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| ORIGINAL

Comparison of the perception of orthodontists and general clinicians on the use of digital dental models in the city of Aracaju/Sergipe

Comparação da percepção de ortodontistas e clínicos gerais sobre o uso de modelos digitais odontológicos na cidade de Aracaju / Sergipe

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ABSTRACT

Context: Digital study models have become a safe and advantageous alternative for diagnosis and planning in dentistry. Despite the superior characteristics in comparison with traditional plaster models, professionals seem to resist the use of new technologies. **Aims**: To assess the level of knowledge and the use of digital models through a questionnaire applied to dental professionals. **Methods**: A questionnaire with 12 multiple-choice questions about plaster models, digital, and use of the 3Shape - 3D viewer software was answered by 76 orthodontists (42 women and 34 men; mean age =37.82 years (SD ± 7.60)) and 30 general dental surgeons (18 women and 12 men; mean age of 33.93 years (SD ± 8.45)) in Aracaju, Sergipe, Brazil. Data were tabulated in Excel spreadsheets and then analyzed using the SPSS statistical software version 20. An absolute analysis of frequency and percentage of responses was performed. **Results**: Most professionals reported using plaster models and claimed their low cost as justification for their use (*P = 0.001*). Aware of the benefits of digital models, professionals of both classes highlighted the facilitated storage and search for information as the main advantages, the cost and infrastructure as the main disadvantages. Regarding the use of the 3Shape - 3D viewer software, orthodontists showed better utilization of this resource than general dental surgeons (*P = 0.0198*). **Conclusion**: It verified that most professionals make use of plaster models. However, despite knowing the advantages of digital models, their cost is sees as a limiting factor for adherence to this technology.

Indexing terms: Dentistry. Dental models. Orthodontics.

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RESUMO

***Contexto**: Os modelos digitais de estudo têm se tornado uma alternativa segura e vantajosa para o diagnóstico e planejamento em odontologia. Apesar das características superiores em comparação aos modelos tradicionais de gesso, os profissionais parecem resistir ao uso de novas tecnologias.* ***Objetivos**: Avaliar o nível de conhecimento e a utilização de modelos digitais por meio de questionário aplicado a profissionais da área odontológica.* ***Material e Métodos**: Questionário com 12 questões de múltipla escolha sobre modelos de gesso, digitais e uso do software 3Shape - 3D viewer foi respondido por 76 ortodontistas (42 mulheres e 34 homens; idade média = 37,82 anos (DP = ± 7,60)) e 30 cirurgiões-dentistas gerais (18 mulheres e 12 homens; média de idade de 33,93 anos (DP = ± 8,45)) em Aracaju, Sergipe, Brasil. Os dados foram tabulados em planilhas do Excel e posteriormente analisados no software estatístico SPSS versão 20. Foi realizada uma análise absoluta de frequência e percentual de respostas.* ***Resultados**: A maioria dos profissionais relatou utilizar modelos de gesso e alegou seu baixo custo como justificativa para seu uso (P = 0,001). Cientes dos benefícios dos modelos digitais, os profissionais de ambas as classes destacaram o armazenamento facilitado e a busca de informações como as principais vantagens, o custo e a infraestrutura como as principais desvantagens. Em relação à utilização do software 3Shape - 3D viewer, os ortodontistas apresentaram melhor aproveitamento desse recurso do que os cirurgiões-dentistas gerais (P = 0,0198).* ***Conclusões**: Verificou-se que a maioria dos profissionais faz uso de modelos de gesso. Porém, apesar de conhecer as vantagens dos modelos digitais, seu custo é visto como um fator limitante para a adesão a essa tecnologia.*

Termos de indexação: *Odontologia. Modelos dentários. Ortodontia.*

INTRODUCTION

Plaster casts are essential study tools in dentistry, frequently used for oral rehabilitation, orthognathic surgery and orthodontic treatment, ensuring a good reproduction of anatomical details [1]. In orthodontics, they are a valuable method for diagnosis and planning, allowing the three-dimensional occlusion detection to assess the degree and severity of dental malocclusions [2]. In oral rehabilitation, the plaster models are used for more challenging aesthetic and functional clinical cases with laminated facets [3] and implant-retained overdentures [4,5]. Besides that, plaster casts are also used in other Dentistry fields, such as the Sports Dentistry, making mouthguards for sports practice, which is an ally to prevent injuries on the orofacial region [6].

