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THE COMFORT AND COST EFFECTIVENESS OF INTRAORAL SCANNING FOR DENTAL EDUCATION AT A PUBLIC UNIVERSITY: A CASE STUDY

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ABSTRACT

The use of intraoral scanners in undergraduate dental education is gaining recognition, but there is still a gap in its utilization at this level. This study aimed to assess the feasibility of incorporating intraoral scanning into undergraduate dental education at a public university. Questionnaires were distributed to dental faculty, students, and patients, with a total of 25 patient respondents, 27 student respondents, and 11 faculty respondents. Statistical analysis revealed a preference for scanning among patients in various variables such as overall procedure, size of the mouth mold, occlusal registration, clinical time, taste, and nausea. The majority of students (85%) had to repeat the impression, and only 19 students felt partially comfortable performing it. Faculty members, on the other hand, believed that students completed the procedure adequately, although they had to intervene in the impression process. In terms of university costs, scanning was found to be less costly due to the reduced number of repeated procedures. The project's innovation lies in its ability to compare costs, comfort levels, and clinical time associated with scanning versus traditional methods, which can have a positive impact on multidisciplinary environments. Overall, the results indicated that scanning was preferred over conventional methods by patients, students, and faculty members. The study highlights the importance of incorporating new technologies into undergraduate dental education and emphasizes the benefits of using intraoral scanners. By integrating these technologies into the curriculum, students can gain valuable experience with cutting-edge tools, ultimately preparing them for the evolving field of dentistry.

Keywords: Digital Dentistry. Health Technology Assessment. Dental Impression Materials. Intraoral Scanners.

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INTRODUCTION

Due to the pandemic, it has become necessary to modify and standardize the way care is provided, seeking greater clinical safety and minimizing possible risks in care.[1] Digital dentistry is safer and reduces the risk of infection by limiting the professional's contact at the time of scanning and allowing effective disinfection of the equipment.[2]

One of the benefits of digital dentistry is improved predictability with treatment results due to the accuracy of the scan and reduced working time with simplified production processes such as CAD/CAM for making different types of prostheses, which is more agile and has greater adaptability of the piece in the mouth. [3,4]

Digital technologies began their global implementation in dental education and have reached varying levels of insertion, depending on local resources and demands.[5,6] Patients also report better convenience in the way they sit in the chair, as they avoid choking, the risk of asphyxiation and irritation from the taste perceived during conventional moldings, which does not occur with intraoral scanning.[7]

Within dental education, there is a latent discussion about new technologies and how this could impact the profession, so much so that between 2004 and 2013, demographic analysis studies were launched discussing dentists and the change from prosthetic technicians to dental technology technicians. With the advancement of the technology industries, companies will aim to partner with dentists to promote equipment in future dental prosthesis laboratories. [8,9]

In addition to the importance of teaching, another important point for the adoption of new technologies and digital dentistry is cost, in which it is possible to analyze that the digital flow reduces costs in the long term, since the main revolution of CAD/CAM technology is the reduction in the costs of finishing sessions, chair time and fabrication time, reconciled with the increased performance of restorations[10,11] and reduces errors[12], consequently greater patient satisfaction.

The topics of teaching and perception of molding and scanning were addressed in an evaluation of the perception of dental students and surgeons about conventional molding in relation to intraoral scanning, which showed that students learned better with digital flow, but at a high cost.[13]An evaluation of the clinical and cost results of making a total prosthesis in conventional and digital flow was also recently carried out at a university, as there are still doubts about the teaching and use of this technology for undergraduate students. [14]

Therefore, the present study aims to evaluate conventional impression taking versus

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intraoral scanning within teaching at a public university, through three different perspectives: the dental lecturer, the undergraduate student having access to digital flow treatment, and the patient, on the variables of cost, clinical time, nausea, taste and overall procedure.

MATERIALS AND METHODS

This prospective research was carried out to evaluate the viability of impression taking versus scanning in undergraduate teaching, through three different perspectives:

1. Patient Group (PG): considering the variables of comfort, treatment time, general procedure and cost of university visits.
2. Student Group (GA): considering treatment time, biosafety, learning and the cost of materials.
3. Teacher Group (GPR): considering student learning, treatment time and assertiveness in the clinical procedure.

The study was carried out in accordance with the principles described by the Human Research Ethics Committee and approved under number 5.704.956. All those involved in the sample accepted the free and informed consent form (Appendix A), and in the case of children, the free and informed assent form (Appendix B). The total sample for each group was defined by convenience, due to the heterogeneity and number of patients, students and teachers present by discipline and period, and also because the evaluation was based on the person's own perception of both procedures, which would not imply a comparison between the groups studied. The sample definition was calculated using the SurveyMonkey online application. The total number of professors working in clinical subjects involving impression taking in undergraduate teaching was taken into account. At the time of the study, there were 14 professors and 10 respondents were needed, with a 95% confidence level and a 20% error. As for the students, at the time of the study there were 140 students in the aforementioned clinical subjects, i.e. those involving impression taking, who agreed to take part in the study, requiring 21 respondents. As for the patients, using the same test parameters, the representative number was 20.

