Complications and Patient Satisfaction in Fully Edentulous Patients Treated with Digital and Conventional Complete Dentures: A Crossover Clinical Study

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Purpose: To evaluate comfort, satisfaction, chewing ability, and complications with digital complete dentures (DCDs) and conventional complete dentures (CCDs). ***Materials and Methods:*** For 16 edentulous patients, two sets of maxillary and mandibular dentures were fabricated by students in a university dental clinic. The impression for the DCD was done using indirect scanning of the cast. When the patients were pain free, each set of dentures was worn for 4 weeks. The Oral Health Impact Profile (OHIP-14) and the Denture Satisfaction Index (DSI) were used to measure patient satisfaction and chewing ability, respectively. Both questionnaires were administered before fabrication and after wearing each set. Adjustments made during the follow-up period were included. At the end of the study, patients could express which set of dentures they preferred. The 25 dental students involved in fabricating the dentures were questioned in terms of discomfort, preference, and future use for both techniques. ***Results:*** OHIP-14 showed significantly higher scores for DCDs for the domain concerning psychologic discomfort. The DSI showed no significant difference for both sets of dentures. In terms of complications, a significant difference was found for occlusion. DCDs required more occlusal adjustments. A minority of the patients (37.5%) chose DCDs as their favorite set. The students preferred the wax try-in and workflow of the CCDs. ***Conclusions:*** CCDs and DCDs showed differences in patient satisfaction. Chewing ability was comparable for both sets of dentures. More occlusal complications were seen in DCDs. Both students and patients preferred the CCDs. *Int J Prosthodont 2025;38:383–390. doi: 10.11607/ijp.9128*

Although CAD/CAM techniques are well established in many different aspects of dentistry, they are less commonly used for removable prostheses. The combined use of different materials (eg, metal clasps, framework, denture base, and artificial teeth) makes the application of CAD/CAM more difficult, delaying its use for the production of dentures.[1]

The World Health Organization estimates that more than 30% of the population will be over 60 years old in 2050. Despite the fact that edentulousness is decreasing, the overall growth of the population will lead to an increase in demand for removable prostheses.[2] Many patients cannot afford dental implants or have anatomical restrictions or health issues that prevent the placement of implants. For these patients, the removable prostheses is a valuable treatment option to enhance their Oral Health Related Quality of Life (OHRQoL) and Health Related Quality of Life (HRQoL).[3–6]

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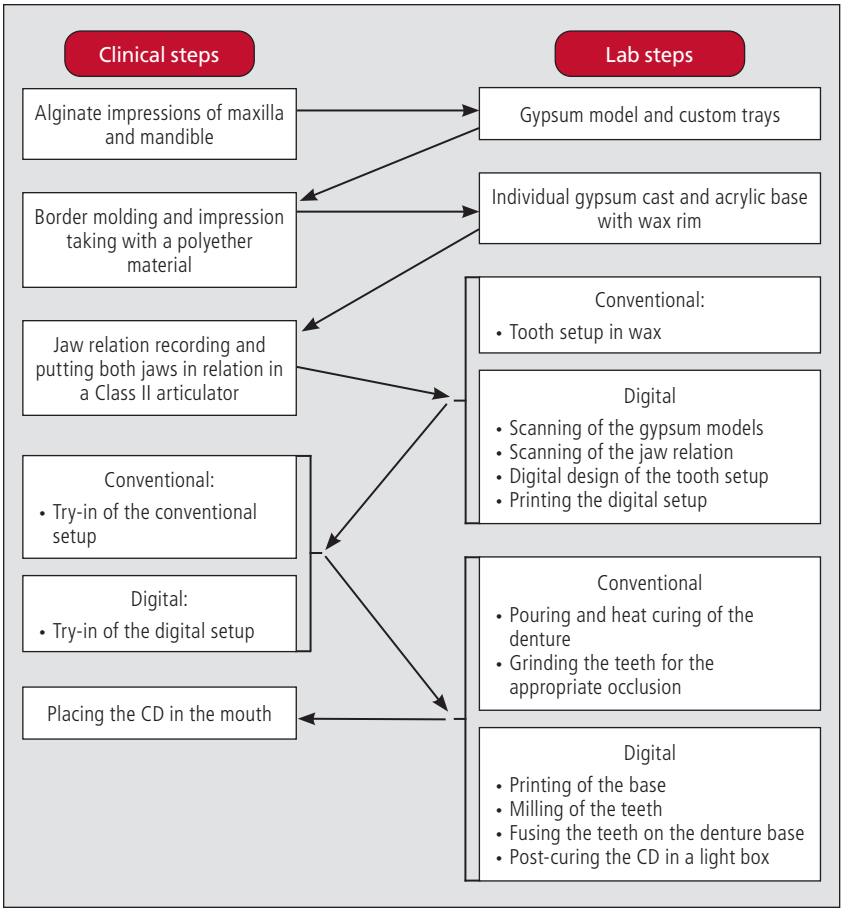

