What's new for the clinician – summaries of recently published papers (April 2025)

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1. Accuracy of full arch scans performed with nine different scanning patterns

In recent years, dentistry has embraced the transformative potential of digital scanning technology, redefining how oral health is assessed, diagnosed and treated. Dental digital scanning technology replaces traditional impression techniques with a noninvasive, precise and efficient method of capturing oral structures. It uses a handheld intraoral scanner with high-resolution cameras and advanced imaging capabilities to create 3D digital models of your teeth, gums and surrounding tissues.

With so many manufacturers to choose from, dentists want to know which are the best intraoral scanners for their investment. The most popular scanners, their features and approximate price in US dollars ($) is shown in the table below.

A complete digital workflow without the process of a conventional impression involves three coordinated steps: data acquisition, data processing and restoration fabrication.[1] The accuracy of the scan, and consequently the data acquisition process, plays a decisive role in this initial step of the digital workflow, as the subsequent steps depend on the quality of this data. Several factors can influence this accuracy. In this context the scanning system and its calibration, experience of the operator and the scanning strategy are critical determinants of the accuracy, in detail trueness and precision of the resulting model data.

For evaluating the accuracy of full-jaw datasets, there is currently no standardised guideline available. Two methods are described in the literature.[1] The first involves using a best-fit algorithm to superimpose test and reference data,

Scanner details	Features	Price in US$*
Aoralscan	• Scan speed 15 frames/second • Data optimisation uses artificial intelligence to help identify and delete extraneous data • Real-time scanning • Realistic colour • User-friendly motion-sensing scanning • Plugs in directly to USD 3.0 port • Offers both .STL and .OBJ output file formats	11 000
Cerec Primescan	• Superior accuracy – processing more than 50,000 images per second • Scans at an incredible density to deliver 3D images instantly • Touchscreen for intuitive use • Comes with a mobile cart	16 000
Carestream Dental 3600	• Uses LED light source • 13mm x 13mm field of view • Anti-fogging technology prevents distortion of accurate images • Handpiece weighs about 11.5oz (326g) • Interchangeable tips in different orientations help you capture scans in hard-to-reach areas • Plugs into USD 2.0 port	20 000
Condor	• Uses 15 white LEDs and 2 blue LEDs as its light source • Lightweight handpiece weighs only 3.9oz (110g) • Scan of a single arch takes 1 minute • Plugs into USD 3.0 port • .STL output files make data transmission seamless • Free software upgrades for the life of the equipment	13 000
iTero Element	• Scans a full arch in as little as 60 seconds • Adaptive anti-fogging technology • Time-lapse system allows patient history visualisation of tooth wear, tooth movement, gingiva • Compatible with Align Technology's Invisalign system	50 000
Medit i700	• LED light source • Scans up to 70 frames/second • Ergonomic handpiece weighs 8.7oz (246g) • Adaptive anti-fogging technology • Plugs into USD C-type port • Full arch accuracy 11 microns • 3D in-motion video technology that allows for full-colour streaming capture • Additional impression scanning and 3D facial scanning features are built in • Modeless crown fitting software reveals whether alterations may be needed to fully seat crown	20 000
Trios 5	• Excellent scanning ability for all indications • Great ergonomics and design • Feature-rich scanner software • Long-lasting battery • Easily connected to visual tools such as monitors, iPads etc • Engagement apps to personalise every patient's experience and boost case acceptance	30 000

allowing the calculation of metric deviations between the two datasets.[1] However, this method is limited by potential unrecognised misalignments introduced by the software algorithm during the alignment process. The second method uses metrical analysis of real geometric values obtained from reference objects, which are either fixed to an in vitro analysis model or attached to the patient's arch in vivo.[1]The current consensus in literature is that the new generation of intraoral scanners demonstrate convincing accuracy for scans up to a quadrant, with equivalent or even superior accuracy of the generated virtual dental model. However, scanning an entire jaw remains challenging as increased scan distances are associated with cumulative scanning and merging errors, resulting in higher inaccuracies, particularly for full-arch scans.[1] Thus, scanning strategy is important to minimise inaccuracies during the scanning process. Schlög et al (2025)[1] reported on an in vitro study that sought to systematically investigate the influence of different movement patterns and targeted scan segmentation on scan accuracy. This study evaluated trueness and precision in the in vitro digitisation of a maxillary model using a new generation IOS scanner (CEREC Primescan AC). The null hypothesis was that varying the scanning pattern will not result in significant differences in trueness or precision.

