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Pilot study on the accuracy of template-guided implant placement with a new method for three-dimensional analysis

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OBJECTIVES

The aim of this pilot study was to establish a new, non-invasive method for determining the accuracy of implant position after template-guided implant insertion and to present the results in a case series.

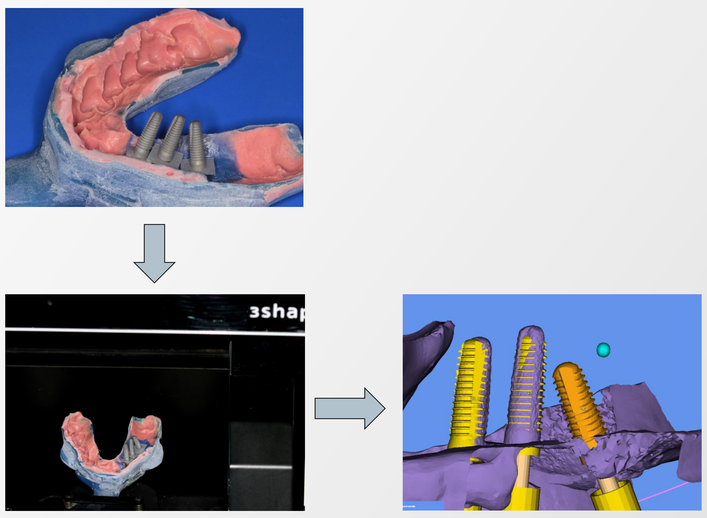

Figure 1 : Implant impression with implant-dummy will be superimposed with the data set from the implant planning software SMOP

METHOD

In this pilot study, 24 patients were included in a consecutive case series. Group I consisted of 12 cases with a free-end situation (FE) in the premolar or molar region. Group II comprised 12 cases with tooth-bound spaces (TS). In all cases only one implant (Screw-Line implants, CAMLOG Guide, Camlog, Wimsheim, GER) was evaluated (Tab. 1). The analysis was performed by superimposing the data set from the implant planning software SMOP (Swissmeda, Zurich, CH) and the digitization (D700, 3Shape, Copenhagen, DK) of the implant impression with an implant-dummy fixed in the impression post (Geomagic Studio 9.0, geomagic, USA) (Fig. 1). Angle and distance (neck and apical) between planned and clinical implant position were calculated (Surfacer 10.6, Imageware, Ann-Arbor, USA) (Fig. 2 and 4). In cases with good congruency, an additional three-dimensional (3D) analysis was performed (Geomagic Qualify 9.0, geomagic, NC, USA). The spread of differences was also shown in color coded graphs (Fig. 3).

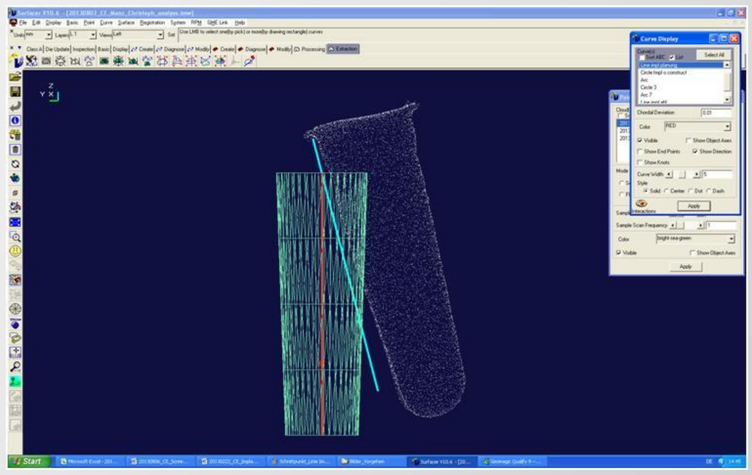

Figure 2 : Angle and distance (neck and apical) between planned and clinical implant position were calculated (Surfacer).

