53rd SIDO 13-16 October 2022
International Congress TOGETHER WITH ...
8th MOIP 15-16 October 2022
Fortezza da Basso - Firenze
167

Sara Drago[1], Luigi Rizzi[1], Giulia Papi[1], Marco Migliorati[1]
1. Orthodontic Department-DISC, Università degli Studi di Genova

GUIDED MINISCREW INSERTION IN THE PALATE: A CLINICAL STUDY ON THE RELIABILITY OF THE COMBINED USE OF LATERAL CEPHALOGRAM AND MAXILLARY STL FILE FOR PLANNING

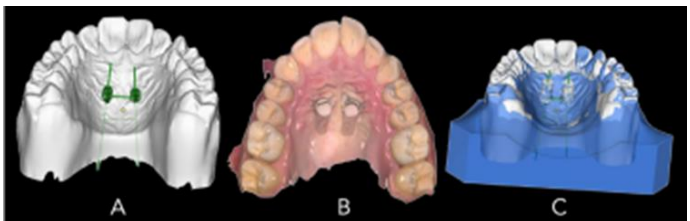
AIM: Temporary anchorage devices in the anterior area of the palate can be placed either directly or using an insertion guide. Different kinds of digital planning and guides are available nowadays, and in some cases a CBCT is required. The aim of the present clinical study is to assess the reliability of an insertion guide obtained by the combined use of a lateral cephalogram and the maxillary STL file.

MATERIAL AND METHODS: 25 consecutively treated patients were included in the study. The maxillary STL file and lateral cephalogram were imported and matched on a dedicated software. Two miniscrews were then virtually added to the matched file and placed in the anterior area of the palate, using the space between the second and third rugae as a reference. The lateral cephalograms were used to control the miniscrew-incisors distance and the depth of maxillary bone. Once the project was completed, a new maxillary STL file was generated with holes corresponding to the miniscrews position. The STL file with the miniscrews position was then 3D printed and the laboratory analogs were positioned. A thermoformed sheet was used to thermoform the guide, and metal sleeves were placed on the analogue's head and fixed to the thermoformed part. The guide was first checked in the patient's mouth and used to insert the miniscrews. After miniscrews insertion, a new intraoral scan was taken covering the miniscrews head with scan bodies to obtain the miniscrews' achieved position. The 3D printed model used to create the guide was scanned and used as a control group. Then miniscrews parallelism and angular and linear displacements were evaluated taking into consideration pairwise comparisons in the three STL models: the digital insertion planning file, the STL file of the 3D printed position, and the STL file of the achieved position.

	Planning	Achieved	Model	*P* value	
N	25	25	25		
Angle XYZ	0.00 [0.00, 0.02]	6.22 [4.35, 9.08]	1.65 [1.17, 12.76]	P vs A	< 0.001
				P vs M	< 0.001
				M vs A	0.315
Angle XY	0.00 [0.00, 0.00]	4.24 [1.51, 7.14]	1.64 [0.84, 12.07]	P vs A	< 0.001
				P vs M	< 0.001
				M vs A	0.941
Angle YZ	0.00 [0.00, 0.02]	4.43 [2.00, 6.34]	0.96 [0.50, 2.00]	P vs A	< 0.001
				P vs M	< 0.001
				M vs A	< 0.001
Angle XZ	0.00 [0.00, 0.00]	8.59 [3.08, 14.49]	2.36 [1.57, 21.01]	P vs A	< 0.001
				P vs M	< 0.001
				M vs A	0.482

Table 1: Angle determined by the mutual position in the space of a couple of screws in a patient with respect to three different settings (Planning, Achieved upon insertion, Model. N = 25 patients). Values in degrees [°] are read in the plane containing both screws direction (Angle XYZ), or between the projections of the directions on the planes generated by the Cartesian axes X, Y and Z (Angle XY, Angle YZ, Angle XZ respectively). Results are expressed as Median [Interquartile Range]; *P* value = Wilcoxon's signed rank test *P* value adjusted by using Bonferroni method.

RESULTS: The median achieved angle between a couple of digitally planned screws was 6.22, IR = [4.35, 9.08] degrees and the difference between angles in the planning and the achievement was significant ($p < 0.001$). Lateral and vertical differences in miniscrews position were also found among the three groups.

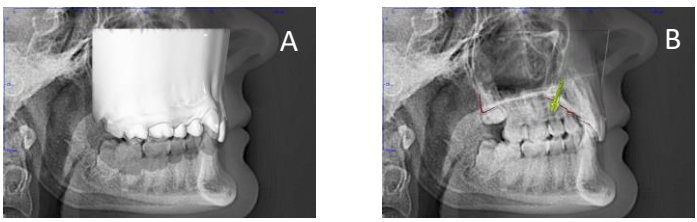


(A.) STL file of the insertion planning project (B.) STL file of the achieved post-insertion outcome (C.) STL file (scan) of the 3D printed model

CONCLUSIONS: the examined workflow resulted as clinically efficient. Differences between the digitally planned position of orthodontic miniscrews, control, and achieved ones were detected. These differences were found both for angular and linear measurements, but they were clinically insignificant.

