Methods: Glass-ceramic specimens were produced of VITA Suprinity (VITA Zahnfabrik) zirconia-reinforced lithium-silicate ceramic, shade A1 T (low translucency) and HT (high translucency), in 0.5 mm; 1.0 mm; 1.5 mm; 2.0 mm; 2.5 mm thickness. Nine types of substrates (cobalt-chromium alloy, copper alloy, zirconia, and six shades of VITA Simulate Material) and three shades of Variolink Esthetic try-in pastes (Ivoclar Vivadent) were used to make 270 different combinations of layered specimens. PerkinElmer® LAMBDA 1050 UV/Vis/NIR Spectrophotometer was used in this study. The device measures the reflectance spectrum by which the $L^*a^*b^*$ and ΔE values can be calculated based on the CIEDE2000 formula. ΔE value indicates the color difference between two colors. Averages were compared to the reference specimen.

Results: ΔE values of layered specimens have been decreasing by the thickening of the lithium-silicate ceramic. The highest ΔE values were measured beside metal and zirconia substrates. The effect of different try-in pastes was below the perceptibility threshold (ΔE 0.8). ΔE of the reference substrate was zero, proving the precision of the measurement.

Conclusions: The optical properties of lithium-silicate glass-ceramic specimens are significantly affected by the shade of the substrate, the thickness, and translucency of the ceramic; however, the effect of try-in paste shades is not significant.

Keywords: CIEDE2000; color difference; glass-ceramics; optical properties; reflectance; spectrophotometric

∗ Contact: József Saláta
E-mail address: dr.salatajozsef@gmail.com

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Virtual reality as a novel approach for dental students' education – a preliminary survey study.

Aleksandra I. Orlańska ∗, Martyna Czekańska, Dominika Domanowska, Łukasz Zadrożny

Department of Dental Propaedeutics and Prophylaxis, Medical University of Warsaw, Poland

Purpose: Students' competency in clinical work is reached via firmly established methods, like training manual dexterity on typodonts and phantom heads. Literature suggests that virtual reality is a novel teaching aid offering advantages over traditional curriculum methods. This preliminary study evaluates students' feedback on a Simodont® Dental Trainer. Simodont® provides the familiar phantom head environment, but in virtual reality with automated real-time feedback.

Methods: A questionnaire consisting of single choice and five-point Likert scale questions was distributed among 51 dental students of varied educational experiences. Participants spent one (16%), three (29%), or four (55%) hours training on the Simodont® under the supervision of a qualified teacher.

Results: Students agreed that Simodont® assisted positively in their learning, the majority (76%) wanting to continue training on the device. Of participants eligible to answer, 62% disagreed that Simodont® provides a similar experience to treating real teeth. Of all respondents, 95% would prefer to practice on the Simodont® with teachers' supervision.

Conclusions: Although Simodont® is a valuable educational tool, well accepted by students, it is not perceived to adequately replace traditional training on phantom heads. Despite Simodont® providing instant feedback with an automated, independent evaluation of performed tasks, students do not wish to use it without academic teachers' supervision.

Keywords: dental education; dental simulator; haptic technology; Simodont; virtual reality

∗ Contact: Aleksandra I. Orlańska
E-mail address: aleksandra.orlan@gmail.com

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Accuracy of IOS on vertical and horizontal deep subgingival preparations: A three-dimensional analysis

Gennaro Ruggiero ∗, Roberto Sorrentino, Maria Irene Di Mauro, Fernando Zarone

Department of Neurosciences, Reproductive and Odontostomatological Sciences, Division of Prosthodontics and Digital Dentistry, University "Federico II" of Naples, Naples, Italy

Purpose: To evaluate the accuracy of an intraoral scanner (IOS) on both horizontal and vertical tooth preparations at different depth levels below the gingival margin and assess if the IOS detects the area beyond the finish line of these preparation geometries.

