

INTRAORAL SCANNERS ON VERTICAL AND HORIZONTAL DEEP SUBGINGIVAL MARGINS: 3D ANALYSIS AND ACCURACY

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Aim: evaluate the accuracy of 2 intraoral scanners (IOSs) (TRIOS 4 and Medit i700) on both horizontal and vertical tooth-preparations at different depth levels below the gingival margin and assess if the IOSs detect the area beyond the finish line of these preparation designs.

Methods: four abutments of a maxillary first molar were designed using CAD software, with vertical and horizontal preparation lines at 1 and 2 mm from the gingival margin. The abutments were printed in resin and placed on a reference typodont. Ten scans were made with the IOSs on each preparation design to obtain 8 experimental groups: about Medit i700 they were named for horizontal preparation “H-1M” at 1 mm from the gingival margin and “H-2M” at 2 mm, while for vertical ones “V-1M” at 1 mm and “V-2M” at 2 mm. About TRIOS 4, they were named “H-1T”, “H-2T”, “V-1T”, and “V-2T”.

The scans were imported into a dedicated software, then trueness and precision were evaluated in μm . In addition to descriptive statistics, the Games-Howell was run to analyze differences among groups ($\alpha=.05$).

Results: about the trueness, statistically significant differences were found for H-1T/H-2T, H-1M/V-1M, H-2M/V-2M, V-1M/V-2M, H-1T/H-1M, H-2T/H-2M, V-1T/V-1M, V-2T/V-2M.

As regards the precision, significant differences were detected for H-2T/V-2T, V-1T/V-2T, H-1M/H-2M, H-1T/H-1M, V-2T/V-2M. Only for vertical preparations, it was possible to record the area beyond the finish line.

Conclusions: although only vertical preparations allow for registration beyond the finish line with IOSs, the mean accuracy values for both the vertical and horizontal geometries are within the clinically approved threshold at 1 and 2 mm below the gingival margin.

DIGITAL AESTHETIC DENTISTRY COURSE FOR UNDERGRADUATES: OUR DESIGN AND ASSESSMENT

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Aim: nowadays, digital dentistry represents a fundamental skill to acquire for dentists of this era. The digital workflow took hold and it is widespread in most of the disciplines of the dentistry. Because of this, it could be advisable to insert this content in the undergraduate program. The aims of this work were to create a course in digital aesthetic dentistry and to evaluate its effectiveness.

Methods: dental students of University of Verona (from the third to the sixth year) attended a pilot course of 2 hours about the topics of photography, digital esthetic analysis and rehabilitations digitally planned. Students were randomly divided into two groups, the first group attended the course held with video-tutorials and second one attended traditional lessons with slides. The ability of students was tested in per-

forming a digital aesthetic analysis and rehabilitation; furthermore, a questionnaire was administered to understand the satisfaction of the students about the course and the method of administration. Statistical analyses were performed.

Results: the course was greatly appreciated, especially by the students who received the video-tutorial lessons. Good results in performing digital analysis and rehabilitation were obtained and they resulted better in the first group.

Conclusions: the digital aesthetic dentistry was a success in terms of new skills acquired, in this perspective the proposal of a course of this topic in undergraduate program deserves to be accurately evaluated. The video-tutorial method seems to be a good form to teach operative digital procedures.

ACCURACY AND PRECISION OF DIGITAL AND CONVENTIONAL IMPRESSIONS WITH SCANNABLE MATERIALS

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Aim: the aim of this study was to compare the accuracy and precision of 3 intraoral scanners and one impression material with scannable properties, by means of three-dimensional analysis of a complete dental arch.

Methods: a modified anatomical model of complete upper fully dentate arch provided of a Scan body, placed in the retroincisive area was used. It was firstly scanned by a laboratory scanner to create a digital reference model. Then, twenty-five impressions ($n = 25$) of the model were taken and the five groups were built: $n = 5$ impressions with scannable PVS material using standard trays (PVSc), $n = 5$ impressions with scannable PVS material using 3D printed customized trays (PVSi), $n = 5$ digital impressions with Trios4, $n = 5$ digital impressions with Omnicam and $n = 5$ digital impressions with Ite-

ro. STL files obtained from the IOS scans and scanned impressions were three-dimensional superimposed on the STL file of the reference model by using the Scan body.

