A Study of perception of dental workers on dental digital equipment and the necessity of related education

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Abstract

The objective of the present study was to identify the need for education and awareness of digital dental equipment among dental workers and to propose the direction of education on digital dental equipment for dental workers. The participants in the study consisted of 264 active dental workers, convenience sampled from all regions of Korea. Statistical analysis was performed using SPSS 23.0 (SPSS Inc. Chicago, IL, USA). Frequency analysis was performed on all questions, while cross tabulation analysis was performed on the necessity of education and necessity of digital dentistry equipment. The statistical significance level was
Meanwhile, 177 respondents (44.3%) had received education on digital dental equipment before, while 147 respondents (55.7%) had not. With respect to whether education on digital dental equipment should be provided separately, 226 respondents (85.6%) believed it should be provided and 38 respondents (14.4%) felt it was not needed, showing that most dental workers believed such education was necessary. In particular, the need for education based on education system showed that those who felt it is needed was 87 (78.4%) and not needed was 24 (21.6%) among 2- or 3-year school graduates, while those who felt it is needed was 81 (88.8%) and not needed was 11 (12.0%) among 4-year school graduates, showing a statistically significant difference (p < 0.05). Through the present study, the educational needs of dental workers were identified, and the findings in the present study may be used as basic data when setting the direction of education and acceptance of digital dental equipment by dental workers.

**Key Words**: CAD/CAM, dental digital equipment, dental hygiene, education, perception.

### 1 INTRODUCTION

In keeping with advances in science and technology, the field of medicine has used them for diagnosis by 3D imaging and during robot-assisted surgeries, and they are also being actively used in the field of dentistry. It has become common practice to produce dental prostheses by using computer-aided design (CAD) from impressions taken directly from the mouth for precise machining via computer-aided manufacturing (CAM).

In 1987, Mormann (2006) first developed the CEREC system and introduced it in dentistry, where it is currently widely used in the fabrication of ceramic crowns and fixed prostheses. The CAD/CAM system offers a major advantage in that it uses an intraoral scanner to acquire impressions and a computer to identify the shape of the prosthesis and relationships with adjacent and antagonist teeth to complete the design, which is used to fabricate the prosthesis immediately by a milling machine to allow the patient to be fitted with the prosthesis on the same day. CAD/CAM is a
system that can perform all stages, i.e., from the initial stage of acquiring the impression to the final stage of fabrication of models or prostheses, and thus, it resolves the discomfort associated with existing impression acquisition methods.

Applying a digital impression method to patients requires a shorter time and yields higher preference and satisfaction than do existing impression methods, without any decrease in effectiveness. As a result, many dental clinicians demonstrated the effectiveness of digital equipment in providing dental treatment and their use in dentistry is expected to increase gradually (Ting-Shu and Jian, 2015). Changes in the pattern of dental care will inevitably progress at a rapid pace, and as such, breakthroughs in such changed treatment field and competition in new treatment fields are also unavoidable. Therefore, fundamental education on traditional treatment methods should continue to take place, but school education for understanding and utilization of digital dentistry in keeping with paradigm changes of the times should also take place.

According to one study, perceptions of clinicians have a major effect on new digital devices or products being implemented for treatments in the field of dentistry (Kim et al., 2015). Therefore, education and skill acquisition are needed for dental workers to develop positive views about using digital equipment in providing treatments in the field of dentistry that is rapidly advancing and changing.

There have been reports in Korea and abroad on patient satisfaction with chair-side digital systems, awareness of CAD/CAM by dental technicians, and attitudes towards and awareness of Canadian orthodontists of digital imaging and digital radiography (Palmer et al., 2005; Flores-Mir et al., 2006). However, compared to the trend of digital equipment having been widely implemented in dentistry, school education on such equipment is lacking, except in the hospitals and clinics that have purchased the equipment. Accordingly, the present study aimed to propose the direction of education related to digital equipment of dental workers by investigating the need for awareness and education about digital dental equipment.
2 MATERIALS AND METHODS

The participants in the present study consisted of 300 active dental workers from throughout Korea who consented to participate in a survey using a structured questionnaire. The survey was conducted in self-reporting format or as an online questionnaire, and after excluding 36 respondents for insincere answers, a total of 264 sets of data were used for the final analysis.

