Conventional *vs.* Digital dental impression: practitioner's and patient's perspective-a pilot study

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***Abstract*— Dental cast is an indispensable part of a routine diagnostic and therapeutic procedure. Conventional impression materials, e.g. alginate and polyvinyl siloxane are used for capturing intraoral details and subsequent dental casts pouring. Intraoral scanners (IOS) were introduced in dentistry in the early 1980s and became a valid alternative to those procedures. IOS are fast, accurate and more pleasant for a patient than conventional impression techniques, making it necessary to introduce that technique in Dental School's curriculum. Eighteen dental students and recent graduates performed both techniques on each other and filled two two-part questionnaires (from patient's and practitioner's perspective; before and after impression-taking) to reveal their preferences and expectations from both techniques. The results showed a statistically significant difference in time needed for digital and conventional impression, with digital being faster. After the scanning, all participants answered that digital impression technique would spare more time in their office. Majority of participants thought that digital techniques would completely replace conventional techniques during their lifetime and that attitude hasn't changed afterwards. Results of this pilot study showed participants' inclination towards new impression techniques and need for their implementation in Dental School's curriculum.**

Keywords—intraoral scanner, intraoral optical scan, digital impression, conventional impression, dental education, operator preference, patient preference, medical imaging, clinical workflow

I. Introduction

Dental impressions are used for capturing details of oral and dental tissues using standard impression techniques and materials [1]. They are essential for plaster study models manufacturing, which are used for diagnostic and treatment planning purposes. However, technical innovations in the dental field gave rise to new, faster and more pleasant solutions for both patient and doctor.

A number of problems are connected with the use of conventional impression techniques that could be eliminated by digital scanning including 'pull', tears, bubbles, voids and material shrinkage [2]. In addition, data storage is made more efficient, with the use of digital models eliminating the need for physical storage space while also avoiding storage issues of plaster chipping or breakage [3].

Although plaster study models are almost indispensable to the orthodontist, because they are cast in plaster or stone they do have a number of drawbacks in terms of storage and retrieval; diagnostic versatility; transferability; durability [2].

Orthodontists and other dental medicine specialists are rapidly accepting the use of digital technology and new materials in everyday work. Facial and dental scanners, cone-beam computed tomography, 3D printing, and other modern technologies allow professionals more accurate patient assessment, virtual model storing, treatment planning and appliance manufacturing. Procedural mistakes during conventional impression taking, casting and measuring are minimized using digital impressions and virtual treatment planning allows fast and simple communication between lab and orthodontist's practice and fast and straightforward appliance production [4-8].

A concept of intraoral digital impressions was introduced in dentistry in the early 1980s and has been constantly evolving ever since. Digital workflow allows us omitting a few procedural phases, making the whole process faster and more accurate. A standard digital procedure includes digital intraoral scan, appliance design, 3D printing, and appliance delivery.

A. Related work

The recent systematic review of Bohner *et al.* showed that the current digital technologies are reported to be accurate for specific applications, but the scanning of edentulous arches still represents a challenge [9].

Another review indicates that while all the intraoral scanner (IOS) systems are capable of generating virtual models of acceptable accuracy in certain applications, they share similar limitations. However, different studies have reported variable outcomes from different IOS systems [10]. Current evidence suggests that patients are more likely to prefer digital

workflow than conventional techniques [11]. Digital impressions compared to conventional techniques in young orthodontic patients were rated more comfortable, but data showed no difference in terms of anxiety and stress; however, patients preferred the use of digital impressions systems instead of conventional impression techniques. Alginate impressions resulted as fast as digital impressions [12].
Burhardt showed that young orthodontic patients preferred the digital impression techniques over the alginate method, although alginate impressions required the shortest chairside time [13].
The conventional impression was more time-effective than digital impressions. In terms of patient comfort, no differences were found between conventional and digital techniques. With respect to the clinician perception of difficulty, the conventional impression and the digital impression with iTero revealed more favourable outcomes than the digital impression with Lava [14].
For single-implant sites, the quadrant-like intraoral scanning was more time efficient than the conventional full-arch impression technique in a phantom head simulating standardized optimal conditions. A high level of acceptance for IOS was observed among students and dentists [15].
Zitzman studied dental students' perceptions of digital and conventional impression techniques and found that majority of students perceived IOS as easier than the conventional technique. Most (72%) preferred the digital approach using IOS to take the implant impression to the conventional method (12%) or had no preference (12%). In this study, dental students with no clinical experience were very capable of acquiring digital tools, indicating that digital impression techniques can be included early in the dental curriculum to help them catch up with ongoing development in computer-assisted technologies used in oral rehabilitation [16].

