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INTRODUCTION TO ORTHODONTIC EDUCATION IN BULGARIA OF DIGITAL TECHNOLOGIES AND 3D ARCHIVING

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Abstract: Our goal is to introduce in the training of students and the post-graduate students in orthodontics studying and working with digital technologies to generate virtual "plaster" models and work with digital X-rays.
For this purpose, we evaluate the volume of gypsum models created by students and residents for two years of their training and create a list of positives and shortcomings in introducing the full digital use and storing of the biometric data of patients.
The study included 661 patients treated by post-graduate and the students in the FDM – Sofia, for the last two school years. In total, in the course of two school years the treatment of patients from students and post-graduate ones is stored 1474 plaster models, for which the materials are consumed and considerable time and human labor. If all these models are digitally scanned and stored as files, they will not occupy space and will turn off the work of the dental technicians. For the accuracy of the plaster models there are several compromising points – used materials and human factor. The implementation of intraoral and facial scanners and the good processing of their data certainly affect the effectiveness, accuracy and predictability of the results of orthodontic treatment.
When establishing database of digital models, a model for diagnosis at any time during the training and testing may be provided to learners at random. Electronically the stored dossiers can provide data, both for biometric analyses and for radiological analyses, which can be combined with the photographic image of the patient. In this way, the practical-diagnostic exercises of graduate and university students will be facilitated, and the examination by the lecturers will be facilitated.
Keywords: Digital models, Intra-oral scanner, Biometric analysis, Orthodontic analysis

1. INTRODUCTION

The orthodontic deformation is a condition in which there is an abnormal alignment of the teeth in the individual tooth arc and/or disturbances of the occlusal tooth ratio of the two teeth. Today's society dictates the norms of the acceptable, normal and attractive appearance. Therefore, the very pronounced forms of orthodontic deformities can create a sense of social rejection, which could lead to negative consequences for individual social expression.
The orthodontic treatments are prolonged in the time, associated with growth of the organism and ending with the almost life-long retention. The changes, that take place with them, affect the level of the tooth-jaw system and the skeleton. This happens slowly and gradually, making them elusive as a process for the patient and parent who daily monitor their own teeth. The orthodontist, who sees the patient in a certain period of time and looks by a professional eye to the treatment, evaluates much more accurately. For the patient, it is also important to have an objective way of making such an assessment, and this is precisely the conduct of good orthodontic documentation. In the context of continuously developing modern medicine, it is very important for patients to offer alternatives to future treatment by discussing negatives and positives in individual variants (Kravitz et al., 2014). So that to be this choice informative and sufficiently understood, it is appropriate to use the VTO (visualization of treatment option) techniques. For this purpose, the patient's data needs to be stored and processed computerized so as to reproduce the planned future treatment outcomes. Orthodontic practice uses data from orthodontic model in occlusion, radiographs and photos. The complete orthodontic treatment requires keeping and storing of the orthodontic documentation, which includes: patient orthodontic card (patient file), orthodontic occlusion model previous, during and after treatment, radiographs and photos previous, during and after treatment, coupons and directions for others specialists, instructions for carrying and hygiene of the appliances, a map for the appointment of visits and others. The digital age allows all of this documentation to be digitized and stored without time limitation because these are the biometric data of the individual who can support any future changes in his status. The digitization of this data involves the use of 3D models of upper and lower jaw and its occlusion, digital recording of X-rays and photographic studies, and the use of a suitable storage form (Martin et al., 2014).
For the first time 3D tooth scanning was introduced about 30 years ago for use with computer-aided design and automated manufacturing (CAD/CAM) to produce dental restorations (Mörgmann 2006). The scanning devices can generate a digital 3D image of the upper and the lower tooth arc of existing plaster cast or impressions (negative

image), directly from the patient's mouth. The created images can be recorded and used as such individually as separate jaws or included in the occlusion. The first orthodontic scanning is believed to have been since 1999, but companies in the market have been developing and refining software and scanning technologies permanently. The future is digital scanning of the arc to become a routine task in clinical practice.

2. AIM

The aim of our study is to create a list of motivational prerequisites for the development and introduction of the digital technology in the orthodontic education and practice in the curriculum for the training of students and dental specialists in post-graduate courses.

3. MATERIAL AND METHODS

The study included 661 patients treated by students and post-graduate students at the Faculty of Medicine in Sofia for the last two years. Patients divide them into two groups, indicating who does the treatment - a post-graduate student (group 1) or a student (group 2). In both patient groups, treatment is conducted under the guidance of assistant or professors.

Table 1 Distribution of the reviewed patients by age

		N	Age			
			Mean	SD	Min	Max
In total for both groups		661	11,97	5,81	5,00	51,00
Group 1- treated by postgraduates	Man	149	13,91	5,69	6,00	39,00
	Women	216	14,95	7,30	5,00	51,00
	Total for group 1	365	14,53	6,70	5,00	51,00
Group 2 – treated by students	Man	144	8,85	1,42	6,00	13,00
	Women	152	8,79	1,49	6,00	18,00
	Total for group 2	296	8,82	1,45	6,00	18,00

The group 1 of patients who treatment included 365 people (149 male and 216 female) with an average age of 14.53 ± 6.70 years. A group 2 includes 296 patients, 144 boys and 152 girls. Because of the specifics of the training, the average age of patients treated in the student group is 8.82 ± 1.45 years, which can be seen in detail in Table 1.

4. RESULTS AND DISCUSSION

The student level training involves clinical work with patients with only removable orthodontic appliances, while in post-graduate education, taught and working with removable and fixed devices, the distribution of this indicator is presented in Table 2.