A. Methods

The measurement tools used in the present study were based on structured questionnaires found through literature review, which were subsequently modified and supplemented to meet the objectives of the study. The questionnaire is comprised of 7 questions on general characteristics, 13 questions on awareness and necessity of equipment related to digital dentistry, and 11 questions on the necessity of education about equipment related to digital dentistry. Among these, awareness of digital dentistry equipment was scored using a 5-point Likert scale, with higher scores indicating greater awareness with respect to the question asked. The internal consistency reliability (Cronbach’s alpha) of the measurement tool for awareness of digital dentistry equipment was Cronbach’s $\alpha = 0.801$.

B. Statistical analysis

Statistical analysis was performed using SPSS 23.0 (SPSS Inc. Chicago, IL, USA). Frequency analysis was performed on all questions, while cross tabulation analysis was performed on the necessity of education and necessity of digital dentistry equipment. The statistical significance level was set at 0.05.

3 RESULTS AND DISCUSSION

A. General characteristics of the participants

In our study, 11.0% were men and 89.0% were women, and 60.2% of the participants were 20-29 years old, 26.1% were 30-39 years old, 9.5% were 40-49 years old, and 4.2% were 50 years or older. With respect to occupation, 7.6% were dentists, 76.9% were dental hygienists, 6.1% were dental technicians, and 9.5% were other dental workers. An investigation of the school system of the schools attended by the 203 dental hygienists who participated in the survey showed that 42.0% graduated from 2- or 3-year schools, while
34.8% graduated from 4-year schools. With respect to clinical experience, 33.7% had $\leq 2$ years, 17.8% had 34 years, 15.9% had 56 years, and 32.6% had $\geq 7$ years of experience. Of all participants, 64.4% worked in a dental clinic, 24.6% worked in a dental hospital, 7.6% worked in a general or tertiary hospital, 0.8% worked in a school, and 2.7% worked in other workplaces.

B. Awareness and necessity of digital dental equipment
a. Awareness of digital dental equipment

Among the respondents, 85.6% responded that they were aware of digital dental equipment, while 14.4% responded that they were unaware. Among those who responded that they were aware, 84.1% had used such equipment before, while 15.9% had never used such equipment. Investigation of the advantages of using the equipment showed 39.8% for effective patient motivation and 7.6% for shortened chair time. Response of "yes" and "no" to the question on whether any discomfort was felt with existing analog methods was 62.1% and 37.9%, respectively, and with respect to which aspect presented discomfort, the responses were 35.3% for impression acquisition, 28.7% for patient motivation, 18.3% for prolonged chair time for impression acquisition, 7.3% for patient appointment and appointment change, and 6.7% for difficulty in securing space for patient data storage (Table 1).

<table>
<thead>
<tr>
<th>Variable</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receptive idea for the equipment</td>
<td></td>
</tr>
<tr>
<td>Not at all</td>
<td>1 (0.4)</td>
</tr>
<tr>
<td>Not really</td>
<td>3 (1.1)</td>
</tr>
<tr>
<td>Average</td>
<td>81 (30.7)</td>
</tr>
<tr>
<td>Somewhat</td>
<td>138 (52.3)</td>
</tr>
<tr>
<td>Very much</td>
<td>41 (15.5)</td>
</tr>
<tr>
<td>Positively think to the dental clinical</td>
<td></td>
</tr>
<tr>
<td>introduction</td>
<td></td>
</tr>
<tr>
<td>Not at all</td>
<td>1 (0.4)</td>
</tr>
<tr>
<td>Not really</td>
<td>1 (0.4)</td>
</tr>
<tr>
<td>Average</td>
<td>55 (20.8)</td>
</tr>
<tr>
<td>Somewhat</td>
<td>157 (59.5)</td>
</tr>
<tr>
<td>Very much</td>
<td>50 (18.9)</td>
</tr>
</tbody>
</table>
b. Necessity of digital dental equipment

To the question of whether digital dental equipment is needed in clinical dentistry, 81.4% responded that it is needed, while 18.6% responded that existing analog formats were sufficient. Those who responded that it is needed also responded that the equipment that is needed are intraoral cameras (52.1%), intraoral scanners (45.6%), CT equipment (41.4%), CAD/CAM (40.5%), 3D printers (29.3%), and Q-ray (20.9%) as seen in Table 2.