Plaster casts provide an excellent duplication of anatomical details in a practical and low-cost way. However, as disadvantages, they require space for their storage, are at risk of being fractured, are more susceptible to loss of information, and need to be manipulated and transported for discussion of the case with other professionals [1,7,8]. Furthermore, conventional dental modeling procedures may represent an unpleasant experience for the patient, and the models obtained may be susceptible to deformation due to the impression material, tray or technique used [9,10].

With technological advances and interest in three-dimensional and digital technology in the medical and dental areas, digital models have been developed with characteristics that eschew the difficulties encountered with conventional models [11]. The advantages include reduced time for analysis, the possibility of sharing information with other professionals over the internet [2,12], more efficient storage and recovery, greater diagnostic versatility, superior durability, and shorter processing time [13].

Digital models were obtained for the first time through digital scanning of plaster models in 1999 by OrthoCad®. This technology can generate digital study models by scanning the alginate impression or by direct intraoral scanning [2]. Much has been discussed about the accuracy and reproducibility of this technique, but studies report them as satisfactory so as not to interfere with the success of orthodontic planning, and the use of these models have become a reality in clinical practice [14,15].

Although digital models are widely used in orthodontics, it does not seem to be a widespread tool among general dentists since their training in dentistry [16,17]. This study aimed to compare the knowledge and perception of orthodontists and general dental surgeons on the use of dental digital models.

METHODS

This is an observational, cross-sectional, and questionnaire-based survey conducted among 106 orthodontists and general dental surgeons randomly selected in the city of Aracaju, state of Sergipe, Brazil. All individuals were

informed about the study and those who agreed to participate, signed a written informed consent. The study protocol was approved by the Institutional Review Board/Independent Ethics Committee (IRB/IEC) for investigation with human beings (Approval number: 61984816.1.0000.5546) in accordance with the Declaration of Helsinki.

General dental surgeons and orthodontists both enrolled in the Board of the Regional Dental Council were included in the study. Participants who did not complete all questions were excluded. The professionals were selected by a convenience sampling, resulting in 106 questionnaires, 76 were answered by orthodontists and 30 by clinical dental surgeons from December of 2019 to January of 2020. The group of orthodontists was consisted of 42 women and 34 men with a mean age of 37.82 years (SD= ±7.60) and the group of general dentists was consisted of 18 women and 12 men with mean age of 33.93 years (SD= ±8.45).

A semi-structured questionnaire was given to the volunteers who answered the questions without an established deadline and without the help of other professionals or supporting bibliography. The questionnaire consisted of 12 questions divided into three parts: plaster models (table 1), digital models (table 2) and 3Shape - 3D viewer software (Table 3), the latter being presented before the application of the questionnaire.

Table 1. Plaster Models: Questionnaire with the absolute frequencies and percentual of responses given by orthodontists and clinical dental surgeons, applying the chi-square test for independent samples.

Questions	Orthodontist		Clinical Dental Surgeon		
	n	%	n	%	*P*-value
Which dental model do you utilize to make the planning of your patients?					
Plaster models	54	71.05%	15	58.57%	<0.001*
Digital models	17	22.36%	0	0%	
Plaster and Digital models	5	6.57%	13	46.42%	
TOTAL	76	100%	8	100%	
Do you know the 3D scanner system?					
Yes	38	48.10%	9	31.03%	0.008*
No	4	5.06%	6	20.68%	
I have already heard about	28	35.44%	13	44.82%	
I utilize this system	9	5.06%	0	0.00%	
No answer	0	0%	0	0%	
TOTAL	76	100%	28	100%	
In your opinion, which are the advantages of the utilization of gypsum orthodontic models?					
Model accuracy	14	18.42%	0	0.00%	0.001*
Cost;	38	50.00%	17	60.71%	
American Board of Orthodontics Model	8	10.52%	0	0%	
Articulator assembling	11	14.47%	11	39.28%	
Three-dimensionality Sensation	30	39.47%	7	25%	
Simplicity in the model production	34	44.73%	9	32.14	
No answer	0	0%	1	3.57%	
In your opinion, which are the situations in which the gypsum orthodontic model should be preferred?					
Surgical cases	32	42.10%	12	42.85%	0.016*
Temporomandibular dysfunction	3	3.94%	3	10.71	
American Board of Orthodontics Model	11	14.47%	1	3.57	
Digital models are utilized in all the cases	28	36.84%	7	35%	
Crossbite, open-bite and deep bite	21	27.63%	8	28.57%	
No answer	0	0%	6	21.42%	