	Angle XYZ	Angle XY	Angle YZ	Angle XZ
Planning versus Achieved				
Screw 1	3.74 [2.41, 6.74]	2.54 [1.05, 3.68]	2.61 [1.22, 5.12]	3.44 [2.23, 6.25]
Screw 2	4.68 [3.38, 6.51]	2.85 [2.08, 4.09]	3.79 ± 2.54	6.79 [3.61, 8.94]
Planning versus Model				
Screw 1	1.61 [0.95, 5.16]	0.83 [0.42, 4.48]	1.12 [0.81, 2.04]	1.61 [0.75, 6.06]
Screw 2	1.75 [1.12, 4.79]	1.69 [0.61, 4.44]	0.89 [0.52, 1.44]	2.10 [1.08, 8.43]
Model versus Achieved				
Screw 1	4.31 [3.15, 6.58]	2.89 [0.63, 6.28]	2.14 [0.72, 3.80]	3.88 [1.18, 11.79]
Screw 2	4.55 ± 3.00	3.11 ± 2.23	2.45 [1.29, 5.08]	5.87 [2.30, 8.27]

Table 2: Angles defined by each screw direction by performing pairwise observations of it in different settings (Planning, Achieved upon insertion, Model. N = 25 patients). Values in degrees [°] are read in the plane containing both the observed directions (Angle XYZ), or between the projections of the directions on the planes generated by the Cartesian axes X, Y and Z (Angle XY, Angle YZ, Angle XZ respectively). Results are expressed as Mean ± Standard Deviation or Median [Interquartile Range].



(A.) STL file and lateral cephalogram superimposition (B.) Miniscrew position planning

	X	Y	Z
Planning with respect to Achieved			
Screw 1 tip	0.20 ± 0.75	0.76 [0.49, 1.21]	1.04 ± 0.76
Screw 1 top	0.08 [-0.07, 0.32]	0.91 [0.75, 1.43]	0.59 [0.29, 0.87]
Screw 2 tip	0.49 ± 0.87	0.87 [0.59, 1.13]	1.16 ± 0.86
Screw 2 top	-0.00 ± 0.51	1.16 ± 0.56	0.55 ± 0.46
Planning with respect to Model			
Screw 1 tip	0.02 [-0.19, 0.10]	0.56 [0.20, 0.84]	0.47 [0.25, 0.77]
Screw 1 top	0.11 [0.04, 0.76]	0.54 [0.31, 0.82]	0.43 ± 0.56
Screw 2 tip	0.23 ± 0.42	0.58 [0.37, 0.97]	0.51 [0.37, 0.87]
Screw 2 top	-0.10 [-0.38, -0.04]	0.68 ± 0.52	0.44 ± 0.45
Achieved with respect to model			
Screw 1 tip	-0.30 ± 0.86	-0.45 ± 0.75	-0.48 ± 0.68
Screw 1 top	0.01 [-0.17, 0.24]	-0.59 [-0.98, -0.18]	-0.04 ± 0.50
Screw 2 tip	-0.25 ± 0.92	-0.27 ± 0.42	-0.44 ± 0.83
Screw 2 top	-0.19 ± 0.47	-0.49 ± 0.44	-0.10 ± 0.34

Table 3: Linear displacement of each screw by performing pairwise observations of it in different settings (Planning, Achieved upon insertion, Model. N = 25 patients). Values [mm] are intended in the three directions of the reference system (Cartesian axes X, Y and Z). Positive values indicate that a more lateral (along X), deeper (along Y) or mesial (along Z) displacement has been observed in the cited setting with respect to the other one. Results are expressed as Mean ± Standard Deviation or Median [Interquartile Range].

REFERENCES:

- Karagkiolidou A, Ludwig B, Pazera P, Gkantidis N, Pandis N, Katsaros C. Survival of palatal miniscrews used for orthodontic appliance anchorage: a retrospective cohort study. Am J Orthod Dentofacial Orthop 2013;143:767-72.
- Miyazawa K, Kawaguchi M, Tabuchi M, Goto S. Accurate pre-surgical determination for self-drilling miniscrew implant placement using surgical guides and cone-beam computed to mography. Eur J Orthod 2010;32:735-40.
- Iodice G, Nanda R, Drago S, Repetto L, Tonoli G, Silvestrini Biavati A, et al. Accuracy of direct insertion of TADs in the anterior palate with respect to a 3D-assisted digital insertion virtual plan ning. Orthod Craniofac Res 2022;25:192-8.
- Maino BG, Paoletto E, Lombardo L, Siciliani G. A three dimensional digital insertion guide for palatal miniscrew place ment. J Clin Orthod 2016;50:12-22.