<table>
<thead>
<tr>
<th>Want to receive education about the equipment</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Not really</td>
<td>2 (0.8)</td>
</tr>
<tr>
<td>Average</td>
<td>74 (28.0)</td>
</tr>
<tr>
<td>Somewhat</td>
<td>131 (49.6)</td>
</tr>
<tr>
<td>Very much</td>
<td>57 (21.6)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The need for digital dentistry equipment</td>
<td></td>
</tr>
<tr>
<td>Need</td>
<td>215 (81.4)</td>
</tr>
<tr>
<td>Enough on existing analog system</td>
<td>49 (18.6)</td>
</tr>
<tr>
<td>Kinds of necessary digital dentistry equipment</td>
<td></td>
</tr>
<tr>
<td>Intra-oral camera</td>
<td>112 (42.4)</td>
</tr>
<tr>
<td>Oral scanner</td>
<td>98 (37.1)</td>
</tr>
<tr>
<td>CAD/CAM (CEREC etc.)</td>
<td>87 (33.0)</td>
</tr>
<tr>
<td>CT (CBCT)</td>
<td>89 (33.7)</td>
</tr>
<tr>
<td>3D printer</td>
<td>63 (23.9)</td>
</tr>
<tr>
<td>Q-ray</td>
<td>45 (17.0)</td>
</tr>
<tr>
<td>etc.</td>
<td>5 (1.9)</td>
</tr>
</tbody>
</table>
C. Necessity of education on digital dental equipment

The survey found that 44.3% had and 55.7% had not received education on digital dental equipment. Among the respondents, 85.6% agreed that separate education on digital dental equipment is needed, while 14.4% responded that it is not needed. To the question of where the education should take place, if it is needed, 29.9% responded that education should be given in advance in school before entering the clinical field, while 30.7% responded it should be internal education after employment from the clinic; 18.6% responded that education should be provided by the manufacturer of the equipment being used; and 6.4% responded that education should be given by associations or academic societies as seen in Table 3.

### TABLE III

Necessity of education on digital dental equipment

<table>
<thead>
<tr>
<th>Variable</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you use the equipment in the working place?</td>
<td></td>
</tr>
<tr>
<td>Use</td>
<td>167 (63.3)</td>
</tr>
<tr>
<td>Do not use</td>
<td>97 (36.7)</td>
</tr>
<tr>
<td>Do you ever received education on the equipment?</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>117 (44.3)</td>
</tr>
<tr>
<td>No</td>
<td>147 (55.7)</td>
</tr>
<tr>
<td>Do you think that education is required?</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>226 (85.6)</td>
</tr>
<tr>
<td>No</td>
<td>38 (14.4)</td>
</tr>
<tr>
<td>Where do you think the education should be done in?</td>
<td></td>
</tr>
<tr>
<td>At school before graduation</td>
<td>79 (29.9)</td>
</tr>
<tr>
<td>Working place</td>
<td>81 (30.7)</td>
</tr>
<tr>
<td>Manufacturers of equipment</td>
<td>49 (18.6)</td>
</tr>
<tr>
<td>Association or Society</td>
<td>17 (6.4)</td>
</tr>
<tr>
<td>etc.</td>
<td>14 (5.3)</td>
</tr>
<tr>
<td>Not applicable</td>
<td>24 (9.1)</td>
</tr>
</tbody>
</table>

D. Comparison of the need for digital dental equipment based on education system and clinical experience of dental hygienists

Survey of the need for digital dental equipment based on the ed-
ucation system of dental hygienists found that among 2- or 3-year school graduates, 75.7% responded that it is needed, while 24.3% responded that the existing analog format was sufficient. Among 4-year school graduates, 89.1% responded that it is needed, while 10.9% responded that the existing analog format was sufficient. Among other dental workers besides dental hygienists, 80.3% responded that it is needed, while 19.7% responded that the existing analog format was sufficient. Analysis of the need for digital dental equipment based on the education system of dental hygienists showed significant differences (p < 0.05) as seen in Table 4.