Note: *p<0.05 (statistically significant difference).

The questions were presented in a multiple-choice format and were related to the dental model preference of the participants to make treatment planning; the advantages and disadvantages of each dental model (plaster caster and digital model); if they have known the 3d scanner system and their perception about its usage. A computer with an Intel Core I7 processor, 6 Gigabytes of RAM memory, a 500 GB hard disk, and a 20-inch liquid crystal display (LCD) monitor with standardized brightness and contrast, was used for evaluation of the 3Shape - 3D viewer software (3Shape, Copenhagen, Denmark).

The collected data were tabulated in a Microsoft Excel 2010 spreadsheet and analyzed on the Statistical Package for the Social Sciences version 20 (SPSS Inc., Chicago, IL, USA). The answers of the participants were analyzed through percentage analysis and chi-square test.

Table 2. Digital Models: Questionnaire with the absolute and percentual frequencies of answers given by the orthodontists and clinical dental surgeons applying the chi-square test for independent samples.

Questions	Orthodontist		Clinical Dental Surgeon		
	n	%	n	%	*P*-value
In your opinion, which are the advantages of the utilization of digital models?					
Model accuracy	18	23.68%	4	14.28	0.316
Development of virtual diagnosis	39	51.31%	12	42.85	
Avoiding of losses and damages in the models	53	69.73%	19	67.85%	
Easy storage and search for information	62	81.57%	21	75%	
New technology	28	36.84%	10	35.71	
Speed and practicality in the measurement	30	39.47%	14	50%	
No answer	0	0%	2	7.14%	
In your opinion, which are the disadvantages of the utilization of digital models?					
Cost and infrastructure	48	63.15%	16	57.14%	0.201
Discrepancy in the occlusion	16	21.05%	3	10.71%	
Lack of three-dimensionality sensation	23	30.26%	6	21.42%	
Lack of software standardization	30	39.47%	9	32.14%	
No answer	0	0%	2	7.14%	
Do you plan to change to digital models?					
Yes	28	38.35%	6	20.68%	0.003*
No	4	5.47%	2	6.89%	
Don't know	20	27.39%	11	37.93%	
Maintain both types	21	28.76%	5	17.24	
No answer	0	0%	5	17.24%	

Note: *p<0.05 (statistically significant difference).

RESULTS

All questionnaires were completely answered and eligible for analysis. Of the 106 questionnaires, 76 were answered by orthodontists (42 women and 34 men; mean age =37.82 years (SD= ± 7.60)) and 30 by clinical dental surgeons (18 women and 12 men; mean age of 33.93 years (SD= ±8.45)).

Most orthodontists (48.10%) were knowledgeable about the 3Shape - 3D viewer system, with a significant difference between the professional profiles in terms of answer pattern (*P = 0.008*). However, both orthodontists (71.05%) and general dental surgeons (58.57%) reported using plaster casts, and expressed a preference for traditional models rather than digital ones (*P< 0.001*). For certain situations, such as surgical case planning, plaster models were

preferred by orthodontists (42.10%) and general dentists (42.65%) (*P= 0.016*). In addition, cost was a factor highlighted as justification for the preference to use plaster models of most professionals (table 1).

