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Effects of Dental Chair Backrest Inclination on Virtual Interocclusal Record of Maximum Intercuspal Position: A Clinical Study



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Statement of Problem

Different dental chair backrest inclinations may influence the maximum intercuspal position(MIP) of the mandible obtained virtually with an intraoral scanner.

Introduction

- Nowadays, digital dentistry enables taking virtual interocclusal records of teeth by scanning their buccal and labial surfaces while in MIP. Various in vitro studies evaluated the accuracy of virtual interocclusal records using an industrial scanner and concluded that the accuracy is comparable to the conventional techniques.
- While virtual interocclusal records are commonly used to obtain MIP in an intraoral scanner, evidence for the best position to obtain them is limited.

Purpose of the study

- To evaluate the influence of dental chair backrest inclination on the accuracy of virtual interocclusal record of MIP obtained with an intraoral scanner and compare it to conventional interocclusal record of MIP obtained with a polyvinylsiloxane(PVS) record at 90 degrees, 120 degrees, and 180 degrees dental chair backrest inclination.
- Also aims to compare the virtual interocclusal record of MIP at 90 degrees backrest inclination with free-hand articulation in MIP.

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Materials and Methods

- A total of 10 dental students with fully dentate volunteered to participate in this study (IRB approved). Each participant's maxillary and mandibular arches were scanned using Trios3 (3 Shape) intraoral scanner to create STL files to enable the fabrication of 10 printed maxillary models and 10 printed mandibular models used in this study.
- Virtual interocclusal records were obtained by scanning buccal and labial surfaces on both right and left sides while in MIP at 90 degrees (Control), 120 degrees, and 180 degrees dental chair backrest inclination. A total of 30 virtually mounted models were obtained.
- Conventional interocclusal records were obtained by using PVS while in MIP at 90 degrees, 120 degrees, and 180 degrees dental chair backrest inclination.
- For each participant, maxillary and mandibular printed models were mounted using free-hand articulation technique and conventional interocclusal record technique (PVS recorded at 3 positions: 90, 120, and 180 degrees backrest inclination).
- A total of 40 mounted digital scans were obtained by using a calibrated desktop scanner.
- All STL files (30 virtually mounted scans and 40 mounted digital scans) were exported, superimposed, and analyzed by using a best-fit algorithm of a professional engineering software program to determine the 3D position deviation in three axes X, Y, Z. (Fig. 2)