Methods: Four abutments of an upper first molar were designed using CAD software, with vertical and horizontal preparation finish lines at 1 and 2 mm from the gingival margin. These abutments were printed in resin and placed each on a reference typodont. Ten scans were made with an IOS for each preparation geometry to obtain four experimental groups: for horizontal preparation "H1" at 1 mm from the gingival margin and "H2" at 2 mm, while for vertical preparation "V1" at 1 mm and "V2" at 2 mm. The scans were imported into a dedicated software, then trueness and precision were evaluated in μm. In addition to descriptive statistics (95%-CI), the Games-Howell was run to analyze differences among groups (α=.05).

Results: Mean values for trueness were H1=29.9(28.4-31.3), H2=22.2(21.3-23.1), V1=25.4(22.4-28.5), V2=26.4(25.2-27.5) with statistically significant differences for H1/H2 (P<.001), H1/V1 (P=.047), H2/V2 (P<.001). Mean values for precision were H1=14(12.3-15.7), H2=14.5(11.8-17.2), V1=23.3(15-31.5), V2=35.6(29.8-41.4), with significant differences for H2/V2 (P<.001). Only for vertical preparations, it was possible to record the area beyond the finish line.

Conclusions: Although vertical preparations allow for registration beyond the finish line with IOS, they are less accurate than horizontal ones when the preparation margin is 2-mm from the gingival margin.

Keywords: accuracy; Finish Line; Fixed Prosthodontics; Horizontal Preparation; intraoral scanner; IOS; precision; Tooth preparation; trueness; Vertical preparation

∗ Contact: Gennaro Ruggiero
E-mail address: gennaro_ruggiero@hotmail.it

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Evaluation of maxillofacial traumatic injuries severity based on STL models

Oleksandr Tsutskov ∗, Myroslav Goncharuk-Khomyn, Pavlo Brekhlichuk, Andrii Keniuk

Uzhhorod National University, Uzhhorod, Ukraine

Purpose: To verify the possibility of using *.stl models for the assessment of maxillofacial traumatic injuries by FISS and MFISS severity scores in the remote mode of forensic evaluation.

Methods: Quantitative assessment of maxillofacial traumas was made by facial injury severity score (FISS) and maxillofacial injury severity score (MFISS) among 27 patients who have undergone CBCT after road-traffic accidents. Initially, FISS and MFISS scores were estimated based on clinical examination, medical documentation, and obtained X-ray data-sets (FISS1 and MFISS1). *.dcm-files of patients were converted into *.stl-files via InVesalius software (CTI, Brazil) and sent to the forensic dental experts with all the needed descriptive information regarding clinical characteristics of maxillofacial traumas, but without access to original *.dcm files. In remote mode, experts estimated injury severity by FISS2 and MFISS2 scores.

Results: Mean scores for maxillofacial traumatic injuries based on clinical examination, medical documentation, and obtained X-ray data-sets were following: 3.54 ± 1.03 and 16.29 ± 5.21 for FISS1 and MFISS1 respectively; while mean FISS2 and MFISS2 scores were 2.98 ± 1.74 and 13.32 ± 8.73, respectively. Statistical correspondence between FISS1 and FISS2 scores reached $r=0.84$ ($p<0.05$), while such correspondences between MFISS1 and MFISS2 scores reached 0.92 ($p<0.05$).

Conclusions: Even though analysis of stl-files obtained from patients with maxillofacial traumatic injuries provoked underestimation of FISS and MFISS scores with an increase of standard errors deviations, such a digital approach also provides the possibility for quick assessment of preliminary trauma severity by a forensic dental expert in the remote mode of evaluation.

Keywords: Digital; maxillofacial trauma; severity; stl model

∗ Contact: Oleksandr Tsutskov
E-mail address: tsutskovoleksandrdds@gmail.com

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Digital Approaches in Forensic Dentistry Practice: Clustering or Fractal Differentiation?