Fig 1 Workflow for the CCDs and DCDs.

Quality of life is an important outcome measure for many dental procedures. Various questionnaires can be used to measure patient satisfaction and comfort. The most widely used questionnaire is the Oral Health Impact Profile (OHIP), developed by Slade and Spencer.[7] Over the years, multiple versions of the OHIP have been developed based on those seven categories.

Furthermore, the Visual Analog Scale (VAS) can be used to determine the ability to chew with complete dentures (CDs), which is also a crucial factor in patient satisfaction. On a VAS for example, the patient can indicate how easily different kinds of food are chewed.

When it comes to the fabrication of removable complete dentures, the biggest drawback is the occurrence of polymerization shrinkage, which may reduce the retention.[5,8–10] Other disadvantages are the treatment time and the extensive manual work by the technician in the lab.[11] Recently, new techniques and materials were developed for the digital fabrication of CD's, based on additive (3D printing) or subtractive (milling) manufacturing procedures.

Even though reliable in vivo studies are scarce, they mostly report subjective rating scales to evaluate parameters such as retention and fit.[1,12]

The aim of this single blind clinical crossover study was to evaluate patient satisfaction and complications when producing a digital complete denture (DCD) compared to a conventional complete denture (CCD). Additionally, the preference of both the patients and clinicians, in this case the dental students, was investigated.

The first null hypothesis is that there would be no difference in patient satisfaction, complications, and chewing ability between CCDs and DCDs. The second null hypothesis is that there would be no difference in preference between CCDs and DCDs for patients and dental students.

MATERIALS AND METHODS

Workflow

Figure 1 depicts the clinical and laboratory workflow for the CCDs and DCDs. The first three clinical steps were identical for both workflows.

During the first visit, patients were informed about the study and signed the informed consent form. They were also requested to fill out two questionnaires: the OHIP-14 to rate their OHRQoL and a Denture Satisfaction Index (DSI) to rate their satisfaction at baseline using a VAS. Alginate impressions (CA37 Normal, Cavex) were made

Fig 2 Digital try-in.

Fig 3 *(a and b)* A CCD and DCD, respectively.

using a stock impression tray for edentulous patients to produce the custom trays. The lab poured the impressions into gypsum casts (SheraPure, Shera), which were then scanned, and custom trays were designed and 3D printed by the lab (zDental tray, Uniz, Asiga UV MAX).

During the second clinical session, the borders of the custom tray were checked and adjusted when necessary. Border molding was performed using ISO Functional compound (Kerr Dental) prior to taking an impression with a polyether material (Permadyne, 3M ESPE).

In the dental lab, the impressions were poured in gypsum (SheraAqua, Shera), and 3D-printed acrylic bases (zDental tray, Uniz, Asiga UV MAX) with wax rims (SLX Wax bite rims, Henry Schein) were fabricated and send to the clinic.

In the third clinical session, the jaw relation was recorded. The maxillary wax rim was adjusted for interpupillary line, Camper plane, midline, smile line, buccal corridor, and lip support. The jaw relation was recorded with gothic arch tracing. The posterior palatal seal position was carved in the maxillary master cast. The dental lab was instructed to create two different teeth setups: one conventional wax setup and one digitally designed and 3D-printed setup.

