

INTRODUCTION

The accuracy of implant impressions is both crucial and critical for the precise and passive fit of implant-supported prostheses. Despite the extensive studies on different implant impression techniques for fully edentulous patients, there is a paucity of literature on a novel impression technique that combines the conventional and digital implant impression modalities. This research study evaluating the accuracy of the ISB technique seeks to utilize the benefits of both conventional and digital implant impressions.



The primary aim of this *in vitro* study is to compare the accuracy of impression scan body (ISB) technique to conventional and digital implant impression techniques for a completely edentulous mandibular arch. The secondary aim is to assess the relationship between different implant angulations and inter-implant distances in relation to the accuracy of impressions.

MATERIALS AND METHODS

An edentulous mandibular master cast (control) was designed with five implants placed at different angulations and inter-implant distances (Figure 1). Three impression techniques were utilized: a conventional impression technique (Group 1) (n=15), an ISB technique where impression scan bodies are attached to the splinted impression copings in a conventional elastomeric impression (Group 2) (n=15), and an intraoral digital impression technique (Group 3) (n=15).

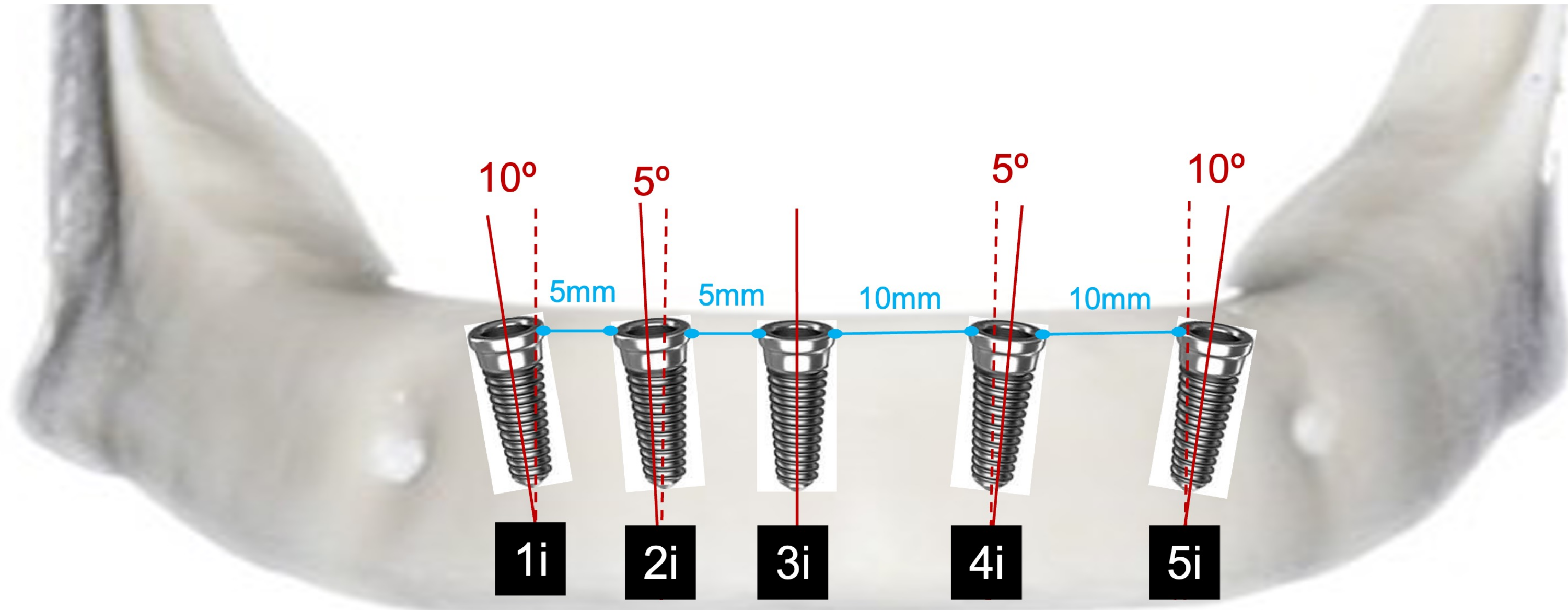


Figure 1. Diagram of five implants (1i, 2i, 3i, 4i, 5i) on the master model with specific angulations and inter-implant distances.