Results: the ANOVA test with post-hoc Bonferroni correction shows statistically significant differences between the accuracy and precision values of the groups analyzed. The most precise and accurate impression technique was that with polyvinylsiloxanes and commercial impression trays. OMNI-CAM results the least accurate group (45.4 ± 29) while PVSi results the least precise (46 ± 11)

Conclusions: scannable impression polyvinylsiloxane materials used in standard trays result equally or more accurate and precise than the IOSs tested. Each impression system shows clinically acceptable deviations from the reference model

PURPOSE OF A NEW METHOD OF DENTAL ARCHES SUPERIMPOSITION

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Aim: the aim of this study was to present a new method of dental arches 3D superimposition for *in vitro* comparison of the accuracy and precision of digital or conventional dental impressions

Methods: an upper dental arch model was provided of a Scan body in the retroincisive area and scanned by a laboratory scanner to create a digital reference model. Then, it was scanned by an experienced operator using an intraoral scanner (Trios4) with the scan strategy recommended by the manufacturer. The STL file obtained from the IOS was three-dimensionally superimposed to the STL file of the reference model with 3 different methods by using a 3D point cloud processing software: full-arch best-fit alignment, best-fit alignment only at the Scan body and best-fit alignment at the tooth where the

scan started. 3D discrepancies of the mesh file from the reference model were registered for each superimposition

Results: the Gaussian distribution of the discrepancies between the two models shows different levels of accuracy depending on the method of superimposition used: 28 ± 95 for full-arch best-fit alignment, 38 ± 165 μm for best-fit alignment at the Scan body and 95 ± 190 μm for best-fit alignment at the tooth where the scan started. Furthermore, the distribution of discrepancies between the models visibly changes according to the superimposition method

Conclusions: different 3D superimposition methods result in different values of accuracy and precision for complete dental arch impressions. A systematic method of comparison should be investigated to obtain more reliable results.

DIGITAL REHABILITATION WITH ENDOCROWN OF A SEVERELY COMPROMISED DENTAL ELEMENT

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Aim: aim of this case report was to validate the efficacy of a endo-resto procedure such as conservative therapy on integrity and durability of conservative treatment.

Methods: the patient presented with severe carious lesion on the element 4.6 with a large periapical lesion. The pulp vitality test and the periodontal probing were negative; the tooth had a grade I mobility. The root canal treatment was performed with Protaper Next and the canal system was obturated with a carrier based system. An immediate chairside endocrown was realized with the hybrid ceramic CAD-CAM. For this kind of chair side restoration, the Cerec System was used. As first step, a set of digital impressions plus a biocopy of the lower arch were taken. Later, the distal portion of the enamel visible was left and easy reachable, instead of build-

ing up completely the distal wall. The prep stage ended using the bud shaped bur, being careful to remain in the depth of the enamel: the shape of the bur will give us a well defined finish line. The chosen block was milled, the clinician finish and characterize it, the inner part was sandblasted and inserted on the tooth.

Results: after 6 months from the endo-resto procedure a clinical and radiographic healing were performed.

Conclusions: this procedure was able to preserve the endodontic seal, the tooth integrity and function. This preparation is designed for adhesive techniques and for CAD-CAM materials, that rely mainly on bonding to the tooth structures, no kind of retention is needed or looked for, simply stability as an aid positioning of the restoration.

VIRTUAL ANTHROPOLOGY IN DENTISTRY: FUTURE TOOLS TO INVESTIGATE THE PAST

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Aim: teeth are an important resource for the study of the populations of the past, due to their great resistance over time, even in poor environmental conditions. Radiology is the most appropriate approach to the study of skeletal remains because it can be used without any damage to the sample. Virtual dental anthropology consists in modern imaging tools applied to paleodontological investigation. The present study aims to evaluate the reliability and accuracy of CBCT and intraoral scanning (IOS) for the assessment of dental and oral diseases of a collective burial discovered in Northern Italy.

Methods: during the renovation of the ancient hospital in Parma ("Ospedale Vecchio"), the commingled and disarticulated skeletal remains of 12 individuals dating back to the 18th century were discovered. After a thorough cleaning of the findings, the mandibles were associated with the respective upper jaws, then a virtual dental anthropological approach was performed using CBCT, IOS and high-detailed photographs.

Results: combining visual inspection and imaging, we identi-

fied features and diseases affecting teeth and alveolar bone. The most frequently observed feature was dental wear (8 of 12), while tooth decay was less prevalent. In some subjects, we detected enamel hypoplasia, which was excellently displayed with IOS. Periodontal disease was the main cause of tooth loss in our sample (6 of 12) and CBCT enabled to improve the examination with metric and non-metric parameters. Also, dental age estimation of a subject with mixed dentition was performed with CBCT.

Conclusions: the investigation of paleodontological material using CBCT is an excellent option to improve the assessment of oral status and it provides an unbiased view of dentition, that conventional 2D radiographs cannot reveal. Scanning with IOS allows to obtain the most reliable record of unique archaeological material, on which dental impression should not be made due to the risk of damage. We expect that these tools will increasingly support traditional techniques in osteo-archaeological research.

ZYGOMATIC AND PTERYGOID IMPLANTS IN SEVERE MAXILLARY ATROPHIES: A FULLY DIGITAL WORKFLOW

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Aim: the use of zygomatic and pterygoid implants in severe atrophies is an increasingly popular surgical solution. The digitalization of dental processes related to these extreme solutions has simplified treatment plans making them accessible to a greater number of practitioners.