In the lab, the models were digitalized for the DCDs. A digital setup of the teeth was made in Exocad. At time of the study, no custom teeth were available in the database to create a lingualized occlusion, thus all teeth had to be manually adjusted and put in this balanced occlusion. After the set-up, the digital try-in was printed in white acryl (DentaTRY, Asiga).

For CCDs, the technician followed the conventional wax try-in setup, using Entacryl teeth in lingualized occlusion (Enta).

During the fourth clinical session, both the conventional and digital try-in were tested and evaluated (Fig 2). Corrections or adjustments of the conventional try-in were made manually (eg, by moving teeth). The digital try-in was trimmed or adjustments were marked. When esthetics and function were approved, the final dentures were fabricated. CCDs were fabricated using heat polymerizing PMMA resin Entacryl (Enta), trimmed, and polished by the dental technician. The technical lab transferred the adjustments made on the try-in to the digital system. The DCD bases were printed (Lucitone, Dentsply Sirona) using the ASIGA UV max with 100 µm layer thickness and 80 degree print angle (as instructed by the manufacturer), while the teeth were milled in PMMA (Cercon Multilayer PMMA, Dentsply Sirona), luted to the base, and placed in a curing oven.

During the last visit, the first CD (CCD) was placed in the mouth, and minor adjustments were made to optimize the fit, occlusion, and articulation (Fig 3). The patients received a check-up appointment to detect and resolve possible discomfort. After wearing the dentures for at least 4 weeks without any discomfort, the questionnaires were filled in again. During this appointment, the dentures were switched to the digital dentures. Again the necessary adjustments were made to ensure fit, occlusion, and articulation, followed by a check-up appointment and a trial period of at least 4 weeks without any discomfort. Thereafter, patients filled out the questionnaires and indicated their preferred set of dentures. Finally, the patients went home with both sets of dentures.

No randomization was possible due to practical circumstances, and therefore all patients started with the

Table 1 Survey Questions for Dental Students

	Very often	Fairly often	Occa-sionally	Almost never	Never
Did you feel uncomfortable during the fabrication of the digital denture?					
Did you feel uncomfortable during the fabrication of the conventional denture?					
Did you have difficulties during the digital try-in?					
Did you have difficulties during the conventional try-in?					
Would you use the digital technique in your own practice?					
Would you use the conventional technique in your own practice?					
	Yes	No			
Did you find the fabrication of the digital denture easier than the conventional denture?					

Survey questions have been translated into English.

CCD. During the study phase, each patient had only one set of CDs in their possession. They were not informed about the type of denture they were wearing.

The outcome variables were patient satisfaction and chewing ability, measured with OHIP-14 and DSI, respectively. The Dutch OHIP-14 questionnaire is a shortened version of the original OHIP.[7] The OHIP-14 contains 14 questions. The patients had to answer each question with one out of four answers. Each answer represented a score, where a score of 4 meant "very often" and a score of 0 meant "never." Chewing ability was rated using a DSI. The patients had to indicate with a cross on a line how difficult different kinds of food were to chew. A low score indicated that it was easy, a high score indicated that it was hard. Foods with different textures were queried: white bread, hard cheese, dried sausage, apples, and carrots. As for the complications, retention was measured using patient reported outcomes, by which patients compared both types of dentures. The number of follow-up appointments was also recorded.

The 25 students participating in this study completed a short Dutch survey to assess their preference, perception, and future perspective concerning both techniques (Table 1). None of the dental students had experience as a dental technician.

Statistical Analysis

All tests were performed using SPSS version 28 (IBM), with the level of significance set at $P < .05$. Shapiro Wilk test was performed to check for normal distribution.

Both groups were paired, because all measurements were done on the same patient at the same time. Because none of the variables had a normal distribution, Wilcoxon matched-pairs test or Friedman test was used. When only dichotomic variables were tested, chi-square goodness-of-fit test was used.

The sample size was based on a similar publication by Ohara et al,[1] in which 15 patients generated significant differences showing an adequate power. When considering a change of 0.75 in the OHIP score as clinically relevant, 16 participants are required to achieve 80% power.