A survey of the need for digital dental equipment based on clinical experience (years) of dental hygienists found that among those with experience of \( \leq 2 \) years, 86.5% responded that it is needed, while 13.5% responded that the existing analog format was sufficient. Among those with experience of 3 years, 40 (85.1%) responded that it is needed, while 7 (14.9%) responded that the existing analog format was sufficient. Among those with experience of 5 years, 31 (73.8%) responded that it is needed, while 11 (26.2%) responded that the existing analog format was sufficient. Among those with experience of \( \geq 7 \) years, 67 (77.9%) responded that it is needed, while 19 (22.1%) responded that the existing analog format was sufficient. Analysis of the need for digital dental equipment based on clinical experience (years) of dental hygienists showed no statistically significant differences (p > 0.05).

### Table IV

<table>
<thead>
<tr>
<th>Variable</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital intra-oral impression process (Oral scanning)</td>
<td></td>
</tr>
<tr>
<td>Not at all</td>
<td>1 (0.4)</td>
</tr>
<tr>
<td>Not really</td>
<td>15 (5.7)</td>
</tr>
<tr>
<td>Average</td>
<td>92 (34.8)</td>
</tr>
<tr>
<td>Somewhat</td>
<td>127 (48.1)</td>
</tr>
<tr>
<td>Very much</td>
<td>29 (11.0)</td>
</tr>
<tr>
<td>Oral examination with digital equipment</td>
<td></td>
</tr>
<tr>
<td>Prevention care using digital equipment (Q-ray etc.)</td>
<td>Not at all</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------</td>
</tr>
<tr>
<td></td>
<td>Not really</td>
</tr>
<tr>
<td></td>
<td>Average</td>
</tr>
<tr>
<td></td>
<td>Somewhat</td>
</tr>
<tr>
<td></td>
<td>Very much</td>
</tr>
<tr>
<td>Counseling patients using digital equipment</td>
<td>Not at all</td>
</tr>
<tr>
<td></td>
<td>Not really</td>
</tr>
<tr>
<td></td>
<td>Average</td>
</tr>
<tr>
<td></td>
<td>Somewhat</td>
</tr>
<tr>
<td></td>
<td>Very much</td>
</tr>
<tr>
<td>Oral digital clinical care</td>
<td>Not at all</td>
</tr>
<tr>
<td></td>
<td>Not really</td>
</tr>
<tr>
<td></td>
<td>Average</td>
</tr>
<tr>
<td></td>
<td>Somewhat</td>
</tr>
<tr>
<td></td>
<td>Very much</td>
</tr>
<tr>
<td>How to use digital dentistry equipment</td>
<td>Not at all</td>
</tr>
<tr>
<td></td>
<td>Not really</td>
</tr>
<tr>
<td></td>
<td>Average</td>
</tr>
<tr>
<td></td>
<td>Somewhat</td>
</tr>
<tr>
<td></td>
<td>Very much</td>
</tr>
<tr>
<td>Using of 3D software (design of prosthetic dentistry)</td>
<td>Not at all</td>
</tr>
</tbody>
</table>
E. Comparison of need for education on digital dental equipment based on education system and clinical experience of dental hygienists

Survey of the need for education on digital dental equipment based on the education system of dental hygienists found that among 2- or 3-year school graduates, 87 (78.4%) responded it was needed and 24 (21.6%) responded it was not needed, while among 4-year school graduates 81 (88.8%) responded it was needed and 11 (12.0%) responded it was not needed. A significant difference in the need for education was found based on the education system of the dental hygienists ($p < 0.05$).

