

Other than the biological factors, a smaller amount of the impression material was used in the dual-arch impression method, which may have reduced the influence of size change in the dental cast (Matsushita et al. 1985). In addition, the extraoral dental cast fitting is omitted because impression taking and occlusal registration are simultaneously performed, reducing human error produced while mounting on an articulator.

Conclusion

The results were shown that the reproducibility of occlusal contacts was high in the dental cast fabricated by the dual-arch impression method, and the reproducibility of occlusal contacts on the frontal and sagittal planes in the ICP was also high.

Reference

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歯列模型上での咬頭嵌合位における咬合接触の分析
－咬合印象法と通法との比較－

林　亜紀子，田中　順子，向井　憲夫，田中　昌博

抄録：　本研究は，咬頭嵌合位における咬合接触再現性の良好な印象法の探求を目的とした．

被検者は個性正常咬合を有する健常有歯顎者20名とした．通法1として上下顎とも既製トレーとアルジネート印象材，通法2として上顎を個人トレーと付加型シリコーンゴム印象材，下顎を既製トレーとアルジネート印象材，通法3として上顎を既製トレーとアルジネート印象材，下顎を個人トレーと付加型シリコーンゴム印象材の組み合わせで印象採得を行った．得られた印象体から歯列模型を製作し，模型法にて咬合器に装着した．咬合印象法では咬合印象用トレーと付加型シリコーンゴム印象材にて印象採得を行い，咬合器上に再現した．

口腔内および模型上の咬合記録を咬合接触検査材にて採得し，add画像を製作した．上顎歯列模型の咬合面，咬合記録およびadd画像を観察し，中尾の咬合小面の分類に照合して，咬合接触部位を同定した．口腔内と模型上の咬合接触部位の比較から，全再現部位数，前頭面でのA，B，Cコンタクトおよび矢状面でのイコライザー，クロージャーストッパーの各再現部位数をそれぞれ求めた．統計学的解析には，Friedman検定およびWilcoxonの符号付順位検定を行った．

全再現部位数，A，B，Cコンタクトおよびイコライザー，クロージャーストッパーの各再現部位数において，咬合印象法の再現性が3種類の通法より有意に高かった．

咬合印象法によって製作された歯列模型では，咬合接触の再現性が高く，咬頭嵌合位における前頭面，矢状面での咬合接触の再現性も高いことが示された．