RESULTS

Population

From 2022 to 2023, 23 patients were eligible for new complete dentures. Of those 23 patients, 4 were excluded and 3 had incomplete data after treatment (Fig 4).

Eventually 16 patients (10 women and 6 men) between 23 and 77 years (mean: 58.8, SD: 16.3) received treatment with two sets of complete dentures and were included in the study. (Ethical committee UZ Ghent registration no. B6802023000135, September 8, 2022).

Because the setup was at a university hospital, dental students participated in this study. A total of 25 master students contributed to the fabrication process of both the CCDs and DCDs, but 3 students were excluded in the final analysis, due to not filling in the questionnaire correctly.

Difference in Outcomes Between CCDs and DCDs

Concerning six domains of the OHIP-14 questionnaire, the rating was not statistically significantly different between both dentures. However, one domain showed a statistically significant difference: psychologic discomfort. This resulted in a significantly higher rating in favor of the CCDs ($P = .041$). The domain physiologic disability had a trend toward better results with the CCDs ($P = .062$).

The DSI did not demonstrate a significant difference between both dentures when it comes to the ability to chew different kinds of food.

Complications

The complications could be categorized into three groups: problems with the occlusion, pressure points,

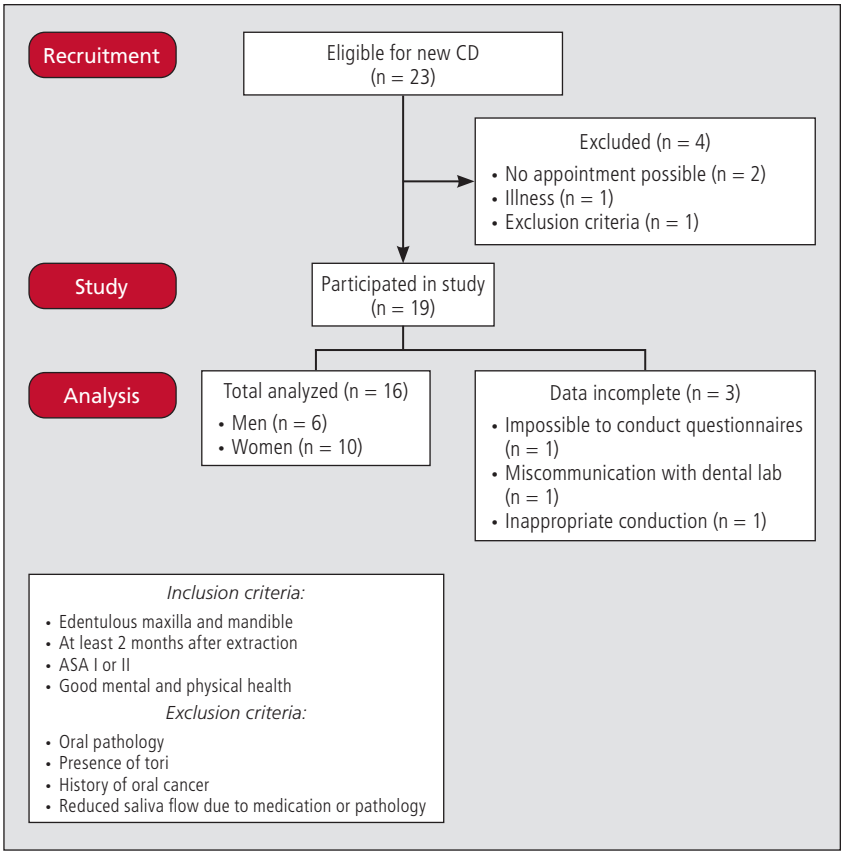

Fig 4 Recruitment of the patients.

and lack of retention. Also, the number of follow-up appointments was recorded, indicating the need for intervention due to discomfort (Fig 5). A total of 25 pressure points required adjustment for the CCDs, of which 22 were located in the mandible and 3 in the maxilla. For the DCDs, a total of 33 pressure points were recorded, of which 29 were located in the mandible and 4 in the maxilla. This difference was not statistically significant, yet there was a trend toward less pressure points with the conventional denture ($P = .074$).

