Effect of Clinicians’ Experience on Chair Time and the Number of Denture Adjustment Visits Required for Complete Denture Treatment

Suguru Kimoto, DDS, PhD, Katsuhiko Kimoto, DDS, PhD, Kinya Tanaka, DDS, PhD, Ai Takeo, DDS, Kaori Sugimura, DDS, Yasuo Imamichi, DDS, Hideki Asai, DDS, Mitsuto Ito, DDS, Hiromichi Aoki, DDS, Minoru Toyoda, DDS, PhD, and Kihei Kobayashi, DDS, PhD

Department of Gnatho-Oral Prosthetic Rehabilitation, Nihon University School of Dentistry at Matsudo, Matsudo, Japan
Department of Oral & Maxillofacial Rehabilitation, Kanagawa Dental College, Kanagawa, Japan

Clinical significance
This study revealed differences in the ability of dentists with varying levels of experience and indicated that final impression and denture adjustment procedures are difficult clinical steps for junior dentists to master. Educators need to specifically understand which steps in complete denture treatment require the most attention.

Abstract
Purpose: The purpose of this study was to demonstrate how a clinician’s experience might affect the complete denture treatment.

Methods: A randomized controlled parallel clinical trial at two hospitals was conducted from April 2004 to July 2006. Written informed consent was obtained from the study subjects. Permutated-block randomization was performed with a block size of 4, indicating that not only was the clinician’s experience randomized but also the denture base materials used (conventional acrylic resin and resilient liner). The chair time required for each step of complete denture treatment was compared between the junior clinician and senior clinician groups. The clinical protocol was carried out as follows: the preliminary impression, final impression, maxillomandibular registration, trial placement, denture delivery, and the number of visits for denture adjustments. Seventy-four subjects were assigned to this trial.

Results: Significant differences were observed between the junior clinician and senior clinician groups with regard to chair time required for final impressions and the number of visits required for denture adjustments. There were no differences in chair time required for the other treatment steps.

Conclusion: This randomized controlled clinical trial revealed that a clinician’s experience has an obvious influence on the chair time required for a final impression and the number of visits for denture adjustment.

Key words: randomized controlled clinical trial, complete denture, clinical experience, chair time, resilient liner

Introduction
Most dental treatments may be influenced by the experience of clinicians. Therefore, educators are eager to discover an effective teaching method that can enable students to acquire optimal preclinical and clinical experience. Moreover, dental students and inexperienced clinicians make efforts to gain experience, and patients seek experienced clinicians who can provide optimal treatment. McGarry et al. formulated a classification system for edentulism, partial edentulism, and dentate patients based on objective criteria. The classification system was devised to identify patients who would most probably merit treatment by a specialist or a practitioner with additional training and experience in advanced techniques. These protocols acknowledge the existence of clinicians’ experience and its influence on treatment success.

In the field of dental education, active discussions have been held concerning methods to acquire and evaluate clinical experiences in cur-
Clinical Experience for Complete Dentures

ricula. Subsequently, many reports describing the importance of clinical experience have been published.4-9

However, limited clinical research has evaluated the influence of dentists' clinical experiences in actual complete denture treatments. A comparison of the treatments provided by experienced and non-experienced dentists in a randomized controlled clinical trial would reveal the influence of clinicians' experiences on the complete denture treatment without bias. This type of study would be useful for educators involved in teaching complete denture treatment to non-experienced dentists who encounter difficulties in mastering this treatment. Moreover, such a study may provide minute but important evidence concerning the influence of clinical experiences in complete denture treatments.

Methods that appropriately measured dentists' experience level were reported. Evans et al reported a correlation between patient-centered outcome scores and surgical experience in oral surgery.10 However, patient-centered outcome scores are not based solely on the technical quality of the dentures; these scores are also influenced by psychological and emotional factors.11 Furthermore, Kimoto et al were unable to reveal any significant differences in the satisfaction ratings of patients who used conventional dentures and those who used dentures with resilient liners.12 These reports imply that patient-centered outcome scores are not sensitive enough to evaluate outcomes related to the influence of dentists' experiences in complete denture treatment. Van der Wijk et al measured the time taken by each oral surgeon and surgical assistant to surgically place implants.13 Takanashi et al also measured the number of visits and the time taken by an oral surgeon, a surgical assistant, and a prosthodontist to perform denture treatments in order to evaluate the outcomes of implant treatments. Further, they compared the outcomes of the treatments performed by an oral surgeon and a surgical assistant.14,15 Based on these reports, the authors attempted to demonstrate the effect of clinicians' experience in complete denture treatment relative to the chair time required for each of the following steps of the treatment: preliminary impressions, final impressions, maxillomandibular registration, trial placement, denture deliveries, and the number of visits for denture adjustment.