The benefits of the research for patients are reflected in the comfort generated by the use of new technology that aims to reduce the clinical stages of dental treatment, for students in learning a new technology and for teachers in the perspective of teaching innovations and reducing stages and costs for the institution. The risks of this study are the same as those inherent in the molding or scanning procedure already planned in dental

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treatment planning, such as nausea, oral discomfort, lip and gum pain. To minimize the existing risks of the procedure, only a trained professional carried out the scans to minimize reading errors, and in the conventional impression taking flow, the undergraduate student and teachers continued to carry out the procedure as recommended by each subject in the undergraduate clinic.

For intraoral scanning the operator of the scanner was the master's degree student responsible for the study. For the conventional flow, the impression was taken by the undergraduate students and, when necessary, the teacher responsible for the subject intervened. With regard to materials, alginate was used in the Full Denture and Orthodontics disciplines and condensation silicone with base paste and light putty in the Removable Partial Denture and Implant disciplines. Due to the heterogeneity of each clinic and procedure carried out during the undergraduate course, the aim was not to compare acuity but rather digital flow, number of sessions and patient comfort. Therefore, this study did not evaluate the accuracy, precision or comparison between materials, but rather the procedure itself.

The patients received a printed questionnaire (Appendix C) adapted from the study by Wismeijer et al.[4] with 18 questions immediately after the molding and scanning procedure, so that the answers could be obtained on the same day as the appointment. The questionnaire includes questions about patient data, such as age and gender, and questions about perceived comfort and cost data. For patients aged between 6 and 10, the same questionnaire was adapted with images to illustrate the answers and make them easier to understand (Appendix D).

Undergraduate students received a printed questionnaire (Appendix E) immediately after the impression-taking or scanning procedure to obtain their answers on the day of the appointment, containing 7 questions about the student's data, age, gender, perception of comfort when carrying out the impression-taking procedure, cost data on materials and learning.

The teachers received a printed questionnaire (Appendix F) with 8 questions at the end of the clinical session of molding and scanning with questions related to clinical assertiveness, importance in learning, need for intervention and clinical time per appointment.

The costs of conventional molding were evaluated by surveying the cost of a molding session, the material chosen, the number of repetitions performed by those involved in the

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study per procedure, the cost of disinfection materials, the plaster used to make the model and the biosafety equipment used per procedure. On the other hand, scanning was evaluated by looking at the cost per scan, the total value of the equipment on the market divided by the number of procedures carried out, the cost per disposable sleeve, the number of repetitions and the biosafety equipment used per procedure.

The questionnaires were analyzed for the sample of patients, teachers and students, each in their own group, and within the same person's perception of both procedures, so it was possible to carry out unit and group comparisons. To analyze statistically, Pearson's correlation test was carried out between the perceptions of the variables involving each of the procedures. The T-test was used to assess whether there was a $p<0.05$, which would indicate a statistically significant difference, and $p<0.01$ was found for the general procedure and nausea variable, $p<0.009$ for the time variable and $p<0.006$ for the size, preparation and use of the tray and mouthpiece. In addition, a statistical correlation was found between nausea and procedure time, and between nausea and taste of the molding material by Pearson's correlation test.

RESULTS

PERCEPTION

In the end, 20 adult patients and 5 children, both adults and elderly, answered, the youngest being 7 years old and the oldest 81 years old.

In the general molding procedure criterion, eight patients reported it as "good", seven patients rated it as "bad" and five responded as "neutral" (Figure 1). Eighteen patients rated the scanning procedure as "good", none as "bad" and two as "neutral". Statistically, there was a difference of $p<0.05$ in this criterion (Figure 2).

Figure 1: Graph about Patient`s perception of the general molding procedure.