A maximum of three follow up appointments were necessary to eliminate all discomfort for the patients, resulting in a mean of 1.38 appointments for the CCDs and 0.94 for the DCDs, which was not significantly different ($P = .142$). As for retention, no statistically significant difference was found between both types of dentures ($P = .317$).

The only statistically significant difference in terms of complications was the occlusion ($P = .017$). Only 4 of the CCDs had problems with the occlusion, while 10 out of 16 DCDs needed occlusal adjustments. Difference in patient satisfaction between initial situation and after treatment.

An increase in patient satisfaction was seen from the initial situation to the delivery of the CCDs or DCDs for both the OHIP-14 and DSI questionnaire (Figs 6 and 7). The psychologic disability exhibited a significant difference between the initial situation and the CCDs, with the CCDs showing better outcomes ($P = .042$).

As for the DSI scores, none of the questions were statistically significantly different between the CCDs and DCDs at initial situation or follow-up. They all showed similar outcomes.

Student Preference

For this study, 25 different students participated in the fabrication of the CDs. No significant difference was seen in being uncomfortable with both techniques ($P = .830$). When comparing both types of try-in, the students perceived the digital try-in as more challenging ($P < .001$). Another question asked the students which technique they would prefer to use in the future. For this question, they chose the CCD procedure ($P = .012$). The digital technique was not perceived as easier ($P = .999$).

Patient Preference

In total, 10 out of the 16 patients preferred the CCD (62.5%). When the DCD was preferred, 4 patients cited their preference because of the lighter feeling of the DCD, while the other 6 preferred the esthetics and retention. The preference for the CCD was mainly because of esthetic reasons, the plastic feel of the DCD, chewing ability, and the presence of diastema on the DCD.

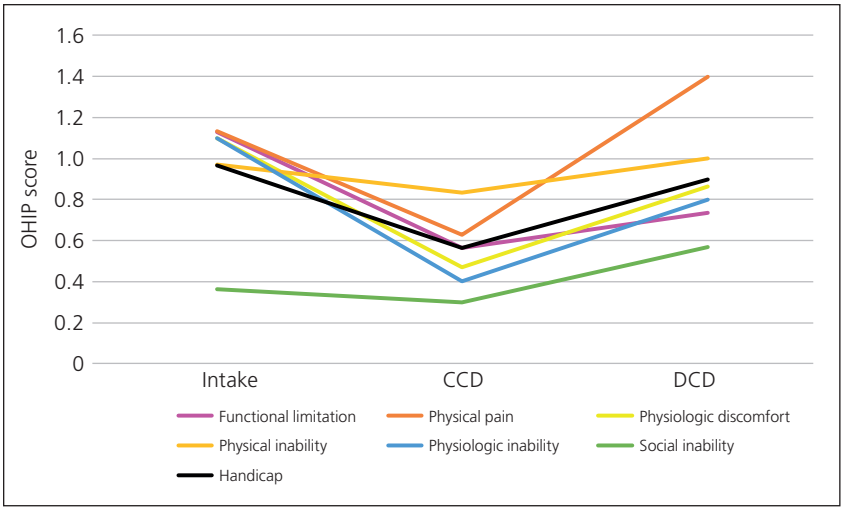

Fig 5 Median patient satisfaction comparing the initial situation, CCD, and DCD.