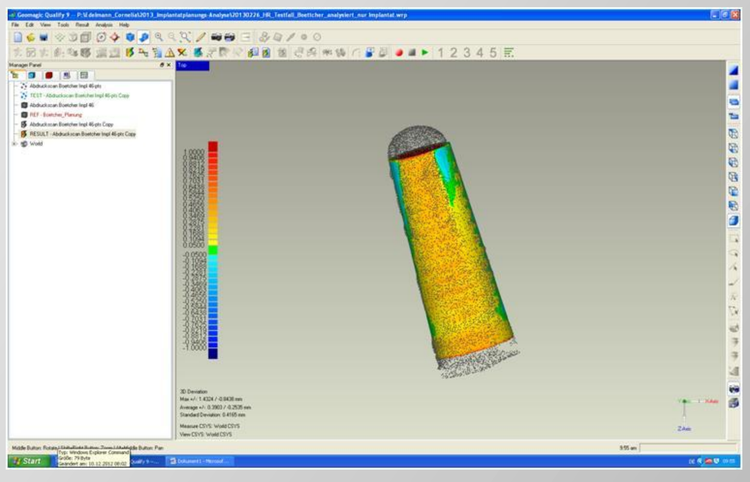

Figure 3 : In cases with good congruency, an three-dimensional (3D) analysis was performed (Geomagic Qualify 9.0)

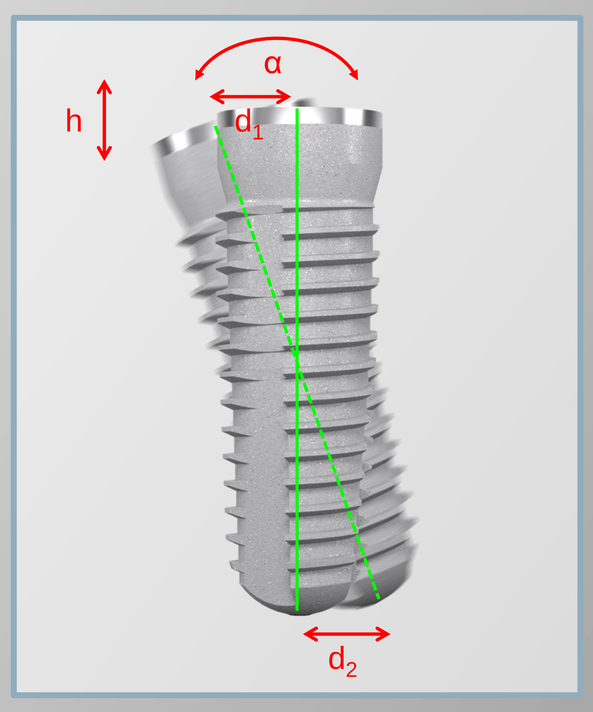

Figure 4 : Calculated deviations

Group		Arch		Surgical technique		Implant length		
		Upper Jaw	Lower Jaw	Open flap	Flapless	9 mm	11 mm	13 mm
FE	No.	5	7	3	9	-	11	1
TS	No.	7	5	5	7	2	5	5

Table 1 : Patients an treatment characteristics

RESULTS

In the FE group, the mean angular deviation of the implant axes was 5.18° (95 % CI: 3.58-6.77). In the TS group, mean angulation was 4.68° (95 % CI: 3.30-6.06). The mean deviation at the implant neck was 1.00mm (95 % CI: 0.70-1.29) for FE and 0.87mm (95 % CI: 0.59-1.15) for TS. The deviation at the apex was 1.57mm (95 % CI: 1.16-1.99) for FE and 1.47mm (95 % CI: 1.06-1.87) for TS (Tab. 2). The 3D-analysis could be performed for 15 of the 24 cases.
No significant differences ($p > 0.05$) between the two groups were found. Results were in accordance with studies on other template-guided 3D-planning systems.

Group		Height h	Angulation α	Deviation Implantat neck d_1	Deviation Implantat apex d_2
FE	Mean	0,27	5,18	1,00	1,57
	SD	0,84	2,83	0,52	0,74
	95%CI	-0,20 - 0,75	3,58 – 6,77	0,70 – 1,29	1,16 – 1,99
TS	Mean	0,62	4,68	0,87	1,47
	SD	0,47	2,44	0,49	0,71
	95%CI	-0,89 – 0,35	3,30 - 6,06	0,59 – 1,15	1,06 – 1,87

Table 2 : Deviations in height [mm] and angulation [°]

CONCLUSION

Within the limitation of the small number of patients, the results show a sufficiently high accuracy of the SMOP procedure. The applied method of analysis is suitable for the assessment of larger cohorts due to its non-invasive procedure.
During the further procedure, data for a cost/benefit-analysis of template-guided implant insertion will be gathered.

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