Master and conventional impressions were digitalized into standard tessellation language (STL) with an extraoral scanner (Freedom HD scanner; DOF Inc., Korea). STL datasets of each test group were superimposed with the control group using Geomagic Control X software, and three-dimensional (3D) deviations were measured. The third implant was used as a reference for superimposition.

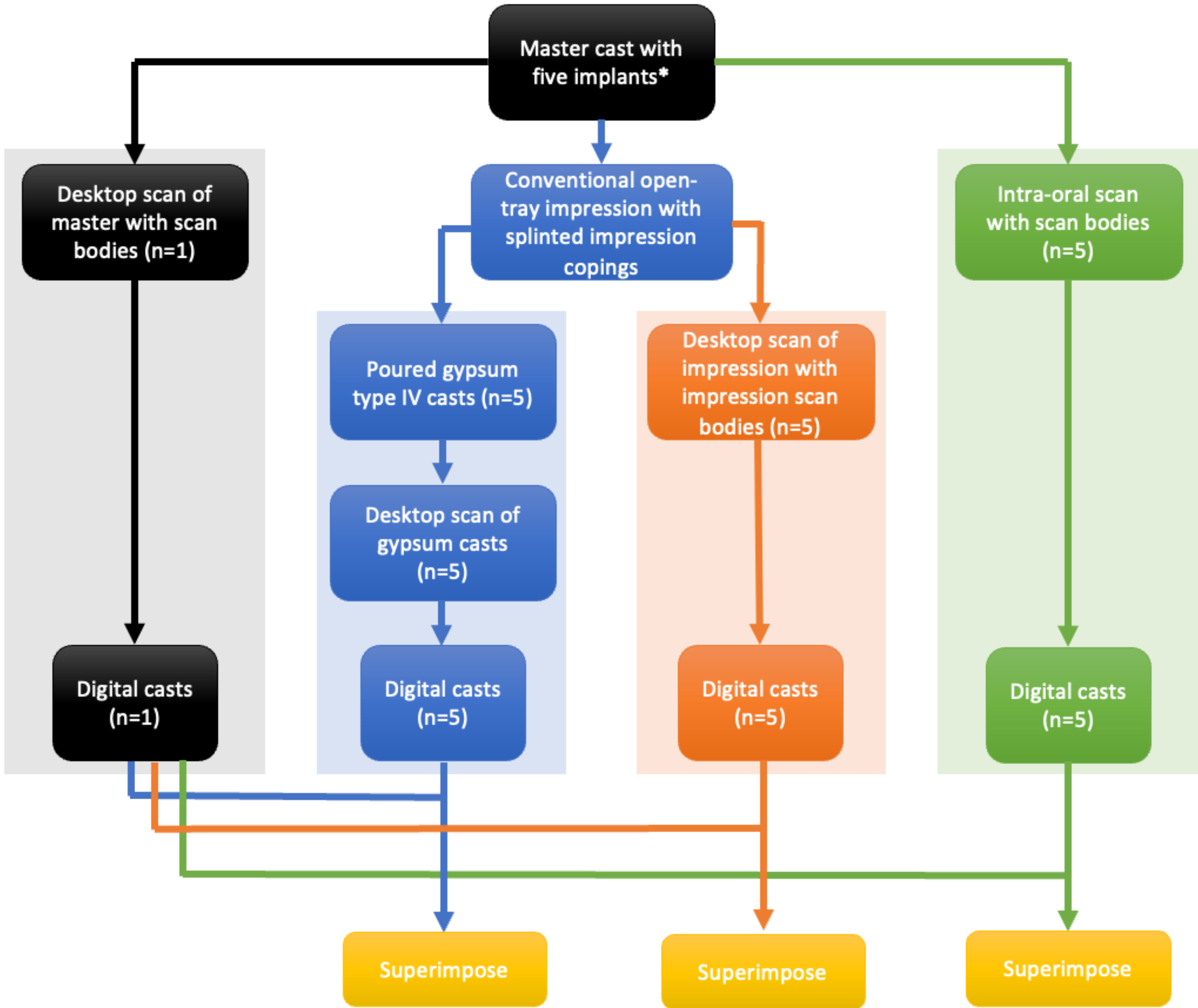


Figure 2. Methodology flowchart.