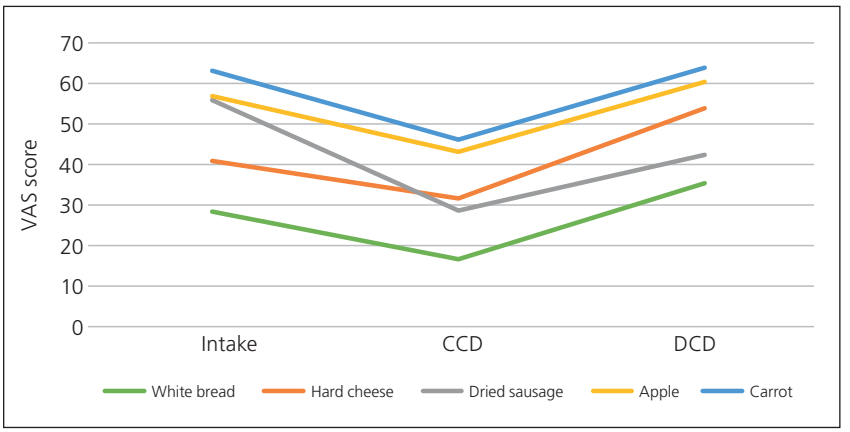

Fig 6 Median chewing ability (DSI) comparing the initial situation, CCD, and DCD.

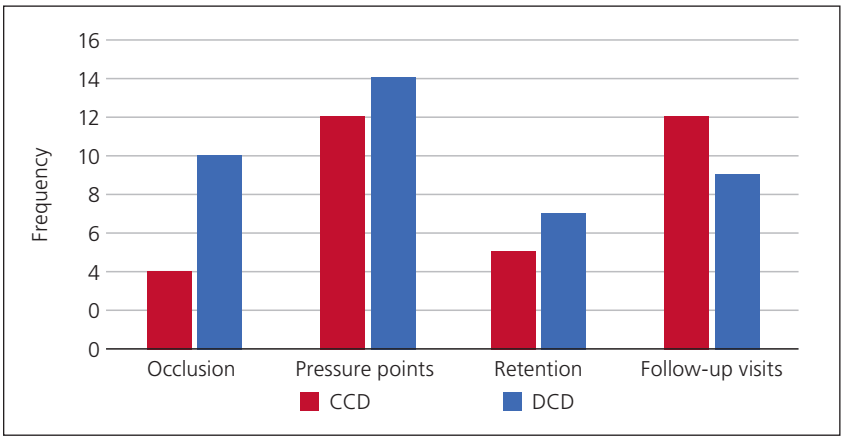

Fig 7 Complications with CCDs vs DCDs.

DISCUSSION

The aim of this clinical study was to assess patient satisfaction, chewing ability, and complications between CCDs and DCDs. The personal opinion and preference of both the patients and dental students was also included in this study. The first null hypothesis—stating that there was no difference in terms of patient satisfaction, complications, and chewing ability—was partly rejected for patient satisfaction and fully rejected for complications. The second null hypothesis was rejected as both patients and students preferred the CCDs.

The OHIP-14 questionnaire showed a significant difference between the CCDs and DCDs for the domain of psychologic discomfort, resulting in partly rejecting the null hypothesis. Both questions resulted in better scores for the CCDs. A plausible explanation is that the occlusion of the DCD had to be corrected multiple times,

indicating a less stable occlusion and articulation, which results in difficulties in keeping the dentures in place. Some patients reported that the DCD was lighter but had the tendency to lack retention and move in the mouth. Both factors were found to be unpleasant and contributed to the participants' psychologic state. Because the OHIP-14 is a self-reported questionnaire, the results are subjective and should be looked at critically. In literature, there is a lot of contradiction based on subjective lists. A systematic review reported better retention for DCDs,[13] while other research showed more stability for CCDs and more social disability for the DCDs.[1] Both retention and stability have an impact on the subjective experience of the patient.

The other questions of the OHIP-14 showed no statistically significant difference, thus accepting the null hypothesis for these questions. These findings correspond with the results of Heikal et al,[14] where no statistically significant difference was found between the CCDs and DCDs for the OHIP-49.

Liu et al[15] also evaluated the esthetic appearance and denture stability and reported no statistically significant difference between both types of dentures. In this present study, it is not surprising, because the first three clinical steps, which determine the tooth setup and denture design, are identical for both dentures. As a result, the borders of the prostheses, the relation between both jaws and esthetics were the same. Thus, this study only evaluates the digital setup and difference in fabricating technique. The literature showed that scanning of the soft tissues results in a loss of necessary information[16,17] and that the esthetics are inferior to the conventional denture.[13,18–19]

The DSI did not demonstrate a significant difference in chewing ability between both dentures. As the impressions and registration procedures were identical, the arch relation and lingualized tooth setup and occlusal scheme were the same. Research has shown that a subjective patient centered questionnaire for chewing ability failed to demonstrate a significant difference.[1] This study only included subjective measures, thus the results should be interpreted critically. A more objective tool, like ViewGum, would provide data to actually measure the chewing ability.