Myroslav Goncharuk-Khomyn ∗

Uzhhorod National University, Ukraine

Purpose: To evaluate the effectiveness of using nurb-to-nurb, line-to-line, and node-to-node superimposition principles during the person identification procedure based on dental status comparison considering clustering and fractal differentiation of targeted points.

Methods: The study included a graphical analysis of 45 skulls that were originally scanned with the use of a CBCT device. Forty-five original *.dcm files were converted into 90 *.stl files (2 copies of each original *.dcm) after image processing. One set of 45 *.stl files was saved, while another 45 copies were deformed with alteration of graphical object integrity via MeshMixer Sofware. Forty-five deformed graphical objects of the skulls were superimposed with originally saved stl-objects using nurb-to-nurb, line-to-line, and node-to-node superimposition principles considering clustering and fractal differentiation of targeted points within original CBCT-files.

Results: Nurb-to-nurb superimposition provides the highest validity with the level of "successful identification" up to $79.2\pm8.4\%$ and the level of "possible identification" up to $94.4\pm3.2\%$. The level of graphical disintegration of study object $\geq 45\%$ was considered critical from the point of possibility to reach "successful identification" result. Fractal differentiation provides a higher level of sensitivity regarding truthful identification as compared to the clustering approach both in integral and deform conditions of analyzed skulls ($p < 0.05$).

Conclusion: The development of modern digital approaches expands the validity of methods used for the forensic-dental identification process during post-mortem expertise. Digitalization is forming a specific pool of quantitative criteria that also helps to estimate the credibility of diagnosed changes during comparative or reconstructive identification.

Keywords: bone analysis; clustering; fractal; superimposition

∗ Contact: Myroslav Goncharuk-Khomyn
E-mail address: myroslav.goncharuk-khomyn@uzhnu.edu.ua

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Optimization of full zirconium crowns manufacturing using hybrid digital approach under the sanitary restrictions during Covid-19 pandemic and limited clinical access to intraoral scanner

Igor Tukalo ∗, Sergii Kondrash, Natalia Kondrash,
Myroslav Goncharuk-Khomyn

Private Dental Clinic and Dental Lab "DobroDent KS", Iza, Ukraine

Purpose: To assess clinical optimization of hybrid digital approach for full zirconium crowns manufacturing developed under sanitary restrictions during COVID-19 pandemic considering specific economical interaction of "low budget clinic–high budget dental laboratory".

Methods: Developed primary approach included following steps: 1) taking analog impression by dental clinician; 2) digitalization of impression by mobile dental technician team outside the dental clinic; 3) transfer of obtained *.stl file to the dental lab; 4) inversion of *.stl file for dental model production with further CAD-CAM manufacturing of zirconium crowns; and 5) delivery of manufactured crowns to the clinic in a non-contact manner. The clinical effectiveness of such an approach was assessed by criteria of clinical time expenditures associated with appropriate crowns fitting and fixation, clinical marginal fit, and risk reduction considering COVID-19 transmission.

Results: Analysis of 116 cases demonstrated that in 81.89% of cases, time expenditures associated with appropriate crowns fitting and fixation were not statistically different ($p > 0.05$) from those needed for crowns manufactured by usual digital protocols. Clinical marginal fit in 70.68% cases was classified as "excellent", in 21.55% cases – as "good", and in 7.76% cases – as "appropriate". Risk reduction of COVID-19 transmission considering a possible way of disease spread varied in the range of 34.61-56.78%.

Conclusions: A proposed approach for full zirconium crowns manufacturing developed specifically under sanitary restrictions during the COVID-19 pandemic optimizes the quality of dental care considering limited clinical access to an intraoral scanner while demonstrating sufficient clinical effectiveness in the means of marginal crowns fit and clinical time expenditures.

Keywords: COVID-19; digital approach; sanitary restrictions; zirconium crown

∗ Contact: Igor Tukalo
E-mail address: myroslavfgoncharukkhomyn@gmail.com

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Can EPS collaborate with the acquisition of the supra-implant emergence profiles simultaneously to the dental implant's digital transference?