Methods: in the first step, an impression is made with an intra-oral scanner of the rebased prosthesis, and through reverse engineering, employing CAD software, a prototype is obtained through 3D printing, with which a digital axiography is recorded. Based on the axiography and thanks to the digital articulator, a temporary restoration is made using CAM. Once functionalized in the mouth, the temporary prosthesis is scanned to obtain a copy that will constitute the radiological template. A CBCT of the patient is performed with the radiological tem-

plate and the resulting DICOM file is superimposed on the STL file of the temporary prosthesis within a guided surgery software. Finally, based on the collected data, the implant insertion is designed with the consequent realization of a surgical template. Once the intervention is performed, it is possible, thanks to the digital workflow, to carry out the immediate load without the need for a further impression.

Results: the final position of the implants is determined by bone availability and the prosthetic project, as the latter especially, being more difficult to comply with inside the traditional technique.

Conclusions: the digital workflow allows to obtain a predictable product in all its phases giving the doctor and the patient a safe and repeatable result.

THE USEFULNESS OF STEREPHOTOGRAMMETRY IN CLEFT LIP AND PALATE SURGERY: A CASE SERIES

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Aim: the aim of this case series is to present the usefulness of stereophotogrammetry in Cleft lip and palate surgery.

Methods: the 3D imaging system that we used is the Vectra M3® (3D Imaging System; Canfield Scientific, Parsippany, NJ, USA) and the inherent software (Face Sculptor®, Mirror® PhotoFile®, Mirror® PhotoTools®). We acquired the images of four children under the age of two. The patients were born with: cleft palate associated with Pierre Robin syndrome; incomplete left cleft lip; right cleft lip and palate; bilateral cleft lip.

Results: we acquired the pre- and post-surgery images for all the patients, compared the change in volume of the soft tissue involved (with a colour distance map) and the overall result of the surgery.

Conclusions: Vectra M3® (3D Imaging System; Canfield Scientific, Parsippany, NJ, USA) proved to be a very useful and accurate tool not only for comparing the pre and the post-surgery, thus allowing to obtain a fast, effective and immediate comparison, but it also allowed to measure changes in volume of the soft tissue and to storage the data.

3D PRINTED CUSTOM POST EXTRACTIVE HEALING ABUTMENTS: AN INNOVATIVE DIGITAL APPLICATION

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Aim: peri-implant tissue healing in the case of post-extractive implant can be difficult to predict due to variables related to both soft and hard tissues. The progress of healing can lead to a deficit of both soft and hard tissues. This case series presents a protocol to preserve the socket and condition the gingiva in case of post-extractive implant placement.

Methods: this case series presents a non-interventional study; all patients consented to the publication of the data. All surgical interventions involved the extraction of a single tooth and the simultaneous positioning of an implant, using a surgical guide. At the end of each surgery, a 3D printed customized healing abutment was screwed in. Each abutment was tailored

upon the extracted tooth and based upon the desired implant emergence profile.

Results: all cases presented had optimal initial healing with no signs or symptoms of complication. Six months after surgery, the alveolar bone was preserved and the desired emergence profiles were achieved. A longer duration of surgery caused by the placement of the customized healing abutment can be compensated for by the absence of membranes, sutures, the need for stitch removal and second surgery.

Conclusions: this protocol is promising for peri-implant tissue healing in case of post-extractive implant. Further large cohort studies are needed.

IMAGING SOFTWARE ACCURACY FOR 3D RENDERING OF DENTITION, A SURFACE-TO-SURFACE ANALYSIS

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Aim: the present study aimed to assess the accuracy of 3D rendering of the dental anatomy obtained from four free-source software.

Methods: a total of 20 Cone-beam computed tomography (CBCT) were selected to perform semi-automatic segmentation of dentition by testing Invesalius, ITK-Snap, Slicer 3D and Seg3D software. The same models were manually segmented (Mimics) and set as the ground truth (GT) of the investigation. A specific 3D imaging technology was used to perform model superimposition (semi-automatic model/GT) and surface-to-surface matching analysis. The accuracy of semi-automatic segmentation was evaluated by comparing volumetric and percentage of matching data.

Results: statistically significant differences were found in the volumetric dimensions and the matching percentage among the tested software ($p < 0.001$). Two software showed an underestimation of the teeth models (Invesalius; Seg 3D), while the other software showed an overestimation (ITK-Snap, Slicer 3D) of the same models. Semi-automatic segmentation methods highly correlated with manual segmentation (0,859 to 0,985) and excellent reliability was found for both intra-observer (0.971 to 0.997) and inter-observer readings (0,877 to 0,980).

Conclusions: dental anatomy obtained with semi-automatic segmentation should be taken with caution when an accurate definition of radicular area is required.

