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CAD/CAM

the international magazine of digital dentistry

3 2016

_clinical case study
The single-visit CAD/CAM workflow

_clinical case
Adding high-quality implant restorations to your digital armamentarium

_clinical case report
How digital workflow simplifies implant and restorative dentistry

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Clint D. Stevens, DDS

When the "horseless carriage" was introduced to the general public in the 1800s, the view of the majority was that the horse and buggy would never be replaced. As the Industrial Revolution progressed, the modern automobile proved the "nay-sayers" wrong, as we're all aware! In today's Digital Revolution, we see similar resistance to digitization in dentistry:

"Dental educators and practicing dentists have, at times, been slow to respond to advances in dental materials and techniques. Operative dentistry, in particular, has often been influenced more by history and tradition than by science."

Many dentists continue to be hesitant regarding digital impression systems and the use of CAD/CAM technology, in spite of substantial research, literature and empirical clinical success supporting its efficacy, accuracy and cost-effectiveness. Meanwhile, our continued reliance on full-coverage restorations as the go-to treatment option for treating damaged and/or diseased teeth is antiquated, given the significant advances made in dental adhesion and restorative materials.

While it's understandable why we got stuck in these paradigms, it's high time we work on changing them. I think we can all agree that we want restorative treatment to be predictable, long lasting and able to meet patient expectations while avoiding creating bigger problems for patients in the future. To best achieve these goals, we should be doing adhesive dentistry, and we should be doing it digitally.

Digital impressioning gives clinicians accuracy and a much better view of their preparation than they would ever have otherwise, resulting in one of the most critical factors for long-term restorative success: a quality preparation. Utilizing digital workflows and chairside CAD/CAM significantly shortens treatment completion times, as well as minimizes and in many cases eliminates complications because of provisionalization.

As you'll see in this edition of *CAD/CAM*, digital workflows are ever expanding and constantly improving yet, at the same time, simplifying the delivery of the highest quality care for our patients. While implementing these changes in your practice can be a daunting proposition, you'll see that implementation has never been easier, and there has never been a better time to go digital in dentistry. I encourage you to embrace the change and help lead our profession into a new era!

– Clint D. Stevens, DDS


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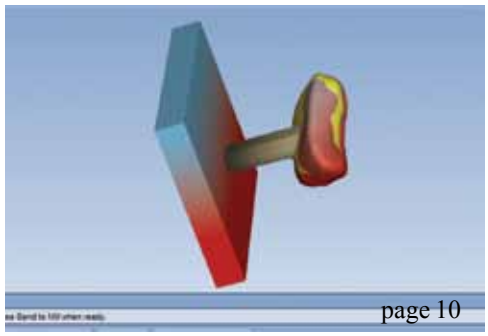
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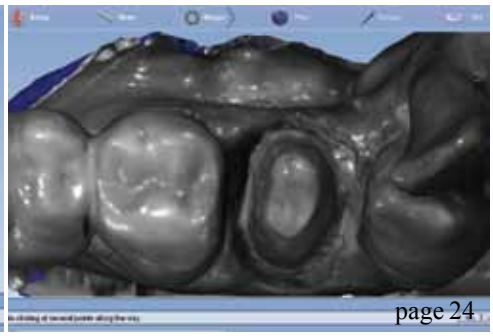
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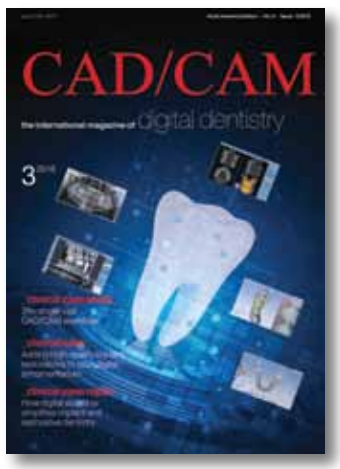

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The use of two digital impression STL files to simplify the single-visit CAD/CAM workflow for multiple ceramic restorations: A case study

Authors_James M. Stein, DMD and Brett E. Stein, DMD

_Introduction

The influence of digital dentistry reaches beyond clinical treatment to the patient as a consumer of our service. The "Age of the Internet" has brought an increased demand for instant results and an evolved element of impatience for the practitioner to manage.