RESULTS

For each test groups, the absolute values of 3D deviations from the control were calculated (Table 1, 2, and 3). Then, these values were compared using Kruskal-Wallis test followed by Dunn's post hoc test (Table 4).

Group 1	1i	2i	3i	4i	5i
N1	0.307	0.328	0	0.965	0.651
N2	0.341	0.226	0	0.502	0.513
N3	0.594	0.601	0	0.805	0.295
N4	0.530	0.329	0	0.529	0.696
N5	0.369	0.340	0	0.872	0.614
Mean	0.428	0.365	0	0.554	0.416
STDEV	0.016	0.020	0	0.043	0.026

Table 1. Measurement of absolute values of 3D deviations (in mm) for Group 1 (conventional).

Group 2	1i	2i	3i	4i	5i
N1	0.456	0.279	0	0.593	0.523
N2	0.309	0.232	0	0.613	0.593
N3	0.208	0.335	0	0.550	0.327
N4	0.392	0.367	0	0.621	0.688
N5	0.261	0.207	0	0.590	0.666
Mean	0.325	0.284	0	0.593	0.352
STDEV	0.010	0.005	0	0.001	0.021

Table 2. Measurement of absolute values of 3D deviations (in mm) for Group 2 (ISB).

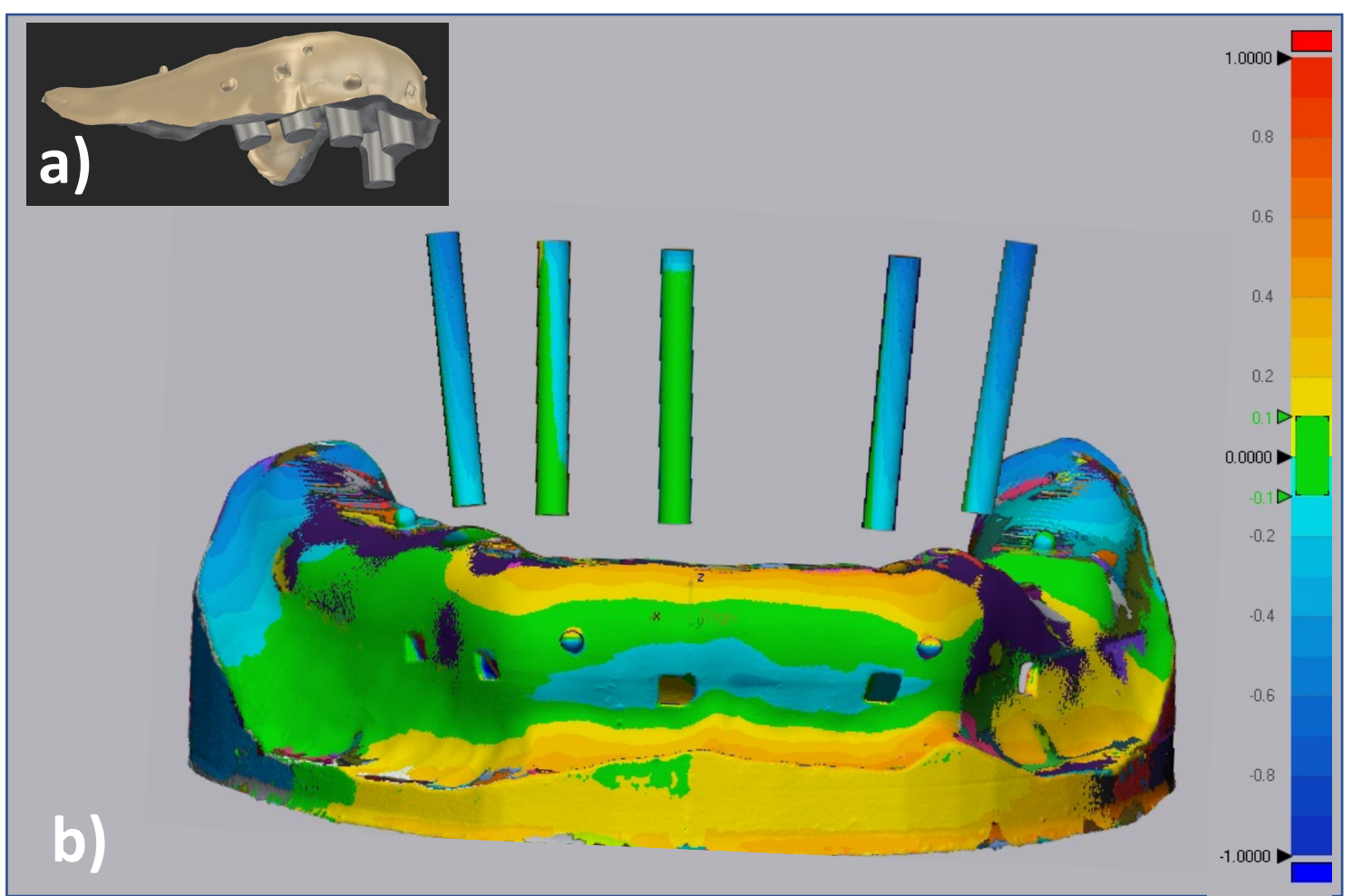


Figure 3. a) digital scan, and b) color-map of Group 2

Group 3	1i	2i	3i	4i	5i
N1	0.379	0.166	0	0.338	0.432
N2	0.423	0.189	0	0.385	0.288
N3	0.533	0.216	0	0.481	0.491
N4	0.358	0.194	0	0.400	0.239
N5	0.369	0.192	0	0.500	0.417
Mean	0.412	0.192	0	0.421	0.373
STDEV	0.005	0.001	0	0.005	0.011

Table 3. Measurement of absolute values of 3D deviations (in mm) for Group 3 (Intraoral scan).

	n	Group 1	Group 2	Group 3	p-value
Overall, mean	20	0.416	0.353	0.280	0.027*