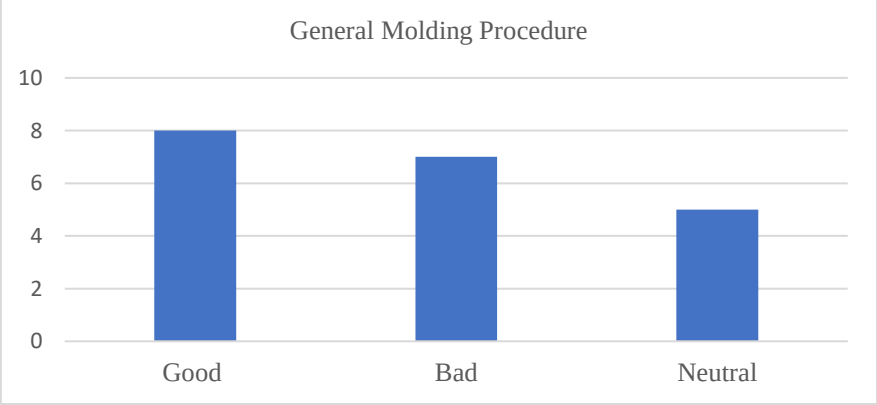

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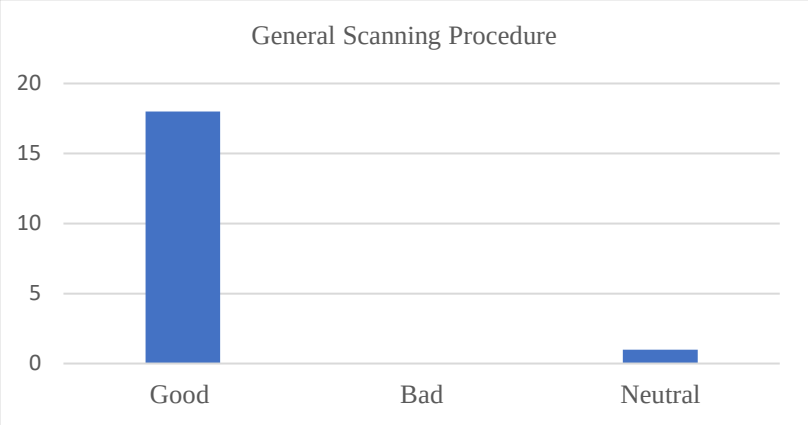
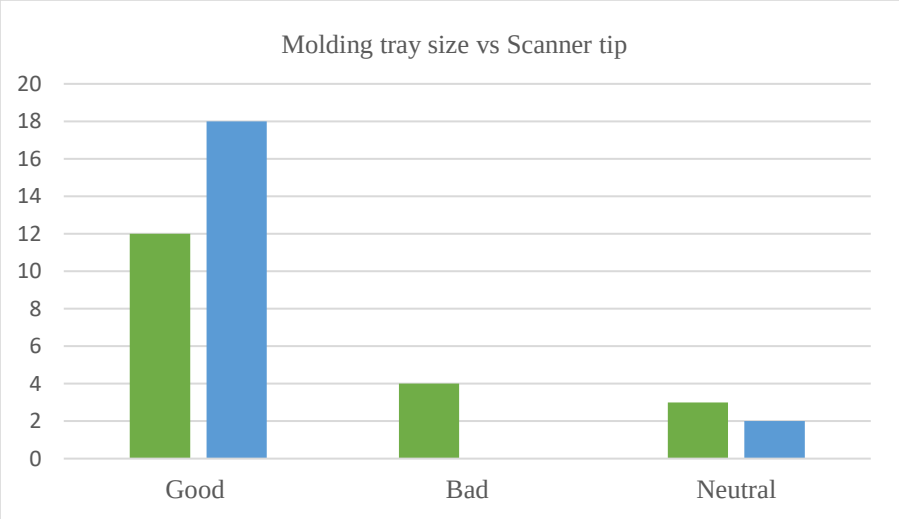
Figure 2: Graph about Patients' perception of the overall scanning procedure.



According to the T-test, there was a statistical difference of $p<0.05$ between molding tray size and scanner tip (Figure 3).

Figure 3: Graph about Comparison of patients' perception of the size of the tray in green and scanner tip in blue.



Regarding the clinical time involved in carrying out the molding procedure, eleven patients rated it as "good", three as "bad" and six as "neutral". With regard to the clinical time involved in scanning, nineteen patients responded as "good" and one as "bad" (Figure 4).

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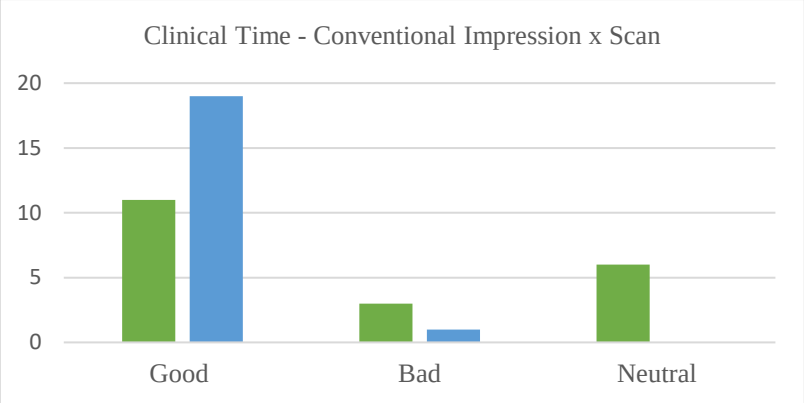
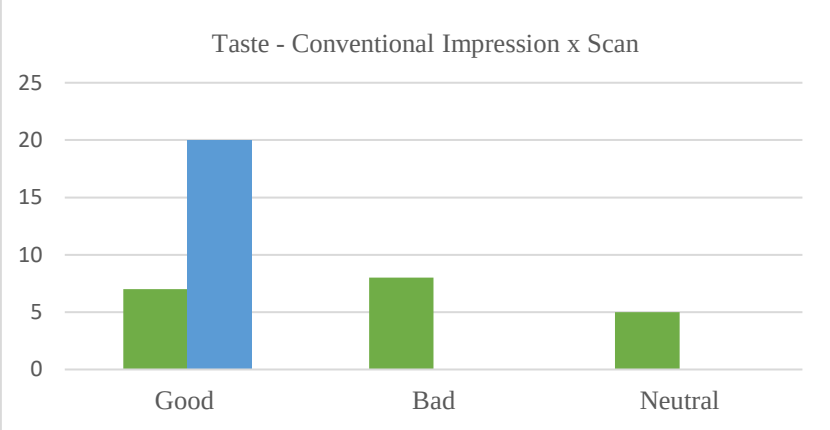
Figure 4: Graph about Comparison of patients' perception of the clinical time of the molding in green and the scanning in blue.