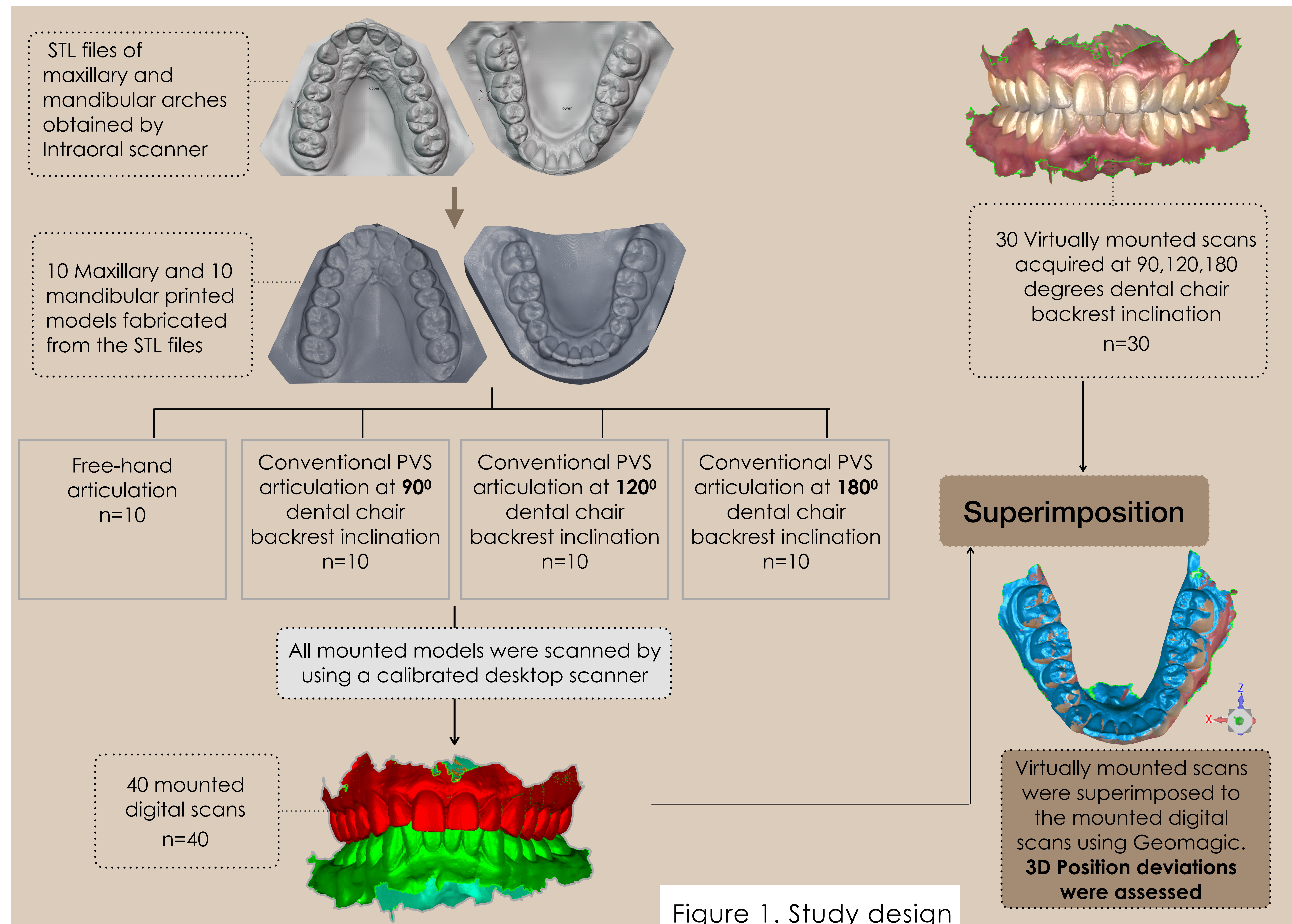


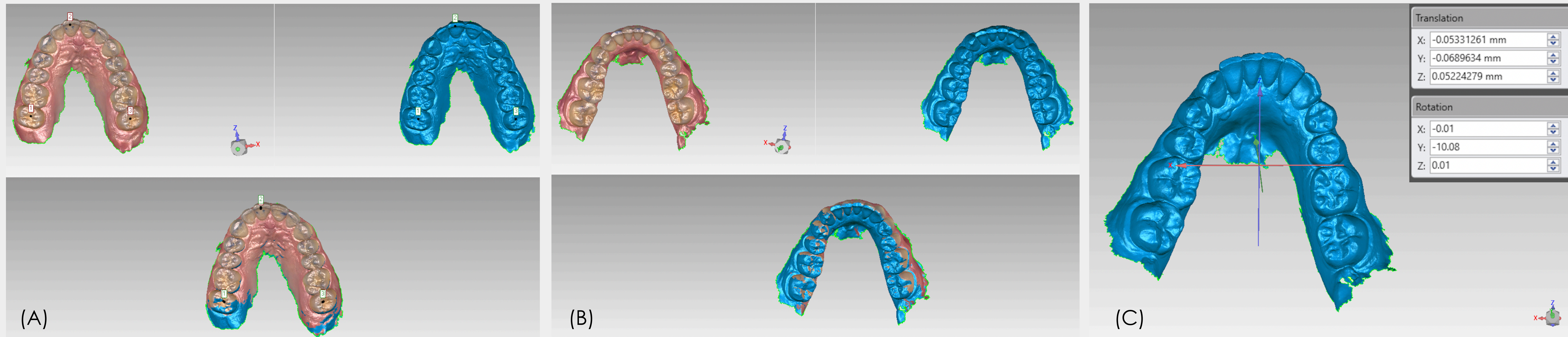
Figure 1. Study design

Materials and Methods

Null Hypotheses

- H1** The virtual interocclusal record captures the same mandibular MIP in the patient at different dental chair backrest inclinations.
- H2** The virtual interocclusal record captures the same mandibular MIP in the patient as the conventional interocclusal record at different dental chair backrest inclinations.
- H3** The virtual interocclusal record at 90 degrees captures the same mandibular MIP in the patient as the free-hand articulation method.

