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RESEARCH AND EDUCATION

Evaluation of patient experience and satisfaction with CAD-CAM-fabricated complete dentures: A retrospective survey study

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ABSTRACT

Statement of problem. Reports of sound, evidence-based treatment outcomes of computer-aided design and computer-aided manufacture (CAD-CAM) of complete dentures (CD) are lacking in publication databases.

Purpose. The purpose of this retrospective survey study was to assess patient preferences and satisfaction when treated with digitally fabricated CDs, by using a questionnaire.

Material and methods. A total of 50 patients who received digital CDs were included in this study. A 10-item questionnaire was sent to the patients in order to assess their satisfaction with their digital CD experience. The items, or statements listed, were concerned with patient satisfaction and also the treatment technique and final outcome. Results of patient satisfaction questions were evaluated using descriptive statistics, means, and medians. All statistical tests were performed using commercially available software. Responses to the questionnaire provided by patients were analyzed using the Mantel-Haenszel chi-squared test (α=.05).

Results. The questionnaire was sent to 50 patients, and the total patient response rate after treatment intervention was 38% (n=19). Data obtained from questionnaire responses revealed that patients were generally pleased and satisfied with digital CDs. The chi-squared test results revealed no statistically significant differences (P=.180) in the ratings of experienced CD wearers. However, 70% of experienced CD patients agreed that their new digital CDs were "better" than their previous set of CDs. In all categories evaluated, patients gave positive responses regarding their digital CDs.

Conclusions. Results of this questionnaire-driven study suggest that ratings from experienced CD wearers rehabilitated with CAD-CAM-fabricated CDs did not differ significantly from their previous ratings of conventional CDs, but overall, their satisfaction ratings of their digital CDs tended to be positive. (J Prosthet Dent 2016;116:524-528)

Complete edentulism is considered a fast-growing public health concern. Even in the most optimistic scenario of improvements in oral health, the percentage of people without teeth will only decrease 9% by the year 2020.[1] With any prosthodontic treatment offered, a high level of patient satisfaction should be the primary goal in treating patients with edentulism[2] as it is an important parameter in determining the quality and success of treatment.[3] Many studies, however, have demonstrated that patient satisfaction with complete dentures (CDs) declines significantly over time because of progressive inadequate fit and other factors.[4] Nevertheless, patient satisfaction could be a multicausal process involving objective and subjective factors.[5]

Different techniques have been described for fabricating CDs. The conventional protocol for fabrication involves a complex sequence of multiple clinical and laboratory steps averaging at least 5 clinical appointments, if the patient approves the overall esthetics at the wax trial insertion appointment before the dentures are

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Clinical Implications

Patients treated with CAD-CAM-fabricated complete dentures (CDs) tended to give positive ratings of their overall treatment outcome and experience. This study provides further insight into the clinical effectiveness of digital CDs.

processed. Even though the conventional protocol for denture fabrication has been clinically predictable for over 70 years,[5] disadvantages include high treatment costs because of increased patient visits, varying laboratory expenses, and extended chair time.[6] These inconveniences may discourage clinicians from offering CDs as part of their services. Therefore, without overlooking the fundamental concepts and still providing favorable outcomes for patients, cost- and time-efficient CD fabrication protocols should be established.[7]

In recent years, computer-aided design and computer-aided manufacturing (CAD-CAM) has contributed to significant advances in implanted and fixed prosthodontics, and these advances have been widely documented[6,8] However, few reports describe the use and application of this technology to removable prosthodontics.[9,10] Also, intraoral scanning of edentulous arches may pose a great challenge, as the functional and dynamic movements of soft tissues cannot be accurately captured in a digital form.[11]

Digital CD systems have been introduced to condense the number of clinical appointments and total treatment time without compromising overall quality.[12] Only a few manufacturers offer this technology, and they claim a reduced number of appointments compared with the 5-appointment, conventional CD protocol. The method of CD fabrication claimed by those companies could prove to be a cost efficient treatment option for patients with edentulism and private clinicians. However, long-term clinical data are lacking regarding the outcomes of these prostheses. Prospective, standardized clinical studies involving CAD-CAM CDs are needed to improve patient-centered care and provide evidence-based research.[6]

The purpose of this retrospective study was to evaluate patient experiences and satisfaction with the overall digital CD treatment received at The Ohio State University College of Dentistry by means of a written survey. The hypothesis was that patients who were treated with digital CDs would be satisfied with their new CDs.

