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A digital companion
to implantology

events

AO's Annual Meeting
to focus on 'Real
Problems, Real Solutions'

industry

Simplicity without
compromise:
ASTRA TECH
Implant System EV

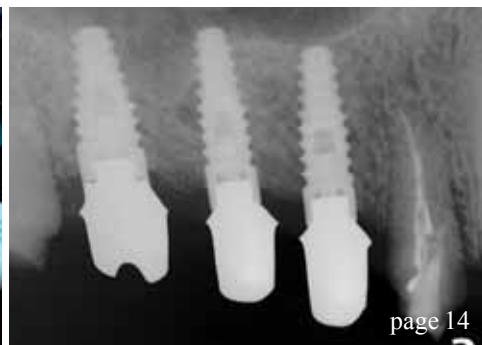




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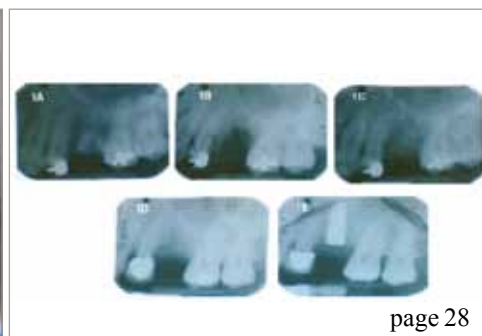
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The Virtual Facebow

A digital companion to implantology

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Author_Les Kalman, BSc (Hon), DDS

_Abstract

The Virtual Facebow has been developed as an open-source tablet app that provides an alternative to the conventional facebow for the mounting of casts to an articulator.

The Virtual Facebow implements several design features to prevent and minimize errors, provide accurate mounting and reinforce the anatomical considerations associated with articulators. The Virtual Facebow is an effective, efficient and accessible digital companion to dental implant diagnoses and treatment planning.

_Introduction

Prior to the delivery of dental treatment, carefully established diagnosis and treatment planning is required. This is particularly important with dental implant therapy.¹

To assist the process, the mounting of a patient's diagnostic casts remains an important step, as it allows the assessment of critical factors such as occlusion, implant position and forces direction.² It also allows exploration into prosthetic options,² such as angled abutments (Fig. 1).

To support proper mounting of patient casts, a

Fig. 1 _Implant treatment planning.
(Photos/Provided by Dr. Les Kalman)

Fig. 2 _Analog facebow.



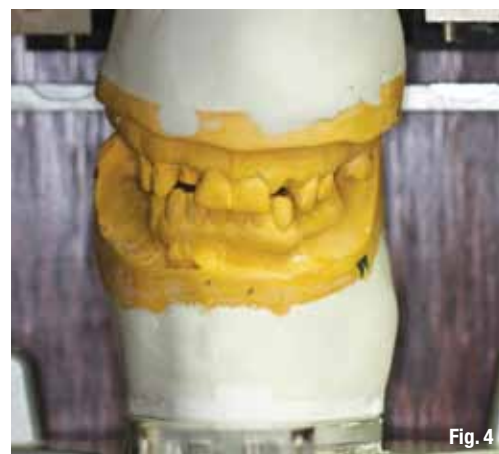


Fig. 5

facebow, which aligns the maxilla to relative facial planes, can be utilized. Errors in the utilization of the facebow, or complete lack thereof, create critical errors in diagnoses and treatment planning that become magnified in the design and delivery of implant prosthetics.

The Virtual Facebow has been developed as a digital substitute to the analog facebow to address the shortcomings.

_Background: Analog facebow

The facebow (Fig. 2) facilitates the mounting of the maxillary cast to the articulator. The Whip Mix Quick Mount facebow (Whip Mix, Louisville, Ky.) is composed of a caliper-type instrument that anchors into the ear canals and is balanced by the bridge of the nose.

A bite fork is utilized, embedded with polyvinylsolixane, to register the position of the maxillary teeth. The bite fork is then transferred to an articulator, through the use of a transfer jig. The maxillary cast is positioned and mounted to the upper portion of the articulator.

The facebow is a largely omitted during the diagnosis and treatment-planning phase due to its shortcomings. It can prove tedious and uncomfort-

able for the patient, as the ear canal projections, bite fork and nose bridge can apply pressure and pain. The facebow can prove tedious and frustrating to the clinician, due to the subjective positioning and multiple adjustments^{3,4,5} (Fig. 3).

If utilized incorrectly, the facebow can result in errors, which include

- facebow application
- assembly
- patient position
- verification
- in maxillary cast orientation
- in mandibular cast orientation
- occlusal relationship

Errors have direct impact on the assessment of inter-arch space, occlusal contacts and force direction (Figs. 1,4). Errors will then affect the diagnosis, treatment plan, implant type, abutment angle and prosthesis.

If inaccurate mounting errors are not recognized early, the outcome may yield a compromised result, poor prosthesis (form and function), timely adjustments and a remake.

As with any compromised result, the ultimate consequence would include inefficient use of time, unnecessary costs, patient unhappiness, stress on

Fig. 3_Facebow application.