Any patient's targeted online search will inform him or her that CAD/CAM dentistry may provide a single-visit solution to the traditional multiple visit process,[1] which is many times coupled with seductive digital proposals.

The multiple visit norm with provisional restorations may induce limitations of function, comfort and perhaps a less than optimal appearance for weeks. The single-visit solution can eliminate many of the steps that dissuade the patient from committing to treatment.

Furthermore, when elective treatment is sought primarily to make an appearance related change in the esthetic zone, traditionally the laboratory technician has no in-person contact with the patient. The following patient treatment example offers a rationale and method to provide anterior milled ceramic restorations in a single visit. The emphasis will be on using a dual STL file method for an efficient workflow and restoration accuracy.

_Patient selection for single-visit milled restorations in the anterior sextant

Patient selection may be the most critical element in providing four or more single-visit milled ceramic restorations in the esthetic zone. When selecting a patient, a match between the dentist's esthetic evaluation and the patient's expectations is the primary

Fig. 1_Pre-treatment full smile.

Fig. 2_Pre-treatment retracted, frontal view.

(Photos/Provided by James M. Stein, DMD)


Fig. 1


Fig. 2

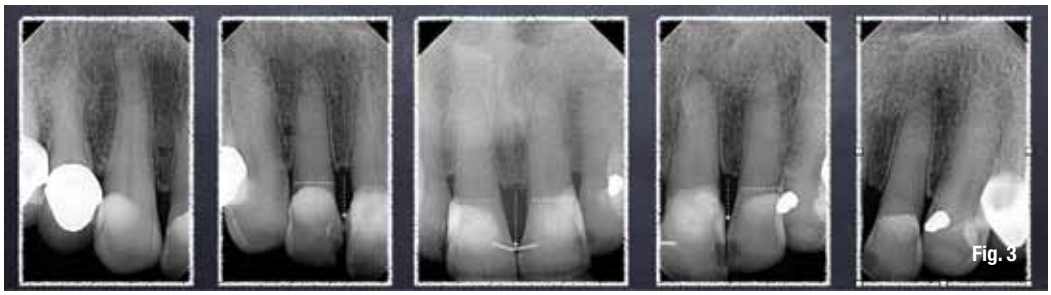

Fig. 3_Pre-treatment radiographs of maxillary anterior teeth. Note the large composite restorations, the root taper and the distance from the contact areas to the crest of bone as it relates to the loss of the gingival papilla.

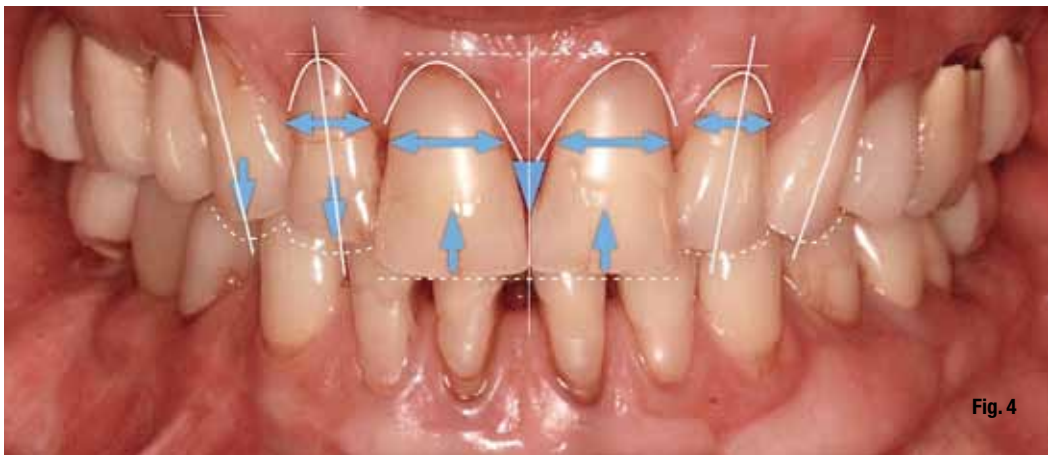

Fig. 4_A digital treatment plan analysis serves to identify and document all of the patient's concerns and document the specific goals of treatment.