MATERIAL AND METHODS

In November 2014, and before the study was conducted, approval was obtained from The Ohio State University's Biomedical Sciences Institutional Review Board (protocol 2014H0024). Inclusion criteria consisted of patients with edentulism who were seeking prosthodontic treatment in The Ohio State University College of Dentistry Clinics and who had received treatment with a digital CD fabrication system (AvaDent). The only exclusion criterion for this study was patients requiring immediate digital CDs. With the assistance of a dental software database search (Windent EE; Carestream Dental), the number of CAD-CAM-fabricated CDs delivered was identified in the predoctoral comprehensive care clinics, the advanced prosthodontics clinic, and the dental faculty practice clinic between 2012 and 2014. A total of 50 patients (25 women and 25 men) between 26 and 90 years of age (mean of 62.64 years of age) who had received digital CDs were included in this study. Informed consent and Health Insurance Portability and Accountability Act (HIPAA) authorization were obtained for the survey portion of the study. Of the 50 rehabilitated patients, 24 patients were treated at the predoctoral level, 24 were treated at the graduate prosthodontics resident level, and the remaining 2 patients were treated by practicing faculty members. A total of 94 digitally fabricated prostheses were delivered: 49 maxillary CDs, 35 mandibular CDs, and 10 implant-assisted overdentures.

A 10-item questionnaire was mailed to the patients included in this study in order to assess their satisfaction, posing questions relevant to their digital CD experience. The items or statements listed addressed patient satisfaction and also treatment technique and final outcome.[11] Patients were given the option to agree, remain neutral, or disagree with these statements[13] (Table 1). Results of the patient satisfaction questionnaires were evaluated using descriptive statistics. All statistical tests were performed using software (SAS v9.1.3; SAS Institute Inc). Responses provided by the patient questionnaires were analyzed for comparison of qualitative data by using the Mantel-Haenszel chi-squared test (α=.05).

Table 1. Questionnaire given to patients

Statement	Agree	Neutral	Disagree
1. Your new dentures are better than your previous ones (if applicable).			
2. Your ability to chew has improved with your new dentures.			
3. Your smile with your new dentures looks nice.			
4. Your speech has improved or remained the same with your new dentures.			
5. Your new dentures are easy to clean compared with the old ones.			
6. Your dentures fit well and they stay in place when you speak and eat.			
7. Your expectations were fulfilled.			
8. Your new dentures are comfortable.			
9. You would recommend these type of dentures to others.			
10. You are satisfied overall with your new dentures.			

Table 2. Patient demographics and summarized data from patient self-questionnaires

Participant	Age (y)	Sex	Operator Level	Prosthesis Received	Months after Insertion	Experience with CDs?
1	72	F	PRED	CD/CD	18	Yes
2	53	F	DFP	CD/CD	17	Yes
3	84	F	PRED	CD/	19	Yes
4	66	F	GRPR	CD/OVD	21	No
5	60	M	GRPR	CD/CD	32	Yes
6	66	F	GRPR	CD/OVD	16	Yes
7	60	F	PRED	CD/CD	36	Yes
8	63	F	PRED	CD/OVD	30	No
9	66	F	GRPR	CD/OVD	2	Yes
10	75	F	GRPR	CD/OVD	3	Yes
11	68	F	GRPR	/OVD	29	Yes
12	63	M	PRED	CD/CD	27	Yes
13	76	M	GRPR	CD/ISFDP	13	No
14	57	M	PRED	CD/CD	15	No
15	55	M	PRED	CD/CD	21	Yes
16	68	M	PRED	CD/CD	23	No
17	66	M	GRPR	CD/	21	Yes
18	60	F	PRED	CD/CD	36	Yes
19	63	M	GRPR	CD/CD	1	Yes

CD, complete denture; DFP, dental faculty practice; GRPR, graduate prosthodontics resident; ISFPD, implant-supported fixed dental prosthesis; OVD, overdenture; PRED, predoctoral (level).

RESULTS

Fifty surveys were sent in the mail, and a total of 19 patients participated by completing and returning the survey along with a signed waiver of consent and a HIPAA authorization form. Survey participants (n=19) had a mean of 20 months after CD insertion, with a range of 36 to 1 month of prosthesis use from the date surveys were sent. The median number of months after CD delivery for the responding population was 21 months. The total patient response rate after treatment intervention was 38%. Of the 19 patient responses received, 11 were women and 8 were men between 53 and 84 years of age, and a mean of 65.3 years of age. Nine patients were treated by predoctoral students, 9 were treated by graduate prosthodontic residents, and 1 patient was treated by a faculty member. Of the 19 patient responses received, 14 of these were experienced denture wearers, and the other 5 were first-time CD wearers. An experienced denture wearer was defined as a patient who had worn conventional CDs and was receiving a new digital CD prosthesis. Of the 14 experienced CD wearers, 8 patients received maxillary and mandibular CAD-CAM-fabricated CDs, 2 patients received a CAD-CAM-fabricated maxillary CD, 3 patients received CAD-CAM-fabricated maxillary CD opposing a CAD-CAM implant-assisted overdenture, and 1 patient received only a mandibular CAD-CAM-fabricated implant-assisted overdenture. Data extrapolated from the surveys are summarized in Table 2. Of these 14 experienced denture wearers, 11 agreed that their new prostheses were better than their previous conventional CDs. The group of 11 patients received 6 maxillary and mandibular CDs, 1 maxillary CD, 3 CAD-CAM-fabricated maxillary CD opposing a CAD-CAM implant-assisted overdenture, and 1 CAD-CAM implant-assisted mandibular overdenture. The patients who agreed to this item on the survey and received implant-supported prostheses were excluded from the statistical analysis for standardization of the data (Table 3). In reference to the statements on patient satisfaction, 78.95% agreed that they were pleased with the esthetics of their dentures; 78.57% agreed that their new digital CDs were "better" than their previous set of CDs; 73.68% agreed they were satisfied with their new CDs; 68.75% agreed that their new CDs were easy to clean; 68.42% agreed that they considered their CDs "comfortable" and that they would recommend digital CDs to others; 57.89% agreed that their speech and chewing abilities had improved with the use of digital CDs; and 52.63% agreed that their CDs fit well and stayed in place during function (Fig. 1). Chi-squared test results revealed no statistically significant differences (P=.180) (Table 3) in these ratings for these 10 patients, even though 70% of these 10 patients agreed that their new CD or CD set was better (Table 4).