Figure 2. Superimposition and measurement of 3D position deviations in Geomegic program. (A) Superimposition between virtually mounted scan and mounted digital scan by merging point on the maxillary scan. (B) Mandibular scan was aligned to a corresponding maxillary scan, then superimposed. (C) 3D position deviations were analyzed, and the deviations were assessed in both translation and rotation in three axes X, Y, Z.



Results

H1

No statistically significant difference was found in mandibular MIP for virtual interocclusal record at different dental chair backrest inclinations for X, Y, Z translation axes, and X, Y, Z rotation axes. (Table 1)

H2

No statistically significant difference was found in mandibular MIP between different techniques of capturing MIP (Virtual VS Conventional interocclusal record) at different dental chair backrest inclination for X, Y, Z translation axes, and X, Y, Z rotation axes. (Table 2)

Table 1. Comparison of mean and standard deviation of 3D position deviations in translation and rotation axes between virtual interocclusal record of MIP captured at 90,120,and 180 degrees dental chair backrest inclinations

Dental chair backrest inclinations	3D Position Deviations											
	Translation (Axis)						Rotation (Axis)					
	X		Y		Z		X		Y		Z	
	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd
V90 (Control)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V120	-0.01	0.10	0.00	0.11	0.05	0.07	0.11	0.23	-0.08	0.15	0.09	0.19
V180	0.13	0.48	0.00	0.16	0.06	0.09	-0.06	0.48	-0.49	1.55	-0.07	2.06
P-value	0.466		0.998		0.153		0.466		0.432		0.285	

Table 2. Comparison of mean and standard deviation of 3D position deviations in translation and rotation axes between virtual and conventional interocclusal record of MIP captured at 90,120,and 180 degrees dental chair backrest inclinations

Dental chair backrest inclinations	3D Position Deviations											
	Translation (Axis)						Rotation (Axis)					
	X		Y		Z		X		Y		Z	
	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd
V90 (Control)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
V120	-0.26	1.89	0.56	0.72	0.24	0.38	-0.17	0.59	0.01	0.23	0.09	0.30
V180	0.37	0.23	0.25	0.15	0.16	0.15	-0.09	0.52	-0.04	0.33	-0.02	0.25
CV90	0.32	0.28	0.27	0.21	0.04	0.21	-0.13	0.50	0.17	0.30	0.26	1.02
CV120	-0.01	0.10	0.00	0.11	0.05	0.07	0.11	0.23	-0.08	0.15	0.09	0.19
CV180	0.13	0.48	0.00	0.16	0.06	0.09	-0.06	0.48	-0.49	1.55	-0.70	2.06
P-value	0.497		0.264		0.459		0.661		0.664		0.513	

Results

H3

No statistically significant difference was found in mandibular MIP between virtual interocclusal record of MIP captured at 90 degrees dental chair backrest inclinations and Free-hand articulation for X, Y, Z translation axes, and X, Y, Z rotation axes. (Table 3)

Table 3. Comparison of mean and standard deviation of 3D deviations in translation and rotation axes between virtual interocclusal record of MIP captured at 90 degrees dental chair backrest inclinations and Free-hand articulation

Dental chair backrest inclinations	3D Position Deviations											
	Translation (Axis)						Rotation (Axis)					
	X		Y		Z		X		Y		Z	
	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd	Mean	Sd
V90 (Control)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Free-Hand	0.13	0.29	-0.17	0.25	0.03	0.43	-0.19	0.54	0.54	0.71	-0.14	0.43
P-value	0.196		0.068		0.822		0.288		0.041		0.343	

Conclusions

Within the limitations of this study, it can be concluded that

- The accuracy of Virtual interocclusal records of MIP obtained by the Intraoral scanner was not influenced by different dental chair backrest inclinations between 90 to 180 degrees.
- Virtual interocclusal records of MIP demonstrated accuracy as compared to conventional interocclusal records.
- Virtual interocclusal records at 90 degrees dental chair backrest inclination captured the same mandibular MIP as compared to Free-hand articulation.