CBCT ANALYSIS OF DEVIATIONS BETWEEN DIGITAL PLANNED IMPLANT POSITION VS *IN VIVO* PLACEMENT

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Aim: implant rehabilitation in cases of mono-edentulism in the esthetic area is a challenge for the clinicians. The aim of our study was to test the diagnostic-therapeutic accuracy of computer-guided implant placement in the esthetic area using implant guided surgical kit (Neoss guide, Neoss Ltd., Harrogate, UK).

Methods: post implant surgery Cone Beam Computed Tomography (CBCT) scans were retrospectively analyzed to assess the accuracy of computer-guided implant placement compared to the pre-operative computer-digital planned implant position. We selective enrolled CBCT scans of patients underwent immediate or delayed implant placement of a single maxillary incisor, treated with computer-guided implant surgery through tooth-supported digitally designed 3D printed guide. Our analysis consisted in 3 digital measurements: the me-

an deviation of implant axis, and the mean mesiodistal implant deviation measured both at the apex and at the head of the implant.

Results: 95 implants were placed in 95 patients (60 Males, 35 Females; age from 27 to 45-year-old). Congruence analysis, between digital planned ideal implant position and after implant placement position, showed a mean deviation of implant axis of $1,04^\circ \pm 0,56^\circ$ in sagittal projection, a mean mesiodistal implant deviation between adjacent teeth of $0,14 \text{ mm} \pm 0,07 \text{ mm}$ at implant head level and $0,8 \text{ mm} \pm 0,3 \text{ mm}$ at the apex in axial projection.

Conclusions: computer-guided implant placement through tooth-supported guide was extremely accurate in the esthetic area because the deviations between real implant position and the preoperative planning was not clinically relevant.

PSYCHOPHYSIOLOGICAL RHYTHMS IN YOUNG DENTISTRY: IS THERE ANY PROOF OF STRESS RELATED ACTIVATION?

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Aim: the primary goal is to evaluate the relationship between physiological parameters like: electrodermal activity (EDA), heart rate variability (HRV) and heart rate (BPM), during working time in comparison with non-working activity. A secondary aim is to evaluate if there is any difference between young dentists self-referring anxiety while approaching the patient in comparison to non-anxious dentists.

Methods: 8 young dentists (5M, 3F), aged between 26 and 33 years, with a mean of 3 years of practice are enrolled in two groups. Group 1, composed of 4 people with anxiety during the relationship with the patient and Group 2 with low level of anxiety, both of them wore a wearable device to measure EDA, HRV and BPM, during a 24-hour period.

Results: there were no statistical differences between Group 1 and Group 2, as regards working time and non-working time physiological activity, but an interesting pattern has been displayed. Anxious dentists showed lower sympathetic activity during sleep and higher parasympathetic activity during working time. However, no statistical difference comparing all subjects in working time versus non-working time in all the parameters was found.

Conclusions: the small size of the sample didn't allow to reach a level of significance, but we observed several sustained electrodermal responses during working time, in both groups and a pattern of physiological activity that need to be further studied. Further research is needed to deepen the understanding of this topic.

ASSESSMENT OCCLUSAL MORPHOLOGY ZIRCONIA CROWNS: CORRELATION TECHNIQUE VERSUS LIBRARY METHOD

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Aim: the purpose of this clinical trial was to compare the occlusal morphology of monolithic zirconia crowns of molars designed by using correlation technique and library technique.

Materials and Methods: 28 molars of 24 participants were included in this trial. For each tooth one interim crown and two definitive crowns were constructed. The definitive crowns were fabricated by using the correlation technique or the library technique. The interim and definitive crowns were evaluated intraorally for Intercuspal occlusion and lateral interference, while were recorded by using articulating paper 24-micron-thick. The clinical photographs were taken immediately to calculate area of static and dynamic contacts (SDC) using software (ImageJ) and analyzed by the Kruskal-Wallis test.

Results: the average and \pm standard deviation (SD) of area of the occlusal contacts on interim crowns was 32.27 ± 3.45

mm^2 . The areas of definitive crowns designed by using the correlation technique and library technique respectively were $31.01 \pm 3.73 \text{ mm}^2$ and $36.85 \pm 5.78 \text{ mm}^2$. No statistically significant difference was found ($p = 0.091$) between the occlusal contacts areas of the interim and definitive crowns designed by using the correlation technique. Instead, there were significant differences between the areas of occlusal contacts of the interim and definitive crowns designed by using the library technique, and between the areas of occlusal contacts of definitive crowns designed by using the correlation and library techniques ($p < 0.001$)

Conclusions: the occlusal information of definitive crowns designed by using correlation technique is similar to that one of interim crown. Crowns designed by using the correlation technique produced improved SDC compared to the library method that is less effective.