In the taste criteria, seven patients rated the taste of the impression material as "good", eight respondents rated it as "bad" and five rated it as "neutral". In the same taste criterion, all twenty respondents rated it as "good" about the scan (Figure 5).

Figure 5: Graph about Comparison of patient`s perception of the taste of the impression (green) and the scan (blue).



Nineteen patients reported feeling no nausea during the digital model-taking procedure with scanning, and one reported feeling nausea, but very mild and scored 1. In the same criterion, nine patients reported feeling nauseous during molding. Eleven patients reported not feeling nauseous (Figure 6).

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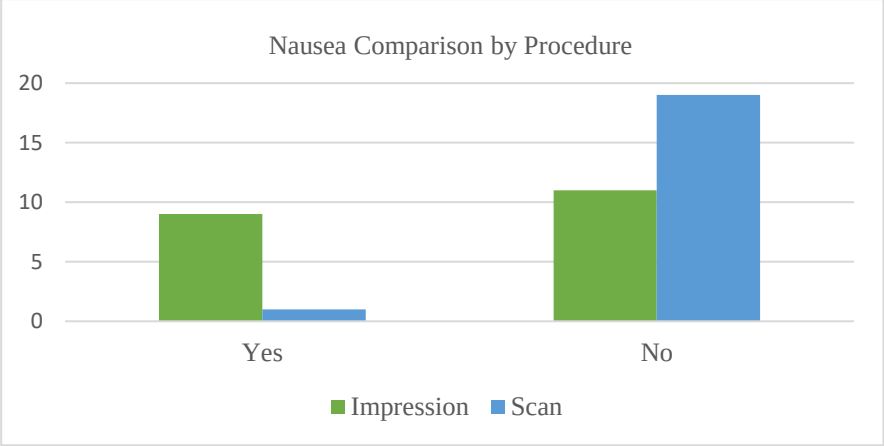
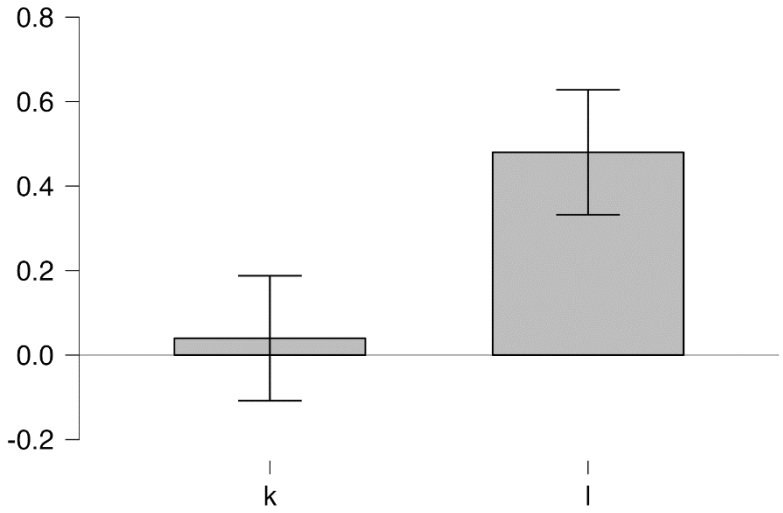
Figure 6: Graph about comparison of patients' perception of nausea. In green, the nausea in conventional impression taking and in blue the scanning



With regard to the statistical analysis of the patients on nausea, it was possible to evaluate that there was a statistically definitive difference in the best performance with the scan, both by the T-test and by the graph below (Figure 7), in which it is possible to evaluate that the incidence of nausea was lower in the scanning group.

Figure 7: Bar Plots comparing nausea with scanning (k) and with molding (l).



In total, 27 students answered the questionnaire. In terms of age, the students were aged between 21 and 31, with the predominant ages being 22, with 6 students, and 23 and 24, both with 5 students each. In terms of gender, there were 22 women and 5 men. Of all the students, four had to repeat the molding procedure only once. The majority, 7 students in total, repeated the molding procedure 5 times for each arch.

Nine students reported feeling partially comfortable due to clinical unfamiliarity, twelve felt partially comfortable due to patient discomfort issues. Six students felt

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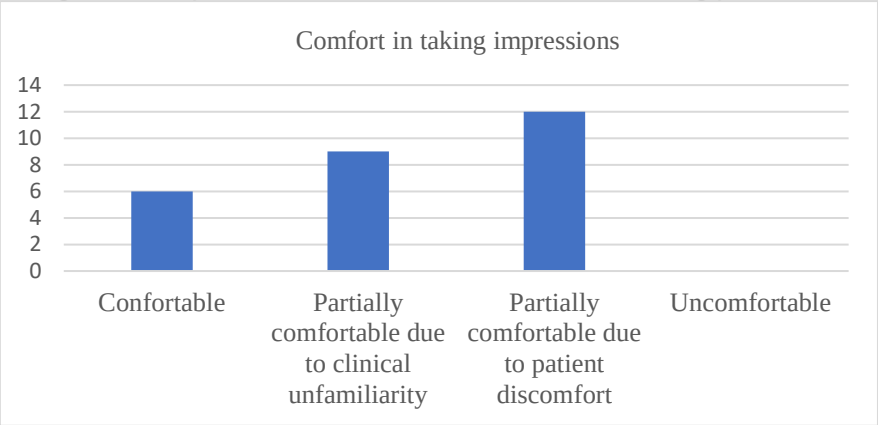
completely comfortable performing the impression procedure(Figure 8). All the students rated the teaching of new technologies as important during their undergraduate studies.