Table 3. Prosthesis received: digital CDs versus "old" CDs

	New digital CDs are "better" than old CDs, n (%)			
Prosthesis Received	Agree	Neutral	Disagree	Total
Maxillary CD only	1 (11.11)	0	1 (11.11)	2 (22.22)
Maxillary and mandibular CDs	6 (66.67)	0	1 (11.11)	7 (77.78)
Total	7 (77.78)	0	2 (22.22)	9 (100)

DISCUSSION

The hypothesis of this study that the patients who were treated with digital CDs would be satisfied with their new CDs was accepted. Of 11 of 14 patients who agreed that their digital CDs were better than their previous CDs, 6 patients received maxillary and mandibular CDs, 3 received a maxillary CD opposing an implant-assisted mandibular overdenture, 1 patient received a maxillary CD, and 1 patient received an implant-assisted mandibular overdenture only. Those patients who received implant-assisted prostheses were not included in the statistical analyses for standardization of data. Chi-squared test results revealed no statistically significant differences (P=.180) in these ratings for these 10 patients, even though 70% agreed that their new CD or CD set was better (Table 3). Generally, of the 10 items listed on the questionnaire, 19 of the study patients who returned the completed survey tended to agree with the statements describing their overall experience with these types of prostheses. Patient expectations were apparently fulfilled in 63% of the patients, and overall patient

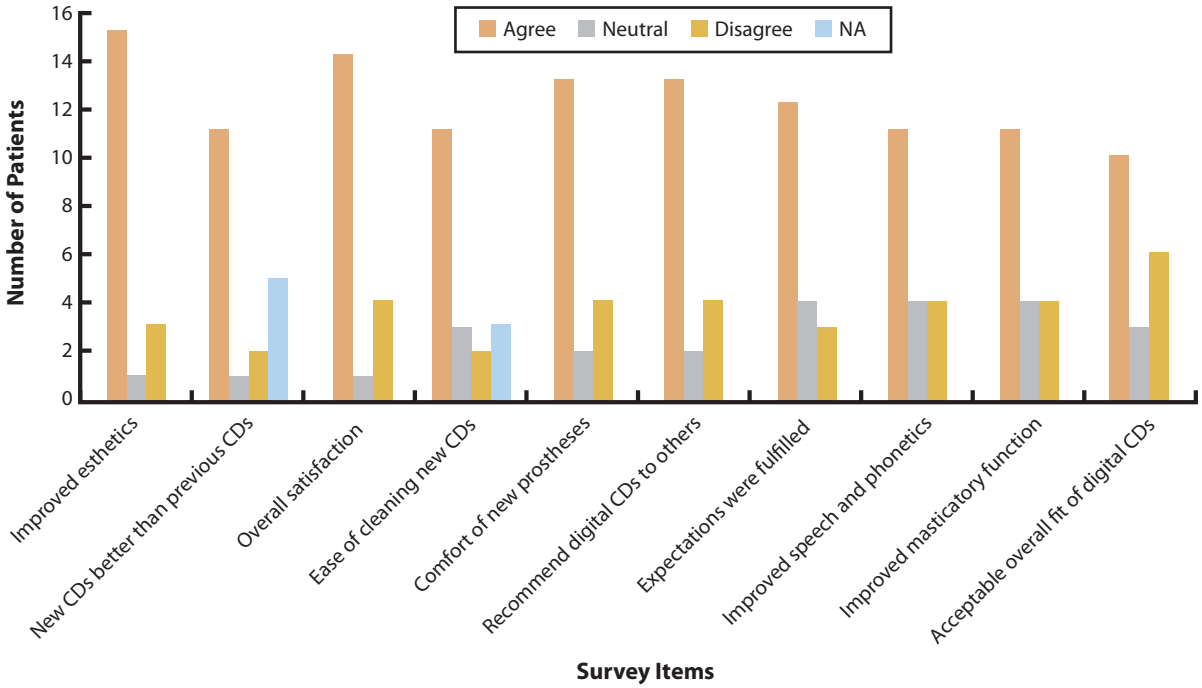

Figure 1. Cumulative results of patient survey statements. CDs, complete dentures; NA, not applicable.