The authors hypothesized that there are differences between experienced clinicians and inexperienced clinicians with regard to the chair time required for each step of the complete denture treatment. The study aimed to show the effect of clinicians' experience on complete denture treatment through the verification of this hypothesis.

Materials and methods

Study population
For this study, which was conducted at the Nihon University School of Dentistry at Matsudo Affiliated Hospital, Matsudo, Japan, and at the affiliated hospital of Kanagawa Dental College in Kanagawa, Japan, we selected patients who expressed a willingness to undergo complete denture treatment again as well as those patients whose old dentures were evaluated as unfit for use and therefore required new dentures from among edentulous patients, including maladaptive complete denture patients. The exclusion criteria were: a) systemic diseases such as diabetic mellitus, ischemic heart disease, ischemic arrhythmia, cerebrovascular disease, cancer or neurological disease and b) a lack of understanding of written or spoken Japanese. The patients participated in this study only after written informed consent was secured. Protocols for this study were reviewed and approved by the Human Ethics Committees at Nihon University School of Dentistry at Matsudo and at Kanagawa Dental College.

Study design
A randomized controlled parallel clinical trial at the two hospitals was conducted from April 2004 to July 2006. The permuted block method of randomization16 with a block size of four consisting of, treatment with a resilient liner denture (RLD) by a senior clinician (SC), treatment with RLD by a junior clinician (JC), treatment with acrylic resin denture (ARD) by a SC and treatment with ARD by a JC, in a combination of treatments and clinicians groups (clinicians = JC and SC; treatments = ARD and RLD) was used. All maxillary dentures were fabricated using only acrylic resin. One block number utilizing the four combinations of treatment and clinician was selected out of twenty-four permutation numbers, \((4 \times 3 \times 2 \times 1 = 24)\), as per the random block table. Blocking was used to ensure a nearly numeric balance for each type of treatment and clinician for any given
time during the study. After block randomization, the number of participants for each type of clinician and material was equalized. One computer-generated random-block table was prepared for Nihon University School of Dentistry at Matsudo Affiliated Hospital and one table for Kanagawa Dental College Affiliated Hospital. The two types of clinicians, SC with over ten years of clinical complete denture treatment experience and JC with a maximum of five years of clinical complete denture treatment experience, performed all treatments at both hospitals. The blinding of intervention was deemed not feasible since it was clear to both the patients and clinicians the types of materials that were being used.

**Treatment protocol**

1) Preliminary impressions

Preliminary impressions were made using stock edentulous trays (DENTCRAFT StO-K TRAY, Yoshida, Tokyo, Japan) and irreversible hydrocolloid impression materials (Algiace Z, DENTSP-LY-Sankin, Tokyo, Japan).

2) Final impressions

Border molding was carried out using custom trays made from a self-curing acrylic resin (OS-TRON II, GC, Tokyo, Japan) and the modeling compound (Peri Compound, GC, Tokyo, Japan), followed by a wash impression with polyether impression material (Impregum, 3M Espe, Germany).

3) Maxillomandibular registration

Jaw relations were recorded using occlusion rims and zinc-oxide occlusal registration paste (Superbite Paste, Harry J. Bosworth, IL).

4) Trial replacement

The wax trial dentures were evaluated relative to trial base stability, vertical dimension, centric and protrusive jaw relationships, tooth selection, the level of the occlusal plane, buccolingual and anteroposterior tooth position, occlusal articulation, pronunciations, and patients’ feeling on dentures et al. according to references.17,18

5) Denture delivery

The denture adjustments for protecting the oral mucosa were performed using pressure-indicating paste (PIP, Mizzy, Inc., Cherry Hill, NJ) and an impression material (Fit Checker, GC, Japan) until the patients were free of tissue irritation and comfortable with their dentures. Then, occlusal equilibration in each patient’s mouth was performed using articulating paper (Articulating paper GC, Japan) until simultaneous contacts of occlusal surfaces on maxillary and mandibular dentures without premature contacts are achieved.

6) Denture adjustments

Follow-up adjustments after denture delivery were scheduled until the patients were free of tissue irritation and comfortable with their dentures. When there was a strong premature contact between the dentures while closing the jaw, remounts were made for occlusal equilibration based on the clinicians’ judgments.