Figure 8: Graph about Students' comfort with the molding procedure.



In total, eleven teachers from undergraduate clinics who take molds in clinical practice responded. In terms of time as a teacher, the most recent teacher has been teaching for 4 years, one has been teaching for 5 years, one has been teaching for 6 years and the two who have been teaching the longest have been teaching for 28 years. The other six teachers have been teaching between 12 and 19 years. In all subjects, the teachers had to intervene during the impression session. Nine teachers believed that the final procedure had been carried out well by the students, while two teachers said it had not. All the teachers considered it important to teach new technologies in undergraduate dentistry.

COSTS

To calculate the cost of conventional impression taking, we contacted the university's cost department in order to obtain the actual amounts spent in 2022 for each material used in the undergraduate clinics. To calculate the cost of scanning, we contacted the sales department of the company responsible for the equipment used in this study with the costs for June 2023. The cost of renting the scanner used in this study is R$4999.00 per month, with insurance and software updates included in this amount, which generates an annual cost of R$59,988.00, R$149.97 per school day, with each tip costing R$14.00.

The Removable Partial Denture and Implant clinics use the Condensation Silicone material, which consists of a base paste, a light paste and a catalyst totaling R$227.29 per clinic. In Implants, each clinic spends R$186.52 per clinic. In comparison, scanning is

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24.5% cheaper per session in Implants and 36.4% in Removable Partial Dentures.

As for the Total Prosthesis clinics, they use alginate for anatomical impression taking, as well as utility wax to individualize the trays, so the cost per clinic was R$306.14. The orthodontic clinic also uses alginate material and the cost per clinic totals an average of R$153.07. In comparison, scanning is 50.3% cheaper per session in Total Prosthesis and 10.4% in orthodontics.

When comparing the costs per impression-taking session for an undergraduate class between conventional impression-taking and scanning, including the cost of plaster and disinfection materials, we calculated the average amount each clinic spends on impression-taking materials plus the cost per clinic of type III plaster to pour the model and 1% sodium hypochlorite to disinfect the impression (R$28.32) and also the cost per clinic of enzymatic detergent with scanning (R$2.00).

The calculated costs are described in Table 1.

Table 1: Cost of impression materials and cost of scanning with disinfection materials per undergraduate clinic. In red, the percentage difference.

	Costs		
Subject	Molding and Desinfection	Scanning and Desinfection	Percentual Difference
Implant	R$ 214,84	R$ 162,47	24,5%
Removable Partial Dentures	R$ 255,61	R$ 162,47	36,4%
Total Prosthesis	R$ 334,46	R$ 165,97	50,3%
Orthodontics	R$ 181,39	R$ 162,47	10,4%

DISCUSSION

When comparing the results obtained with those in the literature, we explored their nuances, using the criterion of the general molding procedure for adults, in which eight patients reported it as "good", five responded as "neutral" and seven patients rated it as "bad". With regard to the same criterion for scanning, eighteen patients rated the procedure as "good" and two rated it as "neutral". This is similar to the results obtained by Yuzbasioglu et al.[14], who compared scanning and molding techniques by evaluating patient perception, treatment comfort, efficacy and clinical results from the point of view of patient preferences and treatment comfort. The study has an N of 24 patients with no experience of impression taking or scanning, good general health, good oral hygiene, no periodontal disease and

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good mental health. This study, like the present one, not only had a very similar N, but also used an evaluation questionnaire. The scanning technique was more effective than the conventional impression technique due to its comfort, and unanimity in patient preference. There was an interval of 2 to 3 weeks between the impression and the scan so that the patient could forget the procedure. In the present study, we performed it in the same session as the impression in order to make a direct comparison between the procedures. The results of the study by Yuzbasioglu et al.[14] also revealed clinical evidence that the scanning technique can be applied to impressions of restorative procedures based on clinical results and patient preferences. The authors concluded that patients preferred scanning because of its comfort and also because it had a more efficient result. With regard to the procedure as a whole, many patients reported that they liked scanning because of the interaction with the screen and the fact that they could see "what their mouth looks like internally", which allows for a better understanding of the diagnosis and treatment plan, which was reported as intuitive.

With regard to the clinical time involved in carrying out the molding procedure in adults, 55% rated it as "good", 30% as "neutral" and 15% as "bad". With regard to the clinical time involved in scanning, 95% of patients rated it as "good" and 5% as "neutral". This result is similar to the description made by Christensen[7] where he raises several questions about the digital flow based on the literature and shows the patients' preference for the scanning concept because it is more simplified, as well as expressing relief at not having the discomfort caused by the conventional molding experience.