Materials and methods

A *maxillary full-arch model* made of polyurethane with a homogeneous, matt surface was used as analysis model to conduct the study. A metal bar was inserted in the area of the second molars and used as a reference structure. The reference measurement of the metal bar was carried out with a coordinate measuring machine (CMM) before it was fixed on the analysis model. This measurement was performed at a temperature of 20°C with a maximum permissible error (MPEe) of the CMM of 1.9µm + (3*L/1000), where the parameter L is defined by the real length of the used metal bar. Subsequently, the STL dataset generated by the CMM was imported into the analysis software. The calculated reference length of the metal bar was 55.066mm.

CEREC Primescan AC (software version 2015.3.1.0, Dentsply Sirona) was used for all scans ($n=25$/strategy). Nine different scanning strategies were developed for direct digitisation, combining the segmentation of the scan area (F=full jaw, H=half jaw and S=sextant) and three different scan movement patterns ($_L$= linear, $_Z$= zig-zag and $_C$= combined). During the scan, it was ensured that a maximum of 20mm of the bar ends were captured by the scanner to avoid connection of the complete bar in the virtual dataset. The full length of the bar was not scanned, due to the following reason: the reference bar contains no geometric structures for optimal merging the single captures of CEREC Primescan AC. Hence, the digitisation of the complete bar was not possible without causing distortions in the complete arch scan, as the software algorithm of CEREC Primescan AC tried to connect both bar ends if the scanning area was too large.

An experienced operator performed all scans using the extraoral data acquisition mode of CEREC Primescan AC. Each scan was obtained under the same conditions with constant ambient light settings. At the beginning of each scan, the CEREC Primescan AC scanning device was calibrated using the "Calibration Set Primescan" according to manufacturer's guidelines. A maximum of two scans were performed successively with a following break of 30min, so that any influence by heating of the scanning device could be excluded.

Each scan ($N=225$, $n=25$ per group) was exported as an STL dataset from the respective scan software of CEREC Primescan AC and imported into the analysis software (Geomagic Control 2015). The data was virtually adjusted in a three-dimensional coordinate system that included XZ-, XY- and YZ-axes as the coronal, transversal and sagittal planes. Trueness was assessed by evaluating linear differences in the X, Y and Z axes and angular deviations (α axial, α coronal, α total) compared to a reference dataset. Statistical differences were analysed using Kruskal-Wallis and Mann-Whitney U tests ($p<0.017$). Precision was analysed by the standard deviation of linear and angular aberrations (ISO 5725-1) ($p<0.05$).

Results

Strategy F_L showed significantly higher trueness and precision than F_Z for VE ($p=0.009$), $V_E(y)$ ($p=0.010$), $\alpha_{overall}$ ($p=0.004$) and α_{axial} ($p=0.002$). Strategy F_C demonstrated significantly better trueness than F_Z for VE ($p=0.007$), $\alpha_{overall}$ ($p=0.010$) and $\alpha_{coronal}$ ($p=0.013$). For scan segmentation, F_L showed better trueness for $V_E(y)$ ($p=0.001$) and α_{axial} ($p<0.001$) than H_L. Strategy H_L showed better trueness for $V_E(z)$ than for F_L and S_L ($p=0.001$, $p=0.002$). The scanning patterns F_L, F_C and H_L exhibited the best performance for trueness and precision.

Conclusions

The researchers reported that:The combination of full arch with the linear or combined movement pattern (strategies F_L and F_C) resulted in better trueness and precision for most measured parameters compared to the zig-zag movement (F_Z).

The linear motion pattern in combination with full-arch or half-jaw segmentation (strategies F_L, H_L) showed significantly better trueness compared to sextant segmentation (S_L) for linear measurement parameters.

Implications for practice

Scanning movement and scan segmentation have a significant influence in trueness and precision of full arch scans.