**Laboratory protocol**

ARDs were fabricated using only conventional heat-activated acrylic resin (Physio Resin, Nissin, Kyoto). Conversely, RLDs were fabricated with conventional heat-activated acrylic resin (Physio Resin, Nissin, Kyoto) and 2 mm thick permanent acrylic based denture liner (Physio Soft Rebase, Nissin, Kyoto). The Physio Soft Rebase consisted of a powder polyethylmethacrylate, as well as liquid non-phthalate plasticizer and methacrylate ester derivatives. Shore A hardness was approximately 35. Maxillary complete dentures were fabricated with heat-activated acrylic denture resin (Physio Resin, Nissin, Kyoto). As per the manufacturer’s instructions, conventional dough-stage heat activated acrylic denture base resin was packed against the master cast and covered with a 2mm spacer. After removing the spacer, the resilient lining material in the dough-stage was inserted to replace the spacer. The flask was then packed and processed. The curing cycle for the prostheses was 90 minutes at 70°C, followed by 30 minutes at 100°C.

**Sample size estimation**

To determine the appropriate sample size, the size estimation was calculated by using the general satisfaction rating as the primary outcome for this trial. A between-group difference of 10mm in the 100-mm visual analog scale (VAS) ratings of general satisfaction during the initial adjustment session was sought using a variance of 15.0 mm for RLD and 10.0mm for ARD, based on data obtained from a previous study.12 In order to fulfill the criteria of 80% power with a two-sided alpha level of 5%, and also to factor in potential participant dropouts, a total of 74 subjects were enrolled in this study.

**Base line measurements**

Assessors collected the base line characteristics
of age, gender, type of denture base materials, edentulous period, age of existing denture, number of previous dentures, height of alveolar ridge, and BMI (Table 1). Based on the classification of complete edentulism as specified by the American College of Prosthodontists, the alveolar ridge heights of the mandibles were measured on a radiograph, and the portion of the mandibles with the least vertical height was identified in order to minimize any variations due to measuring using radiographic techniques. The subject’s BMI was calculated using the following formula: Weight (Kg) / Height (m²).

### Main outcome measurements
Each clinician recorded the chair time required for each of the following steps of the treatment appointments: the preliminary impression, final impression, Maxillomandibular registration, trial placement, denture delivery, and denture adjustment. Additionally, the number of visits for denture adjustment was recorded. The time recording was started when a patient sat on a dental chair, and it was stopped when the patient vacated the dental chair.

### Statistical analysis
The comparisons of the means of the subjects’ baseline characteristics between the JC and SC groups were tested by using Student’s t test. The proportion of gender was tested using the \( \chi^2 \) test. The mean of the chair time required for each treatment step, excluding denture delivery and denture adjustment steps, was compared between the JC and SC groups by using Student’s t test. The time required for denture delivery and the numbers of visits for denture adjustment were analyzed using two-way analysis of variance (ANOVA) because the type of denture base material used might have influenced the number of visits for adjustment. A \( P \)-value below 0.05 was considered statistically significant. All tests were two tailed. All statistical analyses were performed using the statistical package Dr. SPSS II for Windows (SPSS, Chicago, IL) on a personal computer.

### Results

#### Subjects
Seventy-four consecutively sampled patients (aged 53 to 89 years) were randomized for this trial. The random permuted block within the strata method assigned equal numbers of subjects to the ARD and RLD groups (37 each) and approximately equal numbers of subjects to the JC and SC groups (39 and 35 respectively). Significant differences were not observed between the JC and SC groups with regard to gender proportion (\( P>0.05, \chi^2 \) test). Table 1 shows the baseline characteristics of the 74 subjects. No significant differences were observed in any of the baseline characteristics between the ARD and RLD groups (\( P>0.05, \text{Student’s } t \) test and \( \chi^2 \) test). Figure 1 shows the participant flow. Of the 74 allocated subjects, 69 completed the treatment while 5 did not.
Chair time required for each step of the treatment

Table 2 shows the mean and standard deviation values of the chair time required for each step of the treatment. Student’s t test revealed a significant difference between JC and SC groups with regard to only the final impression step (P<0.05). The types of denture materials did not affect on the denture delivery step.

Number of visits for denture adjustment

Two-way ANOVA revealed a difference in the number of visits for denture adjustment between the JC and SC groups as well as between the ARD and RLD groups (P<0.001).

However, the interaction between the type of denture and clinician was not observed.

Discussion

This randomized controlled clinical trial revealed that JCs required much more time in obtaining the final impressions of complete dentures and the number of visits for complete denture adjustments than SCs.

The final impression in this trial was made by border-molded custom impression tray and wash impression with polyether. There was no significant difference in the preliminary impression step between the JC and SC group. Given that the wash and preliminary impressions differ only in terms of the impression materials used, JCs might have no difficulty in obtaining a wash impression after the border molding procedure had been performed. JCs occasionally scheduled two appointments to complete the final impression step because it could not be completed in a single sitting. In general, mastering the border molding procedure is difficult for inexperienced clinicians despite the fact that most clinicians have been trained in this procedure during their undergraduate days. Furthermore, there is a study that surprisingly reports that many clinicians do not employ a few of the procedures taught as part of the complete denture curriculum and take a final impression by using techniques that they consider simpler in their private practices due to the difficulty of border molding. The difference in the time required for a final impression must be attributed to the border molding.