Fig. 5 _Pre-treatment intra-oral digital impression scan.

factor to consider (Fig. 1). Secondly, the patient must have the stamina to partner in what may become a five-hour creative process.

In this single case, the 70-year-old female patient presented with concerns about her maxillary anterior teeth #6-10. Specifically, she did not like the overall color, form and spaces between the teeth where the papillae had receded. Considering the health of the periodontium, there was no evidence of active disease and no patient awareness or concerns about the asymmetry in the position of the gingival margins.

However, in the esthetic zone there did exist generalized, mild loss of interdental papillae, multiple failing and/or unesthetic composite restorations, wear and stains (Fig. 2). The evaluation of the clinical and radiographic size of these restorations reinforced the plan for complete coverage restorations (Fig. 3). These observations were in line with the patient's concerns. Clinical findings and proposed treatment options were discussed and digitally illustrated. The patient agreed to restore teeth #6-10 with full contour crowns (Fig. 4).

_Treatment considerations and digital workflow

When beginning the single-visit CAD/CAM procedure for multiple restorations, an organized workflow will reduce treatment time and increase the patient's satisfaction with the experience. An intimate knowledge of the intraoral scanner, design software and mill capabilities is required.[2] A pre-treatment scan of the existing teeth and/or a diagnostic wax-up (analog or digital) will save time in the design phase (Fig. 5).

In this case, the large composite resin restorations on the facial cervical surface of #6-10 were supragingival, and there was no visible sign of recurrent caries extending beneath the gingival crest to necessitate the placement of preparation margins deep within the sulcus.


Fig. 6

Fig. 6_Tooth preparations for teeth #6 –10 full contour, single unit e.max FDPs using a single-visit CAD/CAM procedure. Care was exercised to avoid damaging the gingival tissues as bleeding may prevent an accurate digital impression scan.

Figs. 7a, 7b_Dividing the digital impression of the five teeth into two scan files results in a more efficient use of treatment time. Fig 7a: An occlusal view of #7–10 tooth preparations. Fig. 7b: The scan of #6 tooth preparation using #7–10 seated in lithium monosilicate phase as landmarks.


Fig. 7a


Fig. 7b

Figs. 8a, 8b_Digital restoration design of tooth #7–10. Fig. 8a: To achieve a balanced esthetic appearance, the restorations should have a similar facial thickness of ceramic material on each central and lateral tooth where possible. Fig. 8b: Tooth preparation should be completed with restoration thickness in mind.

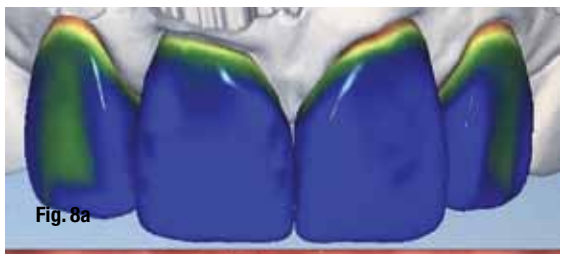
Fig. 8a


Fig. 8b

_about the author CAD/CAM

James M. Stein, DMD, left, maintains a private practice in Boston, Mass. He has been featured in TV, radio and print media for his work with single-visit CAD/CAM ceramic crowns and veneers. He has published and lectured internationally on prosthodontics, implantology, cosmetics and CAD/CAM technology and has completed extensive clinical, surgical and technical training. He has been serving the Boston community through his private dental practice for 30 years.

Brett E. Stein, DMD. completed his undergraduate education at Bowdoin College where he graduated with a BA in biology in 2012. In 2016, he received his DMD from the University of Pennsylvania School of Dental Medicine, graduating with honors in clinical dentistry. He is currently completing his post-doctoral specialty training in the prosthodontics residency program at the Harvard School of Dental Medicine.

Margins placed deeply subgingival are not only an inflammatory irritant to the attachment apparatus[3] but are difficult to scan due to both fluid and tissue deflection issues (Fig.6). When the practitioner presents the option of expedience made possible by CAD/CAM technology, it is difficult to predict or acknowledge possible complications in tooth preparation due to factors such as tooth position and variation in normal dental anatomy.

From experience, STL files can be a challenge to accurately acquire and may lose accuracy[4] with increasing file size in some cases. Therefore, to increase acquisition of accurate scan data, prevent possible scan complications and shorten the treatment time, the five restorations would be divided and produced from two smaller files (Figs. 7a, 7b).