ARTIFICIAL INTELLIGENCE: A NEW DIAGNOSTIC SOFTWARE IN DENTISTRY. A PRELIMINARY STUDY

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Aim: Artificial Intelligence (AI) has taken hold in public health because more and more people are looking to make a diagnosis using technology that allows them to work faster and more accurately, reducing costs and the number of medical errors. The primary objective of this preliminary study was to evaluate the accuracy measures of a diagnostic tool based on artificial intelligence and machine learning. The secondary objective was to analyze the accuracy of this tool for the diagnosis of different dental diseases or conditions.

Methods: in the present study, 120 panoramic X-rays (OPGs) were randomly selected from the Unit of Dental Prosthesis at the Department of Oral and Maxillofacial Sciences of Sapienza University of Rome, Italy. The OPGs were acquired and analyzed using Apox which takes a panoramic X-ray and auto-

matically returns the dental formula, the presence or absence of teeth, the presence of dental implants, prosthetic crowns, fillings and root remnants. A descriptive analysis was performed presenting the categorical variables as absolute and relative frequencies.

Results: in total, the percentage values of true positive (TP) was 2.195 (19.06%); true negative (TN), 8.908 (77.34%); false positive (FP), 132 (1.15%); and false negative (FN), 283 (2.46%). The overall sensitivity was 0.89, while the overall specificity was 0.98.

Conclusions: the present study shows the latest achievements in dentistry, analyzing the application and credibility of a new diagnostic method to improve the work of dentists and patients' care.

REPRODUCIBILITY OF DIGITAL SET-UP FOR TREATMENTS WITH CLEAR ALIGNERS: A STANDARDIZED PROTOCOL

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Aim: the aim of this study was to investigate the reproducibility of digital orthodontic set-up of the same patient when using a standardized prescription protocol.

Methods: 50 patients were evaluated by the same orthodontist who formulated an individual prescription, applying a standardized protocol for set-up planning. Virtual set up, according to these prescriptions, were prepared by 3 different operators at the begin of the study (t_0) and after 1 month (t_1). After a three months wash out period (t_2), the same virtual models were sent to the same operators with a simple request of teeth alignment, leveling and derotation; this procedure was repeated after one month (t_3).

Results: the comparison between t_2 and t_3 set-up showed both statistically and clinically significant differences with re-

gard to extrusion, intrusion, and inclination correction's values in the anterior teeth, and with regard to inclination correction's values in the posterior teeth. The same differences were found after comparing t_0 and t_1 mean results with t_2 and t_3 mean results. No significant differences were found between t_0 and t_1 set-up. The intra-operator reproducibility study showed excellent reproducibility at t_0 and t_1 , and good reproducibility at t_2 and t_3 . The inter-operator reliability showed high reliability at t_0 and t_1 and good reproducibility at t_2 and t_3 .

Conclusions: the use of an individual prescription for each patient and the application of a strict set up protocol are effective in improving virtual set-up reproducibility when planning an invisible aligner treatment.

TELEDENTISTRY: AN OVERVIEW ON ACTUAL DIFFUSION AND FUTURE DEVELOPMENTS IN DENTAL CARE

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Aim: this narrative review aims to investigate the possible applications and the potential future developments of teledentistry (TD).

Methods: an electronical search focused on the keyword "teledentistry" was performed on the MEDLINE (PubMed). The search was limited to clinical trials (CT) and randomized clinical trials (RCT) published in English, without time limitation.

Results: nine studies were included. Four of them were RCT, while 5 were prospective observational studies. Five papers evaluated the use of TD for orthodontic purposes (2 RCT and 3 observational studies), while 3 studies (2 RCT and 1 observational study) analyzed its efficacy in early caries diagnosis in children. Finally, one study investigated the utility of TD as screening method in an inmate population.

When used for orthodontic purposes, TD resulted to be a beneficial time-saving approach both for patients and specialists, improving domiciliary oral hygiene motivation and reducing inappropriate orthodontic referrals. TD was also considered a useful dental caries screening method for children living in rural areas, while no benefits were found when compared to face-to-face visitation in non-rural areas.

Finally, TD appears to ease the first consultation on entry into detention and the organization of dental care.

Conclusions: teledentistry appears to be a useful complementary tool both for clinicians and patients, improving inter-professional communication, easing oral health care access and screening procedures. Future developments may include the prevention of periodontal and peri-implant diseases.

BIOBANKING AND RESEARCH: DIGITAL TOOLS

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Aim: biobanks are not-for-profit services for the collection, processing, storage and distribution of biological samples and data for research and diagnostic purposes. Aim of this update is to illustrate the available digital resources and how to use them in research in the dental field.

Methods: a literature research was conducted in PubMed up to March 2021; a search was also performed on official websites of some biobanks and specific search engines. Most recent evidence and developments in the digital biobanks were summarized.