In terms of complications, the null hypothesis can be rejected, because DCDs required more adjustments. This difference can be explained by the lack of a teeth database for lingualized occlusion in the CAD software. The teeth had to be arranged and adjusted manually, which resulted in a higher chance of complications and a less stable occlusion. When the technicians in the lab moved one tooth in the software system, all the other teeth were adjusted automatically. These adjustments resulted in a longer manufacturing time, because the dental lab required more time to adjust the occlusion. These findings were also confirmed by other research.[20] Because the practitioners in this study adjusted the occlusion when the denture was placed in the mouth, the patients did not experience a difference in chewing ability.

Although not significant, more follow-up appointments were required in the CCD group to relieve the pressure points. Because all patients started with CCDs, most of them could indicate the position of the pressure points during placement of the DCD. They frequently indicated that they felt the same location of pressure with the DCD as the CCD, and thus could immediately ask if the practitioners could adjust it. Therefore they needed less appointments. A wash-out period would be able to eliminate this, but due to practical problems, this was not possible in the present study. The literature is still divided on the amount of different complications.[1,18]

No significant difference was seen in terms of denture retention. Although conventional dentures are subjected to polymerization shrinkage, similar shrinkage also takes place in 3D-printed dentures during light curing. This effect was also reported in another study where there were no differences in terms of misfit, adaptation, or retention of the denture.[21]

When comparing the questionnaires between baseline and the placement of both dentures, it seems like a new, fitting denture would improve satisfaction and chewing ability. The aspect of psychologic disability was significantly different in favor of CCDs. Most of the patients were already used to their previous old denture from the initial situation, resulting in more satisfaction and better chewing ability with this new denture. This outcome is also confirmed by the literature, where it is clear that the results are better a longer time after placement of a new denture.[15,22] The statistical tests indicated that there was a bigger difference between the initial and follow-up for the CCDs than for the DCDs, and this difference is because the patients received the CCD first. For that reason, the difference between the new set of dentures (CCD) and the switch to the DCD was not experienced as a major difference.

Both the students and the patients preferred the CCDs. The patients who preferred the DCD mentioned that the denture felt lighter, a finding also reported by Steinmassl et al.[23] This was the first time the dental students experienced this kind of digital try-in, and this is probably why they preferred the CCDs and felt less confident. These results are in contrast with the study by Kattadiyil et al,[24] which reported that their students preferred DCDs. However, their questionnaire also pointed out that the students felt less secure and less experienced.

One limitation of this clinical study was that a double-blind randomized clinical trial was not possible, which is also reported as a limitation in other studies.[24] The longer delivery time of the lab for the DCDs made this

practically impossible, which is why all patients started with the CCDs.

Secondly, the patients were inhomogeneous, because patients between 23 and 77 years were included and no age limit was set at the beginning of this study. Because of this, the results of this study must be looked at critically, because chewing ability is also influenced by the patients' age.[25] Although younger patients tend to adapt faster to their CDs, the odds for dissatisfaction were 1.7 times higher for patients younger than 60 years.[26]

The present study focused mostly on subjective questionnaires. The researchers noticed that the patients had trouble distinguishing their experiences between the two sets of dentures while scoring the second set. This difference is also because there was no wash-out period included. Despite this, there was an analysis of complications between both types of dentures. Based on the data of the number of required interventions, these results could be accumulated and therefore provided objective data. For chewing ability, as said before, the DSI cannot generate an objective result. More objective measures and research is necessary to confirm the findings of this study.

CONCLUSIONS

The CCDs and DCDs showed comparable chewing ability. Patient satisfaction was only different between both dentures regarding psychologic discomfort. More occlusal complications were seen for the DCDs. Overall, the patients and dental students preferred CCDs.

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