Implant 1, mean	5	0.428	0.325	0.412	0.395
Implant 2, mean	5	0.365	0.284	0.192	0.011
Implant 3, mean	5	N/A	N/A	N/A	N/A
Implant 4, mean	5	0.734	0.593	0.421	0.009
Implant 5, mean	5	0.554	0.559	0.373	0.067
p-value		0.067	0.007	0.012	
post hoc test		Implant 2 vs 4**	Implant 2 vs 4***	Implant 2 vs 4****	

The level of statistical significant: p<0.05.

P-value from Kruskal-Wallis test; post hoc test values from Dunn's post hoc test.

P= 0.027* for Group 1 vs Group 3.

Implant 2 vs 4**: p=0.012

Implant 2 vs 4***: p= 0.006.

Implant 2 vs 4****: p=0.007.

Table 4. Comparison of absolute values of 3D deviations (in mm) for Group 1, 2, and 3.

DISCUSSION / CONCLUSIONS

Within the limits of this study, the following conclusions were drawn:

- For a completely edentulous arch, impression scan body (ISB) technique is as accurate as intraoral digital scan technique, with both appearing to be more accurate than conventional splinted-coping impression technique.
- There was no correlation between the accuracy of implant impressions and implant angulation up to 10° for a completely edentulous arch. .
- The 3D deviations for all 3 test groups compared to the control tend to increase with larger inter-implant distance.
- For all groups, there is a tendency for decreased reproducibility with larger inter-implant distances

References