Some differences were observed between the two professional profiles when they were asked about their plan to migrate to the use of digital models; 38.35% of orthodontists say they would make this change immediately (*p = 0.003*). The main reasons for using digital models were the possibility to avoid the risk of loss and damage to models (69.73% of orthodontists and 67.85% of general dentists) and the easy storage and exchange of information between professionals (81.57% of orthodontists and 75% of general dentists). However, cost and infrastructure were listed as the main disadvantages (63.15% of orthodontists and 57.14% of general dentists) (table 2).

About the use of the 3Shape - 3D viewer software, table 3 shows that 66.21% of orthodontists stated that the software does not have a difficult interface. When asked about taking measurements for treatment planning using the software, general dentists had more difficulty making measurements compared to orthodontists, with a statistically significant difference (*P = 0.0198*).

Table 3. 3Shape-3D viewer system: Questionnaire with the absolute and percentual frequencies or answers given by orthodontists and clinical dental surgeons applying the Fisher test for independent samples.

Questions	Orthodontist		Clinical Dental Surgeon		
	n	%	n	%	*P*-value
In your opinion, 3Shape-3D viewer system software presents an interface of difficult utilization?					
Yes	25	33.78%	8	26.66%	1,000
No	49	66.21%	15	50%	
No answer	0	0%	7	23%	
Did you achieve to make the measurements necessary for the treatment planning of your patients using the Software?					
Yes	49	66,21%	3	10,34%	0.0198*
No	25	33,78%	8	27,58%	
No answer	0	0%	18	62.08%	

Note: *p<0.05 (statistically significant difference).

DISCUSSION

This study assessed the knowledge and use of digital models of orthodontists and general dental surgeons through a multiple-choice face-to-face questionnaire. Face-to-face surveys with questionnaires have higher response rates when compared to surveys with electronic questionnaires or sent by mail [18,19]. However, the presence of an interviewer during the application of the questionnaire can induce bias in the results [20]. Therefore, the questionnaires in this study were answered without the presence of an interviewer.

The possibilities of using digital images result from scientific advances, allowing professionals to use media which were once inconceivable. The search for agility in clinical practice and facilitated communication between professionals has driven the search for digital technologies that aid in the clinical routine [21]. The use of digital models in orthodontics is an alternative to plaster models, and can even overcome the limitations of the latter by presenting less risk of damage to the model, less clinical time for impressions, no need for physical space for storage, and easy management in communications with others professionals without compromising the quality of the diagnosis [2,7,17,22,23]. In addition, digitized material contributes to sustainable dentistry [23].

Most orthodontists in this study said they knew about three-dimensional digital models (table 1). This can be justified by the fact that study models are essential for planning and diagnosis in orthodontics, and thus the types of

existing models, such as digital ones, is a common topic [12,23]. However, even knowing and using digital models, orthodontists believe that plaster models are more accurate (table 1).

In the literature, several studies have compared the accuracy of plaster models and digital models [2,10,12,23,24], but results are controversial. Santoro et al. [7] and Zilberman et al. [25] showed that the results of plaster models were more accurate and reproducible. Controversially, Tomita et al. [24] reported that models obtained by digital scanning are more accurate. Suryajaya et al. [26], support that affirmation since their study demonstrates that plaster models can not be a gold standard reference measurement since it does not represent the actual size of the tooth depending on the type of impression material used.

Besides these controversial statements, Ko et al. [15] and Yilmaz et al. [12] showed in their studies that both models could be used without any negative implication for orthodontic treatments. These differences in measurements between different types of models can be linked to features such as malocclusions prior to treatment Verma et al. [23], type of impression material [26] and type of printing technique [27,28], and that they may present statistically significant differences yet not clinically relevant to justify the contraindication of digital models [23,26-28].

For the planning of surgical cases, most of the professionals interviewed opted for the use of the plaster models (table 1), which may represent a tendency towards their usual method, ensuring greater safety for themselves in the elaboration of more complex cases. In orthognathic surgeries, planning was traditionally carried out mounting dental models articulators. With the novel digital technologies, the use of digital models has been well accepted for the surgical planning of craniofacial anomalies. This alternative has the advantages of increasing surgical accuracy, reducing the time of operation, facilitating the pre-adaptation of bone plates before surgery, facilitating the explanation of the surgical procedure to the patient in a more comprehensive way, and providing educational benefits for the clinical team [29]. Ho et al. [22] showed that intraoral scanning was accurate and reliable for all stages of orthognathic surgery planning, and may even replace the traditional approach. The use of software for digital models allows obtaining important structures measurements such as the height and width of the alveolar crest, the individual buccolingual inclination of the teeth, the length and inclination of the palatal processes, as well as the external contour of the region of the alveolar crest [30,31].