REFERENCE

1. Schlögl K, Güth JF, Graf T et al. Accuracy of full arch scans performed with nine different scanning patterns – an in vitro study. *Clin Oral Invest 29*, 92 (2025). https://0-doi-org.innopac.wits.ac.za/10.1007/s00784-025-06154-2

2. Comparison of the two-year clinical performances of class II restorations using different restorative materials

Resin composites are nowadays the most common direct restorative material to treat carious lesions that cannot be arrested or remineralised. In combination with adhesives the dentists can accomplish defect-oriented preparations, which means that they can limit the removal of sound tooth substance to that area of the defect that needs to be restored, whether it is a carious defect, an erosive defect, a tooth fracture or an aesthetical defect that needs correction.[1] Furthermore, adhesive dentistry allows dentists to repair rather than to replace restorations in the case of chippings, fractures, caries at the margins or aesthetic improvements demanded by the patient.[1] Resin composites are delivered in various shades, opacities and translucencies so that the original tooth structure can be restored in an aesthetically pleasing way.

Based on the market volume and materials sold, it can be calculated that in 2014 more than 1.1 billion dental restorations had been placed in the world. Of these, about 800 million were direct resin composite restorations, followed by 170 million glass ionomer-based fillings, 140 million amalgam restorations and about 25 million compomer restorations.[1] The composite and compomer restorations also include anterior restorations both in primary and permanent teeth (about 30% anterior and 70% posterior restorations). The above-mentioned estimates suggest that the direct placement of a dental restoration represents one of the most prevalent medical interventions on the human body worldwide. Therefore, it is of paramount importance to know the longevity and survival rates of direct resin composite restorations as well as the frequency and reasons of failures and the factors that influence both longevity and failures.

The clinical performance of restorations and restorative materials must be evaluated using detailed, objective and reliable criteria. One of the most commonly used evaluation criteria for this purpose comes from the FDI (World Dental Federation). The FDI evaluation criteria are divided into four main groups: functional (fracture or retention issues, form and contour, marginal adaptation, occlusion and wear, and proximal contact points); aesthetic (surface lustre, surface texture, marginal staining and colour match); biological (caries at restoration margins, dental hard tissue defects at the restoration margin, postoperative hypersensitivity and pulpal status) and miscellaneous (patient's view, assessment of dental restoration on radiographs). The FDI criteria use a scale where 1 indicates "clinically excellent/very good (sufficient)", 2 represents "clinically good (sufficient)", 3 corresponds to "clinically satisfactory (sufficient)", 4 denotes "clinically unsatisfactory (partially insufficient)" and 5 signifies "clinically poor (entirely insufficient)".

Hançer Sarıca and colleagues (2025)[1] reported on a trial that sought to evaluate the clinical performance of Class II restorations using conventional composite, bulk-fill composite and high-filler flowable composite resins according to FDI criteria after two years. The null hypothesis of this study was that there will be no significant difference in the two-year clinical performance of the composite resins used.

Materials and methods For this randomised clinical trial, 900 patients were assessed for eligibility for participation, and 790 patients were excluded due to either failing to meet the inclusion criteria or declining to come for follow-up visits. In total, 110 patients who met the inclusion criteria were selected. Thus, a total of 259 teeth were restored in 110 patients (63 females and 47 males). The mean age of the patients was 24.5±2.5 years (ranging from 19 to 50 years).
All 110 patients underwent radiographic and intraoral examinations and 259 teeth requiring restoration were identified. The teeth had Class II caries lesions in the external and middle third of dentin thickness as determined radiographically. All restorations were performed by the same dentist, with extensive clinical experience in restorative dentistry.

The restorative materials were randomly selected using a random number table. Local anaesthesia was administered to the teeth to be restored before starting the procedure. Cavity preparations were performed using diamond fissure burs at high speed with water cooling. Hand instruments and low-speed tungsten carbide burs were used to remove the caries. Conservative cavity design (Class II slot) was used and bevelling was not applied to the cavity walls to avoid unnecessary loss of hard dental tissue. The cavity preparations did not involve any cusps, all the gingival margins included sound enamel, and two surface cavities (MO or DO) were included in this study. The outline shape of the cavity was limited to the removal of caries lesions. Any additional retention was not prepared. The depth of cavities was approximately 4mm-5mm from the gingival border of the cavity when the mesial or distal marginal ridge was taken as reference.