In a clinical study, Wismeijer et al.[4] evaluated the perception of 30 patients between conventional molding and scanning, using questionnaires that were adapted for this study. They concluded that patient preference was significantly higher for scanning due to two main factors: the time needed to carry out the activities prior to taking the impression and the taste of the impression. With regard to the taste variable, thirteen patients rated the impression as "bad", eleven patients reported it as "good", and six rated it as "neutral". With regard to scanning, all twenty-five respondents rated it as "good". In other words, even though just under half of the patients considered the taste of the molding to be good, the preference for scanning was unanimous in the "Taste" criterion, related to the patient's palate having been exposed to the material. This result was similar to that found by Wismeijer[4], but more heterogeneous as all the patients were adults. In this study we have a sample with a wider age range.

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With regard to taste, there is also the possibility of nausea. Gallardo et al.[15] in a systematic review on patient perception and clinical time for scanning versus conventional moldings concluded that the efficiency of service time was similar for both scanning and conventional molding techniques, but patients prefer scanning due to the comfort and absence of nausea. In this study, nineteen patients reported feeling no nausea during scanning, and only one reported feeling mild nausea and scored a 1. With regard to conventional impressions, nine patients reported feeling nauseous. It is interesting to note that the only patient with nausea during scanning was a child with reflux, and that of the nine patients with nausea during molding, there were both children and the elderly, which suggests that it may not be an age issue and may be more associated with the discomfort of the procedure itself, as patients of all ages reported discomfort with molding.

With regard to financial costs, the cost per session was more expensive in the prosthetics department's courses using conventional molding. This is due to the number of repetitions that students perform, and the cost ranged from R$60.00 for Removable Prosthesis to R$120.00 for Total Prosthesis. This difference is noticeable mainly because this is the subject that introduces the molding technique to undergraduates, so they use more material due to the number of repetitions required in the clinics to pass this stage. This corroborates the study by Talarico et al.[10], who found that when analyzing the overall cost of the sessions and the clinical time involved, the cost is higher for the conventional impression protocol, even though the cost of the material is effectively higher when compared to the complete procedure, because the conventional protocol requires a longer clinical time than the prosthesis obtained by digital flow.

Srinivasan et al.[16] and Daher et al.[17] had similar results in their studies, in which the fabrication of parts in the digital flow required less clinical time and final costs, which could be considered preferential because it offers advantages such as good retention, mechanical properties and adaptation. But most importantly, it preserves a digital record of the patient over the long term, allowing the digital model to be reused for future prostheses or documentary records. The result found in the present study corroborates the two mentioned due to the shorter clinical time reported by the patients during scanning and the overall procedure as a whole, and obtained a positive score for scanning in relation to impression taking. When considering a public university, the costs of manufacturing the part were paid by the patient directly to the laboratory, so they are not related to the study. But it is worth discussing for future studies to compare costs in clinics with integrated laboratories as well.

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When analyzing the perspective of the students, they are between 21 and 31 years old, and mostly women, which corresponds to what is expected at a dental university today. In addition, 23 students had to repeat the conventional molding procedure at least twice in each arch. This result was also found in the study by Lee et al.[13], one of the first studies to analyze the perception of undergraduate students and dentists in relation to Digital Dentistry. They concluded that the level of difficulty in registering the scan was the same among dental surgeons and dental students, but that conventional impression taking was more difficult for undergraduate students and easier for experienced dental surgeons. In the same study, the digital method was preferred by undergraduates due to both time and ease of handling. It should be noted that this study was carried out 10 years ago, and today many dentists would probably be more accustomed to scanning, which would cause a possible change in this result.

Among the students who reported discomfort, they commented that this feeling came from having to perform several repetitions. This result is similar to that found in the study by Schott et al.[18] which evaluated students' perspectives on intraoral scanning and orthodontic impressions. The study concluded that students were able to perform scans and impressions with basic training in the techniques, and that training students in digital dentistry is important to familiarize them with new technologies. In addition, the authors suggest that the implementation of scanning training at undergraduate level is recommended in order to familiarize students with the digital flow.

In this study, the students did not have the opportunity to scan, only to take a mold and observe how the procedure was carried out by a trained dentist. It could be speculated that future studies would be interesting from the perspective of how the students felt about the scanning. Even though they acted as observers, they agreed on the importance of having access to new technologies as undergraduates.

All the students rated the teaching of new technologies as important. This assessment by the students and the above-mentioned result about the discomfort students feel when taking molds corroborates the study by Lam et al.[19] on dental students' preference and perception of intraoral scanning and conventional molding, using an online questionnaire. The study concluded that scanning was the favorite among the students' choices and concludes that more courses with intraoral scanning integrated into postgraduate courses or as short continuing professional development modules should be provided to dental professionals and students.

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A no less important discussion is the responsibility of the public university to promote access to society, and this is where the dentistry course can promote oral health for patients and fulfill its role of teaching students to be competent in both techniques and deal with different clinical situations when they graduate, which can make students better prepared and more competent for the job market.

One of the biggest challenges in digital education is the need to continually adapt and adjust to developments in technology and apply them to dental practice in the most up-to-date way possible[5]. Eleven teachers took part in the evaluation of the teachers' perspective, the youngest of whom has been teaching for 4 years and the oldest of whom has been teaching for 28 years. All the professors believe that undergraduate teaching is extremely important, and some professors commented during the interview that being able to teach the conventional and digital model would be essential in the undergraduate course to prepare students for the market.