What makes a border molding difficult? The time difference between JCs and SCs with regard to performing the final impression procedure was 50 minutes. Given the time required for wash impression was not different between JCs and SCs, 50 minutes must have been the difference in border molding between JCs and SCs. The time required for only adjusting during custom trays and modeling the compound around custom trays without trial and error might not contribute to this time difference to a great extent. However, lack of clinical knowledge regarding the adjustment of custom trays, handling of the modeling compound, and examination of the patient’s oral anatomy may pose difficulties for the JCs. Consequently, they might be unable to complete the border molding procedure in a short time.

The number of visits for denture adjustment in the JC group was greater than that in the SC group. Denture adjustments are influenced by several factors such as residual ridge resorption, oral mucosa, and the patient’s adaptability to dentures. However, these factors were not measured. Considering that the baseline characteristic was randomized well, those factors that were not measured might be controlled by randomization, which implies that these factors were possibly less likely to strongly skew outcomes in the JC and SC groups as compared
to a non-randomized trial. Therefore, the difference in the number of visits must be due to the type of clinician, i.e. JC or SC. Clinicians adjust complete dentures by using comprehensive techniques and by applying their knowledge about oral anatomy, physiology, occlusion, and materials. Langer et al. and Seiffert et al. suggested that patients’ personalities and their relationship with clinicians play crucial roles in the overall successful adaptation to complete dentures. They also reported that clinicians’ skill in fabricating complete dentures is important to successful adaptation to complete dentures. These reports imply that besides technical experience, the bedside manner of the clinician may also influence the denture adjustments. The reason for the difference in the number of follow-up visits for denture adjustment after denture delivery between the JC and SC groups is probably because it takes considerable experience to master this complex technique.

The difference in the number of visits for denture adjustment between the JCs and SCs in the ARD group was 3.3, while that in the RLD group was 1.4. Plotnick reported that the use of resilient liners could reduce the transmitted forces from 20% to 60% and act as a stress breaker. The authors previously reported that application of resilient liners to mandibular complete dentures provided edentulous patients with fewer problems on the oral mucosa during the first adjustment session following the denture delivery when compared to conventional denture treatments. The authors believe that the stress-breaking function of the resilient liner has the potential to bridge the gaps in the experience level between JCs and SCs. It implies that the RLD guarantee less adjustment of dentures without the clinician being experienced in its use. However, it also implies that clinicians should specifically concentrate on the application of the resilient denture liners because they might conceal inadequacies of the denture adjustment.

The time required by the JCs for the trial placement step was likely shorter than that required by the SCs, while the time required by the JCs for the other steps was longer than that required by the SCs. This implies that spending much time, the SCs have a tendency to check the wax dentures more carefully when compared to the JCs. The trial placement step immediately before denture delivery is the final step and is very important to check stability, occlusion and jaw relation, aesthetics, and pronunciation. Although all these factors should be further evaluated during denture delivery as well as during each follow-up adjustment after denture delivery, it is only at the trial placement step where significant changes can be easily accomplished. If clinicians carefully check problems in the waxed dentures during the trial placement step, the dentures will pose lesser troubles subsequently. Owing to their experience SCs may better understand the importance of the trial placement step when compared to the JCs. This step may influence the denture adjustment step for which the number of visits required by the SC group was significantly less than that required by the JC group.

In the current trial, the subjects were randomly divided into the JC and SC groups. In fact, the extent of clinicians’ experience regarding the complete denture treatment may vary widely. However, if the subjects were divided into more than two levels of groups, the sample size for the current randomized controlled trial would markedly increase. Therefore, only two levels of experienced clinicians were recruited to ensure the viability of our approach. This is a limitation of the current study. However, the authors believe that this randomized controlled trial revealed minimum valid evidence regarding the influence of clinical experience in complete denture treatments.

Conclusion

This randomized controlled clinical trial revealed that a clinician’s experience has an obvious influence on the chair time required for a final impression and the number of visits for denture adjustment.

Acknowledgments: The authors would like to thank all the patients who participated in this trial and our colleagues at the Department of Gnatho-Oral Prosthetic Rehabilitation at Nihon University School of Dentistry, Matsudo and at the Department of Oral & Maxillofacial Rehabilitation at Kanagawa Dental College, who assisted in this trial as volunteers. The authors also wish to thank Mr. Munemitsu Hishimoto of Nissin Dental Products Inc. for his contribution of dental materials. This study was supported by a grant from the Japan Society for the Promotion of Science, scientific study subsidies (Grant-in-Aid for Scientific Research (C) (2) assignment number 15592071)
References