Results: Dental biological materials and data are stored in biobanks and can be used for large-scale studies. Biobanks se-

arch engines such as BBMRI are useful tools which redirect to the official biobanks websites where catalogues can often be found, along with instructions to request a biosample from them. Although biobanks in the dental field are available and studies have already been conducted using their resources (i.e. MoBa), a systematic approach to this asset seems to be lacking.

Conclusions: biobanking in dentistry represents an efficient tool for effectively advancing research and clinical translation on oral and systemic disorders. It should also help to generate therapeutic benefits and be a fundamental step towards personalized medicine.

AUGMENTED REALITY AND VIRTUAL REALITY IN DENTISTRY: FROM DENTAL EDUCATION TO DENTAL PHOBIA

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Aim: this review aims to summarize the applications of Augmented Reality (AR) and Virtual Reality (VR) in dentistry.

Methods: this review was conducted according to the preferred reporting items for a narrative review and was guided by the Scale for the Assessment of Narrative Review Articles. Articles in which AR and VR were applied in dental field were considered.

Results: AR and VR may represent essential tools in the educational field since they can facilitate student's learning of anatomical structures and clinical training by specific virtual environment and dental simulator. AR and VR may be also used during clinical practice: AR can be used to add digital data to reality, acting as automatic information filters that display only the most relevant information directly on the patient. In addition, clinicians may apply VR for training or for a digital wax-up providing a pre-visualization of the result, enhancing the com-

munication between dentist, patient, and technician. AR and VR may aid also in patient education. In fact, they can be considered an important tool to educate old and young patient. The expected outcome in using VR and AR for oral home care is to provide a digital instrument to improve oral hygiene practice in children and adults, motivating the prevention of oral diseases, and making educational practices attractive. In addition, AR and VR may also be employed to eradicate dental phobia in patients, absorbing the patient in a total virtual environment. For this reason, not only video stimulation, but also audio simulation may be detrimental to make the users' experience more immersive.

Conclusions: modern digital technologies can potentially reshape dentistry both on educational and clinical level. Students may improve their knowledge and practical skills. Dental clinicians may use these technologies as useful aids in their practice.

MAGNETIC RESONANCE IMAGING FOR GUIDED IMPLANT PLANNING: A VIABLE OPTION

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Aim: multi-slice Computed Tomography (CT) and Cone Beam Computed Tomography (CBCT) are currently the gold standard for computer-guided implant surgery, however they expose patients to high doses of ionizing radiations. For this reason, Magnetic Resonance Imaging (MRI) has been proposed as an alternative. Aim of this review is to summarize the main findings on the feasibility, applicability and accuracy of MRI in implantology.

Methods: a literature research was conducted in PubMed using keywords up to 5th March 2022. Keywords search items included guided-implant surgery, dental implants and Magnetic Resonance Imaging. A hand search was also performed.

Results: 8 articles published between 2019 and 2021 were included. Overall, studies have shown that MRI can achieve comparable results to those with 3D-X-ray-radiographic methods. Furthermore, advantages result in portraying bone tissue without exposing the patient to ionizing radiations and a higher soft tissue contrast (i.e. direct nerve visualization). On the other hand, there are limitations, such as artifacts, cost-availability and length of the procedure.

Conclusions: MRI is an alternative to CT/CBCT. This review highlights the necessity for further research to determine whether MRI can be used in clinical routine.

MRI IN DENTISTRY: AN INNOVATIVE AND ETHIC APPROACH

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Aim: the aim of this poster is to suggest to the oral and maxillofacial community the use of the magnetic resonance imaging (MRI) as an alternative diagnostic exam to the conventional x-ray imaging.

Methods: systematic reviews and metanalysis with high impact factor of the last 10 years in the main scientific databases were investigated and data were retrieved. We only included studies with statistically significant results.

Results: 17 studies were found. The use Of MRI in dentistry was successfully applied in conservative and endodontic procedures (1 study), in oral surgery (1 study), in temporomandibular disorders (1 study), in oral and maxillofacial pathology

(excluding oncology, 2 studies) and in guided dental implant planning (1 study).

Compared to the conventional x-ray imaging, the MRI has numerous advantages; first of all its use isn't associated with any ionizing radiation risk. Moreover, MRI is capable to identify areas of suppuration, oedema, hypovascularized bone and intra bone inflammatory infiltrate.

Conclusions: the usefulness of MRI in dentistry has been confirmed; however, researchers pointed out that there are some disadvantages, such as the longer scanning time, the costs, the waiting lists and the reduced availability of MRI scanners.

A STUDY TO EVALUATE THE LEARNING CURVE AND THE IMPORTANCE OF BACKGROUND IN DIGITAL IMPRESSIONS

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Aim: the study investigates the correlation between the ability of a subject to use an oral scanner and its experience and background and aims at evaluating the learning curve of intra-oral scanning.