The results of this work showed that even the vast majority of professionals who did not use digital models recognized that the use of this new system allows a less time-consuming routine, better use of space for storage of models, greater exchange of information with other professionals, and efficient search for some information in their offices (table2).

There is consensus in the literature that plaster models can be more easily lost and degraded, and that they require space for their storage and transportation to exchange information with other professionals [1,7,11]. Also, measurements on plaster dental casts require more time and are more prone to errors due to anatomical variations [2]. In the present study, the results corroborate with the literature; most professionals recognized these disadvantages. The limitations found in plaster models can be a motivating agent to search for new technologies by these professionals. However, the cost and infrastructure required for technologies such as digital systems are seen as impeding factors from the perspective of the professionals interviewed in this research (table 2).

Most orthodontists in this study considered the possibility of migrating to the use of digital models in view of the need and because of the advantages offered by them (table 2). However, as these tools do not have an affordable cost, this step has been postponed. According to Kravitz et al. [32], the cost of an intraoral scanner can indirectly reduce other costs, but it can also bring greater efficiency in clinical practice, and such an investment can be recovered within two years. In a study by Glisic et al. [10], the cost of the intraoral scanning technique was greater in the first 3.6 years and lower after that time when compared to plaster models obtained from alginate impressions. Studies are still necessary to assess this economic perspective. Moreover, costs are difficult to measure due to the different types of digital software available on the market. As digital technologies are constantly evolving, these costs are expected to decrease over time.

The present work corroborates the findings of the literature with respect to the characteristic ease of using the system to develop measures, which does not present major difficulties, demonstrating to be an easy-to-use system

and that does not require deep knowledge. On the other hand, the results showed that a part of the professionals had difficulties in handling the system, and were noteworthy in the fact that many of them never used this system (table 3). It is evident that making use of this system is just a matter of time and training for most professionals [9].

The profile of the interviewees, including characteristics such as time since graduation or specialty, which could justify the patterns seen in the answers, was not investigated. In general, the literature reveals that older clinicians are less interested in digital innovations in dentistry due to their historic of using the same conventional method for impressions with good clinical results. To get used to new technologies, great experience is required to have good results and it seems that younger dentists are more wiling to face this learning. Little data related to the performance of the professional who is scanning are available, however the interest about digital models and volume of scientific research about it are increasing [33].

CONCLUSION

The present study shows that orthodontists are more familiar with digital models and this fact is justified by the need to use study models for planning and diagnosing cases, which is part of the routine of their specialties. This was highlighted by the easy handling of the 3Shape - 3D viewer software by orthodontists when compared to the general dental surgeons. Although knowing well the advantages of digital models, both orthodontists and general practitioners see the cost of this technology as a limiting factor for their adherence to the use of digital models.

Collaborators

LS Menezes, conceptualization, data curation, formal analysis, investigation, methodology, project administration, resources, software, supervision, validation, visualization, writing – original draft, writing – review & editing. LR Santos, conceptualization, data curation, formal analysis, investigation, methodology, resources, supervision, validation, visualization, writing – original draft. MAL Santos, conceptualization, data curation, formal analysis, investigation, methodology, project administration, resources, software, supervision, validation, visualization, writing – original draft, writing – review & editing. GR Couto, conceptualization, formal analysis, methodology, validation, writing – original draft, writing – review & editing. FS Santana, conceptualization, data curation, investigation, methodology, resources, supervision, validation, visualization, writing – original draft. WM Takeshita, conceptualization, data curation, formal analysis, investigation, methodology, project administration, resources, software, supervision, validation, visualization, writing – original draft, writing – review & editing.

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