B. The aim of the pilot study

The aim of this pilot study was to determine students' and young dentists' perception of contemporary impression techniques and preferences towards conventional or digital impression technique. The results will give us insight into the need for digital scanning impression protocols introduction in the current dental school's curriculum.

II. MATERIAL AND METHODS

Eighteen participants which were included in the study were randomly selected among 5 th and 6 th year's Dental Medicine students from the University of Split School of Medicine and year 2018. Dental Medicine graduates, six from each group. Participants from each group of six were then randomly grouped in pairs. Each pair member was assigned to perform upper jaw digital and conventional impression on each other. Participant's opinion was evaluated with two two-part questionnaires; from patient's and doctor's perspective, before and after impression taking, addressing several domains. After filling the first part of both questionnaires, participants first watched an investigator-led demonstration on digital and two-step full arch impression technique and then performed both impressions on each other, digital scan first and then conventional impression. Sirona Primescan intraoral scanner (Dentsply Sirona, Sirona Dental Systems Bensheim, Germany) was used for digital impression acquisition. Metal stock trays and Zhermack Elite HD Putty NORMAL with plastic spacer foil and Zhermack Elite HD+Light Normal (Zhermack SpA, Badia Polesine, Italy) were used for two-step impression. Both procedures were timed and performed until a clinically acceptable result was achieved. After both impressions were taken, participants filled the second part of both questionnaires.
The collected data were analyzed using GraphPad Prism software version 7.00 for Windows (GraphPad Software, La Jolla California USA, www.graphpad.com).

III. RESULTS

In this pilot study, we included 18 participants; six from 5 th and 6 th year group of students and year 2018. Dental Medicine graduates, a total of 18 participants, with an average age of 24.16.

A. Practitioner's perspective

There was a statistically significant difference (s) in the time needed for digital and conventional impression, with digital being faster (s, 1.786 min, 95% CI (0.8901 to 2.681), p=0.0006, Paired t-test). The younger students-5th year had the lowest average scan time, but it wasn't significant (ns), and the greatest difference between the scan and conventional impression taking time (s, p=0.0074, 2.657 min, 95% CI (4.623 to 0.6906), 2-way ANOVA).
Majority of participants were somewhat familiar with digital impression technique and completely familiar with the conventional technique, but one-third of participants answered that they are completely or partially unfamiliar with independent use of software and different digital/electronic devices.
Before impression taking, the majority thought that digital impression technique would be easier to perform than conventional, and afterwards, results remained the same (ns, p >0.9999, Fisher exact test).
Participants expected conventional impression to be neither easy or difficult before, and the same answer prevailed afterwards (ns, p=0.5313, Wilcoxon matched-pairs signed rank test). As for digital scan, before and after, participants answered it would be easy (ns, p= 0.9316, Wilcoxon matched-pairs signed rank test).
The number of scans they thought to be necessary to take before they could perform it competently hadn't changed before and after (ns, average 11.6 before and 8.2 after).
When asked about a technique which would save more time, there was a significant difference between before and after answers: afterwards all participants answered that digital impression technique would spare more time in their office (s, p=0.0025, Chi-square, Fig.1).
When asked which technique would save more money, the most frequent answer was digital technique and before and after answers were not significantly different (ns, p=0.7961, Chi-square).
Majority of participants thought that digital techniques would completely replace conventional techniques during their lifetime and that attitude hasn't changed afterwards.

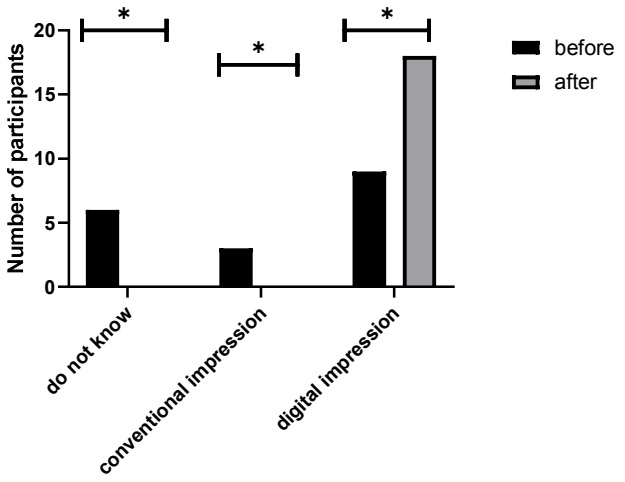

Fig.1. Answers to question: „Which technique do you expect would save you the most time in your dental office?" (*statistically significant)

B. Patient's perspective

All answers in this questionnaire, before and after were analyzed using Wilcoxon matched-pairs signed rank test.