Since the cavity margins are within the enamel and did not require extensive restoration, cotton rolls and saliva ejectors were used for isolation,

The enamel parts of the teeth were then etched using the selective etch technique with 37% orthophosphoric acid (Eco-Etch) for 30sec. After thoroughly washing with water to remove the acid, the tooth was dried with a gentle stream of air. A universal dental adhesive system (G-Premio Bond Universal) was applied to the cavity using an applicator for 20sec in an active manner according to the manufacturer's instructions. After being thinned with gentle air for 5sec, the adhesive was polymerised for 10sec using an LED light-curing device.

In the first group, Filtek One Bulk Fill Restorative (Filtek, 3 M-ESPE) layers were applied without exceeding 4mm in thickness. In the second group, Clearfil Majesty Posterior (Clearfil) was applied and, in the third group, G-aenial Universal Injectable (G-aenial) was applied, with layers not exceeding 2mm in thickness. The layers were polymerised for 20sec from the occlusal surface using an LED light-curing device. After removing the wedge and matrix, an additional 10sec of light was applied to the surface of the restoration. To remove any excess material and irregularities, finishing was performed under water cooling using fine-grit composite finishing burs and Sof-Lex discs. Occlusion was checked using articulation paper, and early contact points were removed. The polishing of the restoration was completed using composite polishing rubbers. Finishing and polishing procedures were performed the same way for all groups.

All restorations were clinically evaluated and scored according to FDI criteria at baseline, after one year, and after two years by two experienced double-blind dentists using mirrors and probes, as well as bite-wing radiographs and intraoral photographs. In cases where there was disagreement between the dentists in scoring, the final evaluation was based on the joint decision of both dentists. Post-operative sensitivity was scored during the baseline assessment by asking patient-related questions within one week after each restorative procedure.

ResultsIn the study, a total of 110 patients (63 females and 47 males) were evaluated for 259 restorations. The average age of the participating patients was 24.5±2.5 years (ranging from 19 to 50 years). At the end of the first year, 238 restorations (in 86 patients) were assessed, while at the end of the second year, 188 restorations (in 74 patients) were evaluated. Due to relocation and changes in contact information, 24 patients could not be reached at the end of the first year and 36 patients at the end of the second year, resulting in their exclusion from the study.

While there was no statistically significant difference between the groups at the end of one year in terms of the evaluated criteria, at the end of two years the surface gloss scores in the Clearfil group were statistically higher compared to both the G-aenial and Filtek groups ($p<0.05$). In addition, at the end of two years, the marginal adaptation scores of Clearfil group were similar to Filtek group and were statistically significantly higher than those of G-aenial group ($p<0.05$).

In intra-group comparisons, a statistically significant increase was observed in colour matching scores at the end of one year in the Filtek group compared to the baseline scores ($p<0.05$), while there was no significant difference between one and two years. In addition, a statistically significant increase was observed in the marginal adaptation scores of both the Clearfil and Filtek groups after two years compared to the baseline and one-year scores ($p<0.05$). Additionally, the Clearfil group's contact point scores after two years showed a statistically significant increase compared to both baseline and one-year scores ($p<0.05$).

Conclusions

High-filler flowable composite and bulk-fill composite exhibited better clinical properties regarding surface gloss compared to conventional composite. It was observed that the marginal adaptation property of the conventional composite was similar to the bulk-fill composite and lower than the high- filler flowable composite.

Implications for practice

The composite resins tested showed similar results in most of the scores evaluated.

REFERENCE

1. Hançer Sarıca S, Arslan S, Balkaya, H. Comparison of the 2-year clinical performances of class II restorations using different restorative materials. *Clin Oral Invest 29,* 128 (2025). https://0-doi-org.innopac.wits.ac.za/10.1007/s00784-025-06207-6

Online CPD in 6 Easy Steps

The Continuing Professional Development (CPD) section provides for twenty general questions and five ethics questions. The section provides members with a valuable source of CPD points whilst also achieving the objective of CPD, to assure continuing education. The importance of continuing professional development should not be underestimated, it is a career-long obligation for practicing professionals.

Online CPD in 6 Easy Steps

1. Go to the SADA website www.sada.co.za.
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3. Select the CPD navigation tab.
4. Select the questionnaire that you wish to complete.
5. Enter your multiple choice answers. Please note that you have two attempts to obtain at least 70%.
6. View and print your CPD certificate.