Table 2 Appliances' type used in the both group of patients – fixed and removable

Removable and fixed devices	Statistics	Group 1	Group 2	Total
Fixed	N	289	0	289
	%	79,2%	0,0%	43,7%
Removable	N	76	296	372
	%	20,8%	100,0%	56,3%
Total	N	365	296	661
	%	100,0%	100,0%	100,0%

The age limit of the patients treated by the post-graduate students in orthodontics covers patients with a mixed dentition who complete the treatment with a fully completed permanent dentition. During this longer treatment period, the treatment went through at least two phases - interseptiv treatment and basically treatment. This suggests that in this group of patients, one fifth (20.8%) of patients were used in the initial phase of removable devices.

Evaluating the the treatment by the students, we can conclude that 296 patients were treated with two casts at the beginning of the treatment period to be used for analysis and diagnostics and also for the preparation of removable healing appliances. At the end of the treatment period, the same patients were taken one cast on a gypsum storage model as documentation attesting the end of the treatment. This makes 888 plaster patterns for the study period, with 592 of them physically casts.

Only one cast was taken in the patients who have being treating in one-stage (289) with a fixed technique by the post-graduate students and a model was developed at the beginning and end of the treatment, representing a total of 578 models. Multiple-stage (76 patients) treated patients were depressed for pre-treatment diagnosis, for making removable appliances, for evaluating first-line treatment, and evaluating the outcome of treatment, as well as for their production of retention appliances. This means taking 6 physical (plaster) casts from a patient and storing at least 4 of them as a documentation or 304 models. A total of 1474 plaster patterns of treatment of patients done by post-graduate students and orthodontic students were stored for two years, which the use of materials and considerable time and labor technics was spend for. If all of these models are digitally scanned and stored as files, they will not take up space and will turn off the work of the dental technicians. For the accuracy of the plaster models there are several critical points: the used print material, the shrinkage of the material over the time to casting, the rigidity of the plaster used for the models and, last but not least, the human factor. All of these points can place significant deviations in the future model and, accordingly, in the diagnosis made on it (Luthardta, Loosb, Quaasc 2005). With new generations of intraoral scanners, all these negatives are minimized (Birnbaum, Aaronson, Stevens, Cohen, 2009).

The digital scanning can be used in orthodontics for a variety of applications: diagnostics, treatment planning, appliance design, or brace jigs; simulation of orthognatic surgery and construction of occlusion guides (Gateno et al., 2007; Cousley and Turner, 2014); evaluation of surgical results in patients with cleft and abnormalities of the palate (Asquith and McIntyre, 2012) and others.

The orthodontic diagnostics use biometric methods that require denture accuracy, since by collecting the medio-distal dimension of teeth size in one dental arch (12 or even 14 sizes) it sometimes accumulates an error within 2-3 mm, which is often close as the number of deficiencies in the tooth arch. Clinically, this amount of discrepancy is often offset by the aproximal stripping method, but this should be pre-set in the treatment plan. If the manual measurement is not accurate, it changes the plan during the course of treatment, and other techniques that have not been previously discussed and discussed with the patient are required. There is an increasing number of articles discussing the assessment of dental discrepancy and the accuracy of dental dimensions (Bailey et al., 2014). Diagnostic software, which develops the software programs themselves, is increasingly reliant on, but facilitates daily practice. Many authors examine the effectiveness of this process (Keim et al., 2008; Rheude, Sadowsky, Ferriera, Jacobson 2005).

The recent studies have shown that 3D scanning is more acceptable in terms of patient perception and comfort than traditional impressions (Yuzbasioglu, Kurt, Turunc, Bilir, 2014). Using the software programs to model the end-effect of treatment is a good motivation for the patient's choice of tretment approach. This is particularly true for so-called border patients and patients treated with teeth extractions. Patients often can not imagine the arrangement of teeth if they lack two or four premolars. The computer simulation of the digital model facilitates perception.

The greatest convenience in working with 3D oral scanning and its ability is to combine and integrate the image with other affordable systems, such as the CBCT technique and images. Through this integrated mechanism, it is possible to reconstruct the entire facial-jaw zone and present to the patient the change after the orthodontic treatment on his face profile.

If a digital model database is created, it could be given to random learners a diagnostic model at any point in their training and testing. Electronically stored dossiers can provide data for both biometric analyzes and radiological analyzes, and this can be combined with the patient's photographic image and so the analyst has the complete picture of the patient. This will facilitate the practical-diagnostic exercises of the post-graduate students and the students, as well as facilitate lectures and tests. For this purpose, the study of digital technologies, working with different software products and archiving digital patient data should be included in new researches.

5. CONCLUSION

The implementation of intraoral and facial scanners and the good processing of their data certainly affect the effectiveness, accuracy and predictability of results from orthodontic treatment. The plaster models have a long and proven history as a routine method and have been a gold standard for orthodontics analysis for the years. However, plaster casts have several disadvantages, including labor-intensive work, searching for physical storage space, instability, degradation, and problems during the transfer.

The digital models of research offer a reliable alternative to traditional models. Their advantages in orthodontic diagnostics and treatment planning include easy and fast electronic data transfer, instant access and easy storage. The digital models can be integrated into various patient information management systems, digital records along with digital photos, X-rays and clinical notes. All biometric analyzes are quickly and easily applied to this type of model. Digital models integrate successfully with CBCT data, making it easier to plan the treatment of orthognatic cases, create surgical guides, or prepare dentures or appliances. If necessary, 3D models can be printed and used as a physical device.

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