This result was similar to that found by Fernandez et al.[5] in a study on the digitalization of total prostheses at a postgraduate university, where questionnaires were administered to teachers to assess the inclusion of digitalization in teaching in the field. They concluded that all the participants were aware of the new technologies, with the exception of one. The majority of responses indicated that teachers plan to add digitalization to their curricula in the manufacture of total prostheses within the next 4 years. Even at postgraduate level, there is still some way to go.

At undergraduate level, students are in the process of learning more about techniques and precepts. Fernandez et al.[5] recommend reflection on greater accessibility to digital flows in undergraduate and postgraduate universities, and we stress the importance of disseminating and making teaching more accessible.

In the systematic review by Zitzmann et al.[20] on digital education in undergraduate dentistry, digitalization offers great potential to revolutionize dental education and help prepare future dentists for their daily practice.

In this study, in all subjects, teachers had to intervene in the molding session, with the teacher who intervened the most having to intervene in the procedure of eight pairs in the same clinic, and the teacher who had to intervene the least to mold was from a subject in the final year of the degree. This result shows an upward trend in the student's molding learning curve over the course of the degree.

Thinking about the high number of interventions such as impressions, the teacher

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would not need to intervene if the scan had already been carried out by the patient's screening department. In the electronic medical record, the teacher could show the student exactly what wasn't copied correctly on the screen, facilitating the teaching-learning process. Still with learning in mind, the student could scan their patterns throughout their degree and visualize their performance over the years.

When evaluating and calculating the cost of digital and conventional dentistry to obtain models, scanning was less expensive because it avoided repetition and discarding material. Arakawa et al.[21] carried out an evaluation of the clinical and cost results of conventional and digital full dentures at a university, as there are still doubts about the teaching and use of this technology for undergraduates. In this study, it was also concluded that treatment with scanning and digital flow was less costly due to both repetitions and adjustments to the parts.

After comparing the current literature with this study, it can be seen that there is still a lot of room in the literature for discussion about digital dentistry, especially when applied to undergraduate teaching and its qualitative nuances. In the present study, the limitation of a single trained dental surgeon being responsible for carrying out the scans was good for patient comfort, but in future studies it would be interesting for students to experience the execution in order to give their opinion on the intervention. This limitation is in line with the study by Yuzbasioglu et al.[4] in which only one operator carried out the molding techniques to avoid possible errors between operators. Another limitation was that not all the teachers were able to respond during the clinic. In other side, this study brings opinions of different areas and departments, which supports the multidisciplinary importance of working with digital dentistry.

Finally, it is possible to note that this study has great potential for impact by demonstrating that scanning is a procedure that helps patients understand, who felt more included by being able to visualize their diagnosis in the public network and having access to digital dentistry, students by learning a new technology in undergraduate courses and increasing their range of techniques learned for clinical practice, and teachers by being able to use the tool and reduce interventions in future clinics. In addition, there is also a reflection on the reduction in costs generated by the use of a scanner in undergraduate clinics, which exceeds R$100.00 in savings per clinic.

For the students, it was possible to notice that many don't understand how much they spend on materials in an undergraduate clinic, that most of them don't feel comfortable

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taking an impression due to the high repetition rate and that they all agree with learning new technologies, as do the teachers, who also emphasized the importance of new technologies, as well as needing to intervene in procedures. With regard to costs, scanning proved to be less expensive due to the number of repetitions carried out in the undergraduate clinic, although in recent years repetition has been lower.

CONCLUSION

For the students, it was possible to conclude that they don't feel totally comfortable taking an impression due to insecurity and patient discomfort and that they all agree with learning new technologies.

For the teachers, the importance of new technologies was unanimous and all of them needed to intervene in the molding procedures. In addition, 81% of the teachers believe that the students were able to complete the procedure well. With regard to the university's costs, scanning proved to be less expensive due to the number of repetitions carried out in the undergraduate clinic.

For the patients, the scan was better evaluated in comparison to all the variables questioned, being general procedure, size in mouth, intraoral record, clinical time, taste and nausea.

At a public university, it is interesting to use scanning to maintain the quality of undergraduate teaching with up-to-date technologies, both for the patient's experience and for the teaching and learning process between teacher and student on different ways of obtaining a model, whether conventional or digital, which better prepares the student for the job market and to reduce costs with repetitions in the final years of undergraduate studies.

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REFERENCES

1. Barenghi, L., Barenghi, A., Cadeo, C., & Di Blasio, A. (2019). Innovation by computer-aided design/computer-aided manufacturing technology: A look at infection prevention in dental settings. *Biomedical Research International*, 2019, 60–92. https://doi.org/10.1155/2019/6092018

2. Papi, P., Di Murro, B., Penna, D., & Pompa, G. (2021). Digital prosthetic workflow during COVID-19 pandemic to limit infection risk in dental practice. *Oral Diseases, 27*(3), 723–726. https://doi.org/10.1111/odi.13442

3. Lee, S. J., Macarthur, R. X., & Gallucci, G. O. (2013). An evaluation of student and clinician perception of digital and conventional implant impressions. *The Journal of Prosthetic Dentistry, 110*(5), 420–423. https://doi.org/10.1016/j.prosdent.2013.06.012