Survey of the need for education on digital dental equipment based on clinical experience (years) of dental hygienists found that those who responded that such education was needed was 77 (86.5%) and the existing analog format was sufficient was 12 (13.5%) among those with experience of $\leq 2$ years; 43 (91.5%) and 7 (14.9%) among those with experience of 3-4 years; 34 (81.0%) and 11 (26.2%) among those with experience of 5-6 years; and 72 (83.7%) and 19 (22.1%) among those with experience of $\geq 7$ years, respectively. There were no significant differences in the need for education based on clinical experience ($p < 0.05$) as seen in Table 5.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Not really</th>
<th>Average</th>
<th>Somewhat</th>
<th>Very much</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>16 (6.1)</td>
<td>118 (44.7)</td>
<td>98 (37.1)</td>
<td>30 (11.4)</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Need (%)</th>
<th>Enough on existing analog system (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Recent advances in digital technology and the implementation of the CAD/CAM system in dentistry have provided an opportunity for change from traditional analog impression acquisition methods and manual prostheses fabrication methods. Compared to the existing analog format, digital dental equipment offers numerous advantages, such as shorter treatment time, convenient and accurate impression acquisition, securing of dental space, and patient motivation. Because of these points, digital dental equipment is being widely used by resolving the discomfort that was felt with the existing analog format, while offering convenience, accuracy, and efficiency from a speed aspect (Chochlidakis et al., 2016; Yuzbasioglu et al., 2014; Ahlholm et al., 2016).

The objective of the present study was to investigate the level of awareness and the need for education among dental workers in regards to recent diverse uses of digital dental equipment in dentistry. The level of awareness of and the need for education about digital dental equipment was lower in those with a longer period of experience. In contrast to the present study, in a study by Kim et al., awareness of digital use was significantly higher when age and work experience were higher, showing higher education experience and intention to participate in education (Kim et al., 2013). This was interpreted as those with greater experience being acclimated to using the existing analog format, which resulted in lower need for new digital equipment.

With respect to awareness of education based on experience, in our study those with 14 years of experience showed higher awareness than those with ≥ 5 years of experience. The reason for this is believed to be due to greater percentage of those who come across
recent clinical changes in school and/or at seminars. In the results presented above, a gradual increase in the use of and need for digital dental equipment was found, while the need for education was also recognized. Consequently, an increased number of dental workers are demanding education about digital dental equipment, and thus, education about digital dental equipment for dental workers needs to be more active.

Therefore, since skills that meets the latest trend must be learned and acquired, dynamic curriculum changes, through timely curriculum reform, are being demanded to allow continued acquisition of work-related skills.

Due to digitalization of dental treatment, CAD/CAM education in clinical and school education based on the latest trends are requiring reorganization curriculum and work demand. Within the curriculum, the results suggested that priority should be given to reinforcement of education tailored for clinic practice, expansion of field practical education, and revision of courses to be suitable for the digital age. The instructional time necessary for introducing digital scanning into the curriculum is significantly greater than conventional impression technique in both classroom (lecture) and clinical simulation settings (Marti et al., 2017). To increase the awareness of digital dental equipment and more active implementation of digital dental equipment, development of more systematic educational programs is needed. Most dental students at our school felt that information technology will support them in their clinical decision making, which in turn will increase patient satisfaction (Jathanna et al., 2014).

Moreover, dental hygienists who work in clinical settings need to put forth continued efforts through self-motivation for education to strengthen their capacity and expand their work scope.

The limitations in the present study included the fact that the participants in the study were from only certain regions, and thus the results cannot be generalized. Therefore, additional studies are needed in the future with larger sample sizes containing more diverse participants, as well as comparative studies that consider the presented questions and variables.

However, to date, there have been no studies that investigated the awareness of the need for and education about digital dental equipment among dental workers, and as such, the significance of
the present study was that the findings of the present study may be used as basic data when setting the direction of education and acceptance of digital dental equipment by dental workers.

4 CONCLUSION

Recent advances in digital technology and the implementation of the CAD/CAM system in dentistry have provided an opportunity for change from traditional analog impression acquisition methods and manual prosthesis fabrication methods. Compared to the existing analog format, digital dental equipment offers numerous advantages, such as shorter treatment time, convenient and accurate impression acquisition, securing of dental space, and patient motivation. Because of these points, digital dental equipment is being widely used by resolving the discomfort that was felt with the existing analog format, while offering convenience, accuracy, and efficiency from a speed aspect.

Through the present study, the educational needs of dental workers were identified, and the findings in the present study may be used as basic data when setting the direction of education and acceptance of digital dental equipment by dental workers.

References