Fig. 4_ Incorrect mounting.

Fig. 5_ VF scan code.

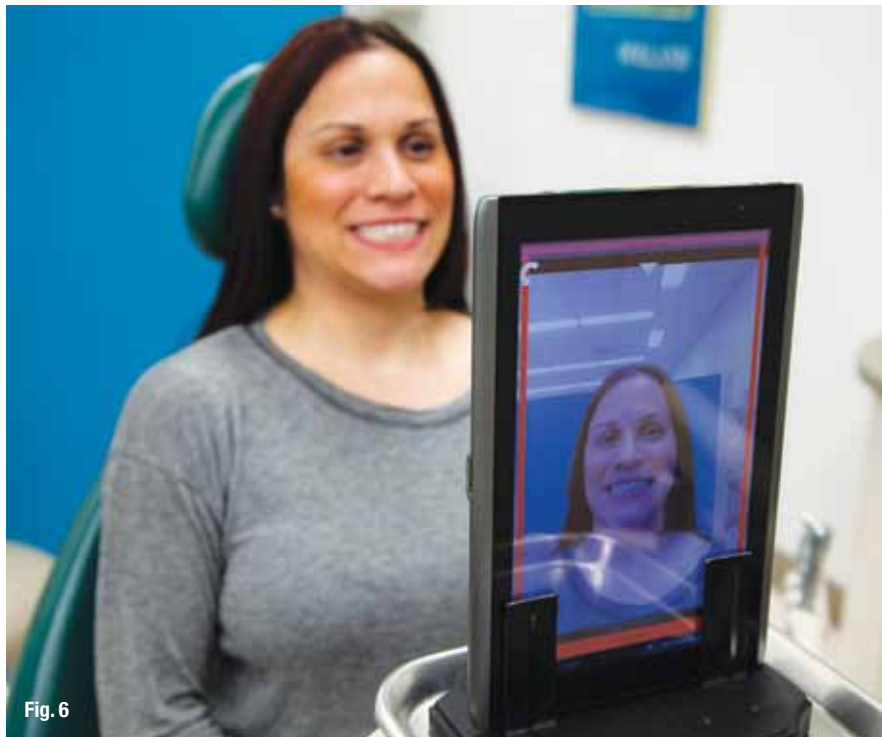


Fig. 6



Fig. 7



Fig. 8

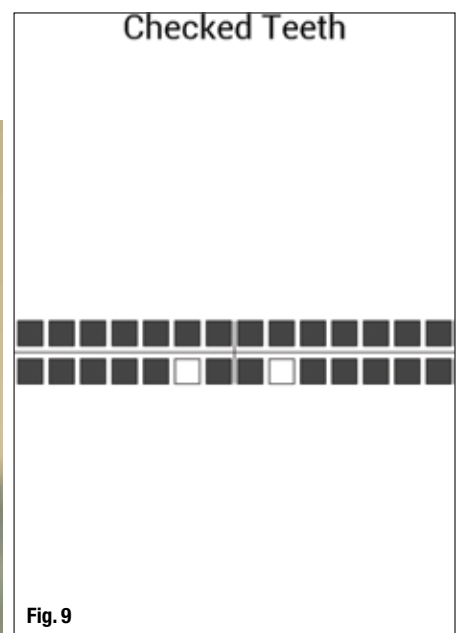


Fig. 9

Fig. 6_Tablet-patient position.

Fig. 7_Screenshot face-skull.

Fig. 8_Occlusal contacts.

Fig. 9_Screenshot tooth map.

the clinician and an unnecessary environmental impact.

Virtual Facebow

To rectify these compounded issues, the Virtual Facebow app (VF) (Research Driven, Komoka, Ontario) was developed as a digital substitute for the analog facebow (Fig. 5).

Several safeguards were incorporated to minimize errors in positioning and orientation. The VF

has been developed as an app that incorporates patient photos, alignment verification, anatomical relevance and confirmation of occlusion. The open source tablet app has been developed to be accessible through affordable tablet cost, affordable app cost and unlimited use.

Data can be readily shared, used on various devices, requires no specialized software, is simple to open and read and provides an easy-to-email option. The VF was designed to be efficient, effective, economical and educational. The VF's current



Fig. 10



Fig. 11



Fig. 12



Fig. 13



Fig. 14

requirements include: any supported tablet device with an Android operating system, a back-facing camera and a minimum system update of 4.0.3. The VF is currently available on the Google Play market.

Although the VF app has been designed to be used as a standalone substitute for the analog facebow, several peripherals have been developed to offer even more simplicity to the process. A patient positioner verifies patient orientation, a vertical tablet stand simplifies operation and an articulator mount positions the maxillary cast.

Methodology: Case study

The following is a step-by-step instruction on the VF utilization. Properly position the patient and confirm orientation. Place the tablet in the stand within 6-12 inches of the patient. Launch the VF app (Fig. 6).