Specifically, teeth #7-10 will be scanned, and #7 will be designed and milled followed by teeth #8-10 (Figs. 8a, 8b). The normally idle milling time was used to prepare tooth #6 and then scan this preparation with the milled #7 in place for an accurate contact and design landmark. The possibility of achieving a good quality clinical outcome with a single scan and design of all five teeth simultaneously could certainly have produced clinically acceptable result, but it would be less productive in terms of time management and without the improved accuracy.

Tooth preparation design will influence whether the block is milled more quickly on a "standard" setting vs. on a "detailed" setting (Figs. 9a, 9b). Accordingly, teeth should be prepared with scanning in mind and design should be completed with milling in mind: We scan to provide data for an accurate design, and we design the proposals to maximize the parameters of the mill's abilities. Anterior tooth preparations with incisal area dimensions smaller than the mill's

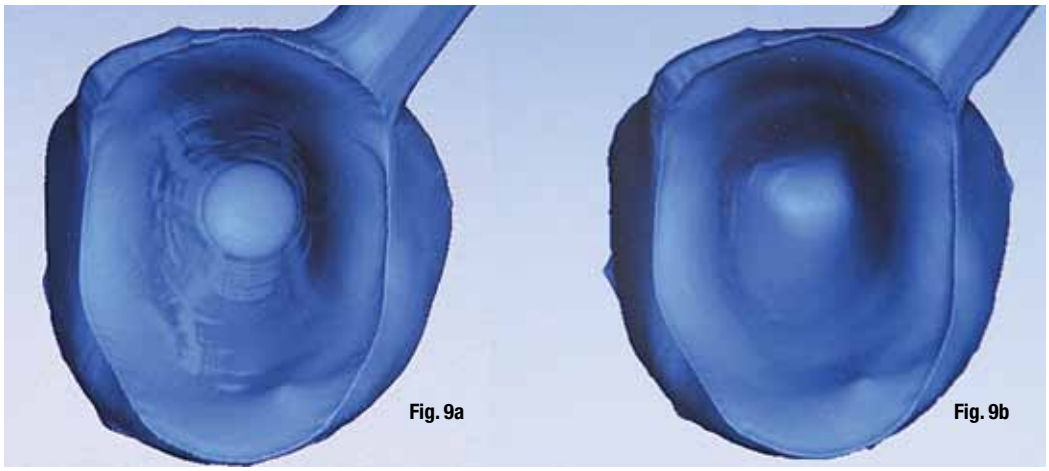

Fig. 9a

Fig. 9b

Figs. 9a, 9b_Mill settings are critical with ceramic restorations to not produce over-milled restorations on anterior teeth. The reduced material thickness can not only be weak but less retentive. Compare the milling proposal of tooth #10 on the 'standard' setting (A) vs. 'detailed' setting (B).

Fig. 10

Fig. 10_Post-treatment single-visit CAD/CAM restorations.

cutting instruments may become excoriated beyond the intended design parameters. The consequence is compromised internal adaption thereby decreasing prosthesis thickness, retention and esthetics due to preparation show-through.

As each restoration finished milling, the contact areas and occlusal function were adjusted and evaluated in the patient's mouth. The patient had communicated her desire for minimal tooth characterization. Therefore, a limited amount of cervical, body and incisal characterization with subtle surface texture was employed prior to the crystallization and glazing cycle. The insertion protocol called for treating the lithium disilicate restoration with combined acid etch and ceramic primer.[5] The tooth preparations were conditioned with a one-step etch and prime formulation. The restorations were inserted one at a time with a dual-cure translucent resin cement (Fig.10).

_Summary

There are many factors that can influence the patient's treatment, chair time and experience with single-visit CAD/CAM restorations. In this particular patient example, the workflow was made most efficient by preparing the four maxillary incisors and scanning them as a single file followed by the preparation and scanning of the single cuspid.

The patient's ultimate satisfaction was ensured through the copious pre-treatment gathering and analysis of clinical information.

An understanding and strict adherence to the protocols for acquiring scan data and mill performance eliminated interruptions in the digital workflow. Future case controlled studies might investigate the added accuracy and patient satisfaction using a two-file method._

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