satisfaction was achieved in 74% of the sample size. Several studies have shown that most patients are "reasonably satisfied" and "very satisfied" with their CDs.[14] Based on the survey results, the experienced denture wearers tended to feel that their new CDs were better than their previous ones as they agreed these were "better" and "improved." Results of this study are in accordance with those of another recent study in which patient preference and satisfaction with digital CDs was significantly higher than with conventional CDs in all categories evaluated.[12] However, increased sample sizes are probably needed to prove their ratings as significantly different.

Several studies have proposed that patients have positive perceptions of CD therapy.[15] The level of patient satisfaction has been associated with age, sex, prosthetic experience, and psychological factors.[3] In regard to the survey component of this study, of the 19 patients who participated, 14 of those were experienced denture wearers, and in this group, a significant difference could not be demonstrated in their ratings of agreement regarding the digital CDs being better than their conventional set. However, these data could suggest, as the company claims, that this is a cost-effective treatment and proves beneficial for both the clinician and the patient as the number of appointments needed to place these dentures is considerably less than those fabricated in the conventional way. This statement is supported by a study conducted by Kattadiyil et al,[12] where the authors determined that clinical treatment times for the conventional CD fabrication process required approximately 3.5 hours more that the digital CD fabrication process. This outcome, in turn, could translate into reduced chair time and cost burden to the clinician without compromising the quality of the overall treatment.

Table 4. Results of chi-squared test for equal proportions

Parameter	Result
Chi-squared test result	2.7778
df	1
Asymptotic Pr >chi-squared test	0.0956
Exact Pr ≥chi-squared test	0.1797
P=.180[a]	

df, degrees of freedom; Pr, proportion. [a]*P*=.05 value comparison.

Some limitations are associated with this retrospective survey study. One important limitation is the reduced number of patient responses for the subjective aspect of this study (n=19). The authors attempted to contact the patients who had not returned their written surveys in an effort to increase the sample size, but the relatively low percentage remained. A reason for nonresponse may have been dissatisfaction with the overall CD experience. In order to achieve statistically significant differences between digital CDs compared with conventional CDs in respect to patient satisfaction and preference, a higher number of patient responses might have been beneficial. In addition, ideally, this study's sample could have been compared with a conventional CD group for an extended period of time (6 to 8 weeks) to assess true clinical outcomes. This, in turn, could have led to conducting a true randomized

trial, thus providing the highest level of evidence.[16] Another important limitation is the potential patient recall bias when introduced to an "innovative" method of prosthesis fabrication which considerably shortened their clinical chair time and number of appointments. The sample patient population included patients up to 90 years of age and memory impairment might have influenced their ability to recall adequately their previous denture experiences and therefore positively inclined them toward this new concept of denture fabrication. This in turn, may produce misleading conclusions that could negatively alter the data collected. In addition, the use of a customized survey instrument rather than a standardized, comprehensive assessments such as a visual analog scale and/or the Oral Health Impact Profile (OHIP-49/OHIP-14) is a limitation. This retrospective survey study did not address quality of life outcomes; however, future research using this methodology is needed to assess the psychosocial impact of these types of prosthesis among the fast growing edentulous population. True treatment outcomes could have been assessed had the domains of the oral-health quality impact index been used. The patient's response options were limited to "agree, neutral, disagree," which in turn could have affected the quantification of true patient outcome and experience and could have been better evaluated and represented had a more thorough assessment been used. The method of assessment used in this study may have misled the patient into selecting an option that they were not in complete agreement with, and this could have been avoided by categorizing various options on a numeric scale. Another important limitation is the lower cost of CD therapy in a university setting, and treatment being performed by inexperienced dental students and training graduates may have influenced patient expectations and accordingly the overall ratings. In addition, patients could not be evaluated at baseline, as a prospective clinical trial was not performed. Therefore, pretreatment and posttreatment outcomes varied significantly (36 months to 1 month post CD insertion) and may have influenced patient perceptions and responses to the questionnaire.

CONCLUSIONS

Within the limitations of this study, the following conclusions were drawn:

1. Most responses received indicated that the patients agreed they were satisfied with their digital CD treatment.
2. In the experienced CD group, a significant difference was not detected in their ratings of agreement regarding digital CDs being better than their conventional set.

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