Methods: a sample of 40 subjects was selected among the Dentistry Department of the University of Parma. Through a survey participants are divided into subgroups according to their experience and background. A 3Shape Trios scanner was used to carry out the investigation and the impressions were performed on the same patient, as to avoid bias. *Time* and *number of images per dental arch*, were taken into consideration as variables to compare impressions performed by different subjects and evaluate any correlation between their digital scanning ability and their experience and background. Af-

terwards, the study focused on the evaluation of the oral scanning learning curve. Therefore, 6 subjects without any previous scanning experience were selected among the group, and they were instructed to perform 10 impressions to assess any improvement in terms of reduction of scanning time and number of images per scanning session.

Results: statistical analysis was performed, showing a significant correlation between the subject's background and its scanning ability and proving that repeated scans lead to an immediate improvement followed by a plateau.

Conclusions: more experienced subjects seem to have a better scanning ability. However, given the steepness of the learning curve, scanners should be implemented thanks to their versatility.

EVALUATION OF THE READING ACCURACY OF 7 INTRAORAL SCANNERS, ON AN IMPLANT ARCH. *IN VITRO* STUDY

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Aim: the goal of this *in vitro* study is to evaluate the accuracy of 7 intra-oral scanners (I.O.S.) in taking an impression in a situation of extensive implant rehabilitation.

Methods: the measurements were detected on a model representing a structure that replicates an impression on several implants solidarized together. In this case we examined a clinical situation with six implants on a dental arch. The reference points for the measurements were made by position-

ing a point in the exact center of all scan bodies; this allowed to reduce the possibility of errors during paths calculations. For each scanner, 9 scans of the entire model were performed by a single operator to avoid operator-dependent variables.

Results and conclusions: the results show differences both in defect and in excess with respect to the reference values, depending on the intraoral scanner used.

EVALUATION OF THE ACCURACY OF READING DEPTH OF INTRAORAL SCANNERS. WIRELESS VS WIRED. *IN VITRO* STUDY

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Aim: the goal of this *in vitro* study is to measure and compare the reading depth detectable by two types of intraoral scanners with different acquisition technology: wireless vs wired.

Methods: the measurements were detected on a cube-shaped reference solid with grooves of different depth and width marks on the 4 sides, in order to best simulate the

possible situations encountered in clinical practice. For each scanner 9 scans were performed, all detected by the same operator to avoid operator dependent variables.

Results: the results show a possible evenness of the evaluations found between the two intraoral scanners used.

Conclusions: the wireless scanner represents a future solution for evolution and ease of use.

EVALUATION OF THE READING ACCURACY OF INTRAORAL SCANNERS, ON IMPLANT ARCH. WIRELESS VS WIRED

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Aim: the goal of this *in vitro* study is to evaluate the accuracy of two intraoral scanners with different acquisition technology: wireless vs wired (I.O.S.), in taking an impression in an extended implant rehabilitation situation.

Methods: the measurements were detected on a model representing a structure that replicates an impression on several implants solidarized together; in this case we examined a clinical situation with six implants on a dental arch. By positioning a point in the exact center of the transfer, the measurements we-

re estimated; this allowed to reduce the possibility of error during paths calculations.

For each scanner, 9 scans of the entire model were performed by a single operator to avoid operator-dependent variables.

Results: the results show a possible evenness of the evaluations found between the two intraoral scanners used.

Conclusions: the wireless scanner represents a future solution for evolution and ease of use.

EVALUATION OF THE ACCURACY OF THE READING DEPTH OF 7 INTRAORAL SCANNERS. *IN VITRO* STUDY

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Aim: the object of this study is to measure and compare 7 different intraoral scanners (I.O.S.) and their reading depth.

Methods: the measurements were taken on a solid cube with grooves varying in depth and width on 4 lateral sides in order to best simulate possible situations encountered in clinical practice. For every scanner 9 scans were performed. All scans

were performed by the same operator in order to remove the variable of differing operators.

Results: the results of these scans show a large inconsistency between different scanner models.

Conclusions: the reading depth of intraoral scanners (I.O.S.) is closely related to the technology that each scanner uses.

EVALUATION OF THE OPERATOR-DEPENDENCE IN FULL-ARCH SCANS ON IMPLANTS

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Aim: in this study we are going to evaluate how the operator experience changes the performance of an intraoral scanner (IOS). We will evaluate and compare trueness and precision of 5 IOS (TRIOS 4[®], 3-Shape, Copenhagen, Denmark; i-700[®], Medit, Seoul, South Korea; CS 3600[®], Carestream Dental, Atlanta, GA, USA; AoralScanner[®], 3DSHINING, China; Panda 2[®], FREQTY, China) in a scan performed by an experienced operator “EO” (> 5 years of experience) and an inexperienced operator “IO” (< 1 year of experience).

Methods: a type IV plaster model of a maxilla on which 6 implant analogs have been placed with 6 scan body Oxy Implant[®] (BIOMEC, Colico, Italy) screwed in, will, initially, be scanned by a lab scanner (DOF Freedom UHD, Seongdong, Seoul, Korea) in order to digitalize it to obtain a virtual referen-

ce model. Then the model will be scanned by EO and IO using the 5 IOS (10 scans each). The scans will then be compared with the virtual reference model.