Majority of participants thought that conventional impression wasn't pleasant, and that hasn't changed afterwards (ns, p>0.9999).

There was a significant difference between before and after answers regarding the speed of conventional impression execution (s, p=0.0171). Participant thought that conventional was less quick to perform afterwards.

When asked if scanning was pleasant, the majority thought that it was completely true before, and that changed for one Lickert point afterwards, but was not significant.

Opinion about scanning speed significantly improved afterwards (s, p=0.0264). Majority of the participants before were neutral about scanning speed, but afterwards thought it was partially true that scanning was quick.

When asked whether scanning was easy for the practitioner, the majority thought it was partially true, and afterwards, it improved slightly, but not significantly (ns, p=0.0918).

IV. DISCUSSION

Digitization of medicine and dental medicine has started decades ago and is influencing practitioners' workflow on a daily basis. Development of computer technology and accompanying equipment results in deep changes in clinical approaches and there is a great need for adapting dental schools' curricula to those changes and develop new training methods.

In this pilot study, we tried to assess current students' and young dentists' perception of contemporary impression techniques and preferences towards conventional or digital impression technique.

Our results showed a statistically significant difference in time needed for digital and conventional impression, with digital being faster. Younger students (5th year) had the lowest average scan time and the greatest, significant difference between the scan and conventional impression taking time, which can be attributed to the fact that they are less experienced in conventional impression technique. As expected, participants were more familiar with conventional than with digital impression technique, since the conventional technique is being taught in dental schools and digital techniques are left out and usually available only on paid courses.

Interestingly, as much as one-third of participants answered that they are completely or partially unfamiliar with independent use of software and different digital/electronic devices. It is a rather surprising revelation since today's students differ from earlier generations for being in constant contact with different gadgets and applications in a virtual environment.

Before impression taking, the majority thought that digital impression technique would be easier to perform than conventional, and, as expected afterwards results remained the same.

Participants expected conventional impression to be neither easy or difficult before, and the same answer prevailed afterwards. As for digital scan, before and after, participants answered it would be easy.

The number of scans they thought to be necessary to take before they could perform it competently hadn't changed before and after.

When asked about a technique which would save more time, there was a significant difference between before and after answers: afterwards all participants answered that digital impression technique would spare more time in their office.

When asked which technique would save more money, the most frequent answer was the digital technique. Before and after answers were not significantly different, although they were informed about the cost of the intraoral scanner after scanning.

Majority of participants thought that digital techniques would completely replace conventional techniques during their lifetime and that attitude hasn't changed afterwards.

Patient's perspective is the irreplaceable tool in assessing the implementation of new technologies. Majority of participants thought that conventional impression wasn't pleasant, and that hasn't changed afterwards.

There was a significant difference between before and after answers regarding the speed of conventional impression execution. Participant thought that conventional impression was less quick to perform after they experienced it.

When asked if scanning was pleasant, the majority thought that it was completely true before. After they experienced it, participants slightly changed their minds, stating it less pleasant than before, but the change was not significant.

Opinion about scanning speed significantly improved afterwards. Majority of the participant before were neutral about scanning speed, but afterwards, they opinion about that significantly improved.

When asked whether scanning was easy for the practitioner, the majority thought it was partially true, and afterwards, it improved slightly, but not significantly.

Our pilot study yielded interesting results and is an introduction in a bigger study dealing with the implementation of new technologies in dental schools' curricula.

V. Conclusion

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

- The practitioners needed significantly less time for digital impression than for conventional impression.
- Younger students (5th year) had the greatest, significant difference between the scan and conventional impression taking time.
- One-third of participants were completely or partially unfamiliar with independent use of software and different digital/electronic devices.
- After the impression-taking, all participants answered that digital impression technique would spare more time in their office.
- Majority of participants thought that digital techniques would completely replace conventional techniques during their lifetime.
- From a patient's perspective, the digital scan was more pleasant than the conventional impression.
- New dental techniques require the development of new training methods and adaptation of dental schools' curricula.
- Courses for developing skills in the independent use of software and different digital/electronic devices are needed as a part of dental education.

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