Position the skull and reference markers over the patient's image. Confirm alignment of tablet and markers and simply take a photo. Resize and reposition the patient photo if required and save the image. Verify orientation of midlines, incisal

edges, occlusal planes and anatomical references by altering the transparency of either the skull or face image (Fig. 7). Clinically assess occlusal contacts (Fig. 8) and input via the touch screen (Fig. 9). Clinical component has been completed.

Laboratory

If the clinician has delegated mounting to the laboratory, then the records phase has been completed. The following applies to those who mount their own casts. Position the tablet in the stand 6-12 inches from the cast and launch the VF app. Place the maxillary cast on the articulator mount (Fig. 10). The patient image will appear.

Adjust orientation of cast (tilt) to confirm alignment with the patient markers. Verify orientation of midline, incisal edges, occlusal plane and facial references (Fig. 11).

When the cast is correctly positioned, simply take a photo. Resize and reposition the image if required and save the image. Orientation can be confirmed by altering the transparency of either the

Fig. 10_Cast photo.

Fig. 11_Screenshot face-cast.

Fig. 12_Screenshot skull-face-cast.

Fig. 13_VF mounted casts.

Fig. 14:_YouTube video scan code.

Fig. 15_ Implant case.



face or cast image. Mount the maxillary cast to the upper articulator. The record of occlusal contacts (Fig. 9) will then be displayed. Position the mandibular cast to the maxillary cast, confirming contacts, and mount the mandibular cast.

The VF will then generate a composite of the skull, face and cast. The operator has the ability to alter the transparency of any image to reconfirm the position of the skull to the patient's face and, ultimately, to the cast (Fig. 12). The laboratory component has been completed (Fig. 13). A YouTube video demonstrates the process (Fig. 14).

The files are then saved on the hard drive as a series of PDFs and JPGs, both of manageable size. The user has the option of emailing either the complete series or individual images, in PDF or JPG, to any third party. The user has the ability to refer back to any image but cannot modify any of the images. A series of six screenshots document the VF process.

_Discussion

The VF utilizes several proprietary design features that enable a tablet device to have the ability to record, confirm and reproduce the orientation of the maxilla to relative facial landmarks. This enables a simple, efficient and effective technique in the mounting of the maxillary cast to the articulator.

The VF also records the maxillo-mandibular relationship vital to correct mounting, enabling the accurate mounting of complex implant cases (Fig. 15). With exact mounting, the proper position and angulation of dental implants can be achieved (Fig. 16).

A pilot study was recently performed at the Schulich School of Medicine & Dentistry at Western

University. Patients with restored dental implants were selected. A practitioner assessed the occlusion. Impressions and required records were taken, and casts were mounted.

One dental student utilized the analogue facebow, the other the virtual facebow. Mounting was assessed in terms of: cast position (anterior-posterior and lateral), quantity of occlusal contacts, required clinical, laboratory and total time and cost. Preliminary analysis suggests that the VF is more accurate, efficient and cost-effective. Data will be presented in the near future.

The use of cone-beam computer tomography remains the gold standard of dental implant treatment planning.⁶ However, many clinicians have barriers to the technology either from limited finances, physical access or intimidation. Many implant cases are planned and delivered with little to no clinical records, other than final impressions. The Virtual Facebow provides a digital companion that is accessible, affordable and understandable.

_Conclusion

The Virtual Facebow is an open-source tablet app that not only facilitates the mounting of the maxillary cast but offers a record of occlusion. The VF also reinforces the anatomical basis of articulator mounting and supports clinical records through patient photographs.

The VF provides the clinician with a digital alternative to the analog facebow. Although evaluated through a pilot study, a larger research project would provide further validation.

By reducing errors in the diagnosis and treatment phases of implantology, the VF hopes to



Fig. 16_ Implant radiograph.

prevent and minimize errors incurred through incorrect mounting. Dental implant therapy can then be planned and delivered with the affirmation that mounting has not faulted the process of treatment delivery.

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about the author

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Les Kalman, DDS, graduated from the University of Western Ontario with a doctor of dental surgery degree in 1999. He then completed a GPR at the London Health Sciences Centre. He has been involved in general dentistry within private practice since 2000. He has served as the chief of dentistry at the Strathroy-Middlesex General Hospital. In 2011, he transitioned to full-time academics as an assistant professor at the Schulich School of Medicine and Dentistry. Kalman is also the coordinator of the Dental Outreach Community Services (DOCS) program, which provides free dentistry within the community.

Kalman has authored articles on subjects ranging from pediatric impression to immediate implant surgery in both Canadian and U.S. journals. He has been a product evaluator for several companies, including GC America and Clinician's Choice. Kalman is the co-owner of Research Driven Inc., a company that deals with intellectual property development. His most recent dental product invention has been featured on the W Network's "Backyard Inventors" television series.

Kalman is a member of the American Society for Forensic Odontology, International Team for Implantology, Academy of Osseointegration, American Academy of Implant Dentistry and the International Congress of Oral Implantology, where he has been recognized with diplomate distinction. He can be contacted at (519) 661-2111, ext. 86097, or via email to lkalman@uwo.ca.



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