Results: what emerges is that the results with regard to the precision, obtained by EO and IO are substantially superimposable and that in some cases, even, the precision of the IOS is greater when using IO. Having to identify the best scanner for its trueness in the case of IO, it is possible to state without doubt that the Panda 2[®] scanner is the best scanner; in the case of EO the scanner that shows the best results in terms of trueness Medit i700[®].

Conclusions: the results of the study allow us to say that the performance obtained by EO and IO are substantially overlapping.

PRECISION OF HORIZONTAL JAW MOTIONS REGISTRATION USING A DIGITAL ARTICULATOR

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Aim: the aim of this study was to evaluate the range described by jaw movements on the horizontal plane using a virtual 3D articulator in 5 patients.

Methods: the mandibular horizontal movements of five different subjects were registered using the 3D digital articulator Cyclops (Itaka way med) in five different moments of the day. The horizontal movements considered described the gothic arch of the patient maintaining the teeth in contact. The angles, obtained between the frontal plane, MI and sagittal condylar path, were evaluated on the horizontal plane with the Angle Meter app. For each subject the mean, the median and the standard deviation of the angles for the right and the left side were calculated.

Results: the mean values obtained shows a high range from the lowest $7^{\circ} \pm 0,83$ and the highest $38^{\circ} \pm 12,35$. Wide differences between and within each subject and between the right and the left side were found.

Conclusions: from the data obtained, a wide range of individual paths described during horizontal mandibular movements can be observed. The system analyzed and in general 3D virtual articulators may be the starting point for the individualization of the occlusal plane to avoid interferences in excursions for the rehabilitation of high complex clinical cases. Other studies should be performed also considering the occlusal anatomy.

PALATAL SHAPE IN OPEN BITE VS NORMAL OVERBITE PATIENTS: A GEOMETRIC-MORPHOMETRIC ANALYSIS

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Aim: this pilot study aimed to evaluate the influence of open bite on palatal shape in patients with crossbite.

Methods: eight patients, two males and six females, aged between seven and nine years, with unilateral (seven) or bilateral posterior crossbite (one) were enrolled and divided into two groups: the experimental group included four patients with posterior crossbite and open bite, while the control group enrolled four patients with posterior crossbite but normal overbite. Upper arch digital models of these patients were imported into Stratovan Checkpoint software; eighty-one landmarks were identified over the palatal vault. Landmark coordinates were then imported into the MorphoJ software. Procrustes fit and

Discriminant Function Analysis (DFA) with leave-one-out cross-validation and permutation test were used to evaluate the presence of statistically significant differences between the two groups.

Results: DFA revealed the presence of significant differences ($p = 0.046$) between the two groups. Patients with open bite showed a palate narrower in the occlusal region and deeper in the midpalatal zone, along with a more anteriorly displaced concavity.

Conclusions: this pilot study revealed a significant difference in palatal shape between patients with crossbite and open bite and patients with crossbite without open bite. A larger study will be useful to investigate this aspect.

ACCURACY OF MILLED FRAMEWORKS FABRICATED WITH DIGITAL AND PLASTER IMPRESSIONS: A CLINICAL STUDY

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Aim: the aim of this research will allow to highlight the accuracy of a new digital impression system, comparing it to the plaster impression technique already validated for many years of clinical use in the creation of full-arch implant-supported frameworks.

Methods: in the present clinical investigation 11 scans (8 of the upper maxilla and 3 of the lower jaw) were taken on a sample of 9 patients, previously treated with immediate loading full-arch rehabilitation following the Columbus Bridge Protocol (CBP) since at least 4 months. On each patient selected, two impressions were taken: one traditional cast impression using pick-up copings and an open tray technique and a second one using an intra-oral scanner. In the following 48 hours two metal substructures were constructed, using the luting technique. The precision and the passivity of the substructures were analyzed through: Sheffield test endo-oral radiographs and comparing the digital scans according to the Hausdorff's method.

Results: the Sheffield test showed an excellent passivity for the frameworks obtained through both the digital and the analogic method. Precisely in 81.81% of cases ($n = 9$) both substructures were found to have a perfect fit with excellent passivity, in 18.18% ($n = 2$) of cases the substructures were found to have a slight discrepancy. From the radiographic examination, no gaps between the frameworks and the implant heads or MUAs were highlighted, with 100% accuracy. By superimposing digital files of scans according to Hausdorff's method, a reduced discrepancy was found between the digital scans and for the digital models obtained from plaster impressions.

Conclusions: despite its limitations, this study clinically demonstrated that full-arch frameworks obtained through a digital scan have an accuracy comparable to those obtained with the traditional plaster impression.