Testing the accuracy of the condylar position measurement (CPM) algorithm in the CADIAS[®] 3D software

Thomas Haberl¹, Christian Slavicek^{1,2}

¹ GAMMA Medizinisch-wissenschaftliche Fortbildungs-GmbH, Klosterneuburg, Austria ² VieSID – Vienna School of Interdisciplinary Dentistry, Klosterneuburg, Austria

INTRODUCTION

The CADIAS[®] 3D module of GAMMA Dental Software[®] allows performing a condylar position measurement (CPM) by computing the transformation necessary to overlap two 3D-scanned lower jaw models in virtual space. This transformation is subsequently applied to the right and left condyle to facilitate an assessment of the condylar displacement between two lower jaw positions, such as ICP and RP, or before and after treatment.

5. Asymmetry correction

The adjustment parameters of the CPV were recalculated to the standard intercondylar distance of 110 mm before comparing them against the CPM result values.

RESULTS

VieSID Summer School 2022 In honor of Prof. Rudolf Slavicek



Figure 5: Inwards movement of right condyle caused by unilateral offset along Z axis.

AIM

In this work, we evaluated the accuracy of the surface matching algorithm used in the CADIAS[®] 3D CPM by performing the measurement on a set of artificial lower jaw positions with known transformations, generated in the same software.

MATERIALS AND METHODS

3. Remeshing 1. Model scan An articulated lower jaw model The surface mesh of each was scanned using a desktop model duplicate was altered by 3D scanner (*smart optics Vinyl*). remeshing to simulate a



repeated scanning procedure.



Deviation in condylar displacement (right/left $\Delta X / \Delta Y / \Delta Z$):

Range of deviations: $-1.4 \mu m$ to $+3.3 \mu m$

Mean absolute deviation: 1.0 μ m (±SD = 0.5 μ m)

Deviation in incisal pin height change (\DeltaIPH):

Range of deviations: $-0.4 \mu m$ to $+1.4 \mu m$

Mean absolute deviation: 0.5 μ m (±SD = 0.4 μ m)



Figure 1: Scanning of articulated models in the smart optics Vinyl 3D scanner.

2. Virtual repositioning

The model scan was duplicated 12 times and moved into as many distinct positions using virtual Condylar Position the Variator (CPV) of CADIAS[®] 3D. defined Positions were by varying right and left condylar offset and incisal pin height.

Figure 3: Surface mesh of the 3D model before (left) and after remeshing (right).

4. CPM

A CPM was calculated between the original model and each repositioned copy to overlap their surfaces. The result includes condylar displacement and incisal pin height change.

Figure 6: Distribution of the deviations between expected and measured condylar displacement and incisal pin height change for the 12 lower jaw positions.

DISCUSSION

Under clinical considerations, the values measured by performing a CPM in CADIAS[®] 3D were practically identical to the parameters used for the generation of the artificial lower jaw positions. For comparison, electromechanical measurement using the E-CPM has been shown to yield a reproducibility of 100 μ m to 150 μ m [1]. Future work should assess the differences between the virtual CPM and conventional methods, covering the entire digital workflow from 3D scanning to virtual functional analysis.



Figure 2: Repositioning of models in the virtual CPV (bite splint for illustration).

Figure 4: The result of matching a lower jaw model in two distinct positions (red and blue) using the CADIAS[®] 3D CPM.

CONCLUSIONS

The error introduced by the matching algorithm of the CADIAS[®] 3D CPM is to be considered insignificant, especially

in comparison to other possible sources of error in the digital

workflow and to conventional CPM methods.

[1] Vahle-Hinz et al., "Condylar Position Analysis with a New Electronic Condylar Position Measuring Instrument E-CPM: Influence of Different Examiners and a Working Bite on Reproducibility," International Journal of *Computerized Dentistry*, vol. 12, no. 3, pp. 235-246, 2009



GAMMA Medizinisch-wissenschaftliche Fortbildungs-GmbH

Wasserzeile 35 3400 Klosterneuburg Austria