4. Wismeijer, D., Mans, R., van Genuchten, M., & Reijers, H. A. (2014). Patients' preferences when comparing analogue implant impressions using a polyether impression material versus digital impressions (Intraoral Scan) of dental implants. *Clinical Oral Implants Research, 25*(10), 1113–1118. https://doi.org/10.1111/clr.12234

5. Fernandez, M. A., Nimmo, A., & Behar-Horenstein, L. S. (2016). Digital denture fabrication in pre- and postdoctoral education: A survey of U.S. Dental Schools. *Journal of Prosthodontics, 25*(1), 83–90. https://doi.org/10.1111/jopr.12287

6. McCann, A. L., Schneiderman, E. D., & Hinton, R. J. (2010). E-teaching and learning preferences of dental and dental hygiene students. *Journal of Dental Education, 74*(1), 65–78.

7. Christensen, G. J. (2009). Impressions are changing: Deciding on conventional, digital or digital plus in-office milling. *Journal of the American Dental Association, 14*(10), 1301–1304. https://doi.org/10.14219/jada.archive.2009.0054

8. Espejo-Trung, L. C., Elian, S. N., & Luz, M. A. (2015). Development and application of a new learning object for teaching operative dentistry using augmented reality. *Journal of Dental Education, 79*(11), 1356–1362.

9. McGarry, T. J., & Jacobson, T. E. (2004). The professions of dentistry and dental laboratory technology: Improving the interface. *Journal of the American Dental Association, 135*(2), 220–226. https://doi.org/10.14219/jada.archive.2004.0156

10. Tallarico, M. (2020). Computerization and digital workflow in medicine: Focus on digital dentistry. *Materials, 13*(9), 2172. https://doi.org/10.3390/ma13092172

11. Thu, K. M., Molinero-Mourelle, P., Yeung, A. W., Abou-Ayash, S., & Lam, W. Y. (2023). Which clinical and laboratory procedures should be used to fabricate digital complete dentures? A systematic review. *The Journal of Prosthetic Dentistry, 132*(5), 922–938. https://doi.org/10.1016/j.prosdent.2023.07.027

Revista ARACÊ
ISSN: 2358-2472

12. Manoharan, P. S., Wase, P. R., & Sivakumar, S. (2024). Challenges and solutions in clinical workflow for the rehabilitation of completely edentulous patients through CAD/CAM dentures: A case study. *Cureus, 16*(3), e55394. https://doi.org/10.7759/cureus.55394

13. Yuzbasioglu, E., Kurt, H., Turunc, R., & Bilir, H. (2014). Comparison of digital and conventional impression techniques: Evaluation of patients' perception, treatment comfort, effectiveness, and clinical outcomes. *BMC Oral Health, 14*(1), 10. https://doi.org/10.1186/1472-6831-14-10

14. Gallardo, Y. R., Bohner, L., Tortamano, P., Pigozzo, M. N., Laganá, D. C., & Sesma, N. (2018). Patient outcomes and procedure working time for digital versus conventional impressions: A systematic review. *The Journal of Prosthetic Dentistry, 119*(2), 214–219. https://doi.org/10.1016/j.prosdent.2017.07.007

15. Srinivasan, M., Kamnoedboon, P., McKenna, G., Angst, L., Schimmel, M., Özcan, M., & Müller, F. (2021). CAD-CAM removable complete dentures: A systematic review and meta-analysis of trueness of fit, biocompatibility, mechanical properties, surface characteristics, color stability, time-cost analysis, clinical and patient-reported outcomes. *Journal of Dentistry, 113*, 103777. https://doi.org/10.1016/j.jdent.2021.103777

16. Daher, R., Ardu, S., di Bella, E., Krejci, I., & Duc, O. (2022). Efficiency of 3D-printed composite resin restorations compared with subtractive materials: Evaluation of fatigue behavior, cost, and time of production. *The Journal of Prosthetic Dentistry, 1*(22), 481–484. https://doi.org/10.1016/j.prosdent.2022.08.001

17. Schott, T. C., Arsalan, R., & Weimer, K. (2019). Students' perspectives on the use of digital versus conventional dental impression techniques in orthodontics. *BMC Medical Education, 19*(1), 81. https://doi.org/10.1186/s12909-019-1512-3

18. Lam, W. Y., Mak, K. C., Maghami, E., & Molinero-Mourelle, P. (2021). Dental students' preference and perception on intraoral scanning and impression making. *BMC Medical Education, 21*(1), 501. https://doi.org/10.1186/s12909-021-02894-3

19. Zitzmann, N. U., Matthisson, L., Ohla, H., & Joda, T. (2020). Digital undergraduate education in dentistry: A systematic review. *International Journal of Environmental Research and Public Health, 17*(9), 3269. https://doi.org/10.3390/ijerph17093269

20. Arakawa, I., Al-Haj Husain, N., Srinivasan, M., Maniewicz, S., Abou-Ayash, S., & Schimmel, M. (2022). Clinical outcomes and costs of conventional and digital complete dentures in a university clinic: A retrospective study. *The Journal of Prosthetic Dentistry, 128*(3), 390–395. https://doi.org/10.1016/j.prosdent.2020.12.014