Influence of Ridge Morphology and Manufacturing Methods on Mandibular Denture Base Trueness and Precision

Ahmed Youssef, BDS, MS* · Nader Abdulhameed, BDS, MS, MSc, PhD · Omnia Saleh, BDS, MSc, PhD · Josephine F. Esquivel-Upshaw, DMD · Sherif Hosney, BDS, MS, FACP

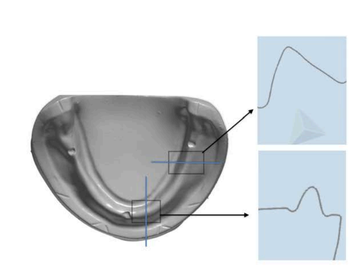
University of Florida College of Dentistry, Department of Prosthodontics · Boston University Henry Goldman School of Dental Medicine
* Presenting author · ahmadyoussefbds@gmail.com

1 Objectives

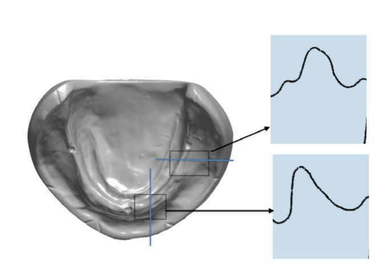
This in vitro study evaluated *the effect of mandibular ridge morphology and denture base manufacturing technique on the trueness and precision of definitive mandibular denture bases.*

2 Methods

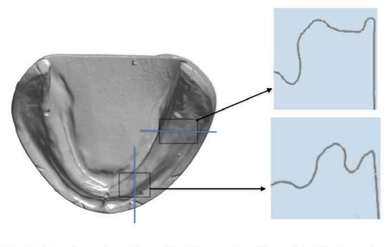
Three edentulous mandibular reference models representing **different ridge morphologies** classified **according to Cawood and Howell** were used. **Model A** exhibited **anterior Class III** and **posterior Class IV** ridge form. **Model B** exhibited **anterior and posterior Class III** ridge forms. **Model C** exhibited **anterior Class III** and **posterior Class IV** ridge form with a more anatomically compromised posterior region.
For each morphology, **denture bases were fabricated** using three techniques: **conventional injection molding**, **subtractive manufacturing** from prepolymerized PMMA discs (milled), and **additive manufacturing** using digital light processing (printed) (**n = 13 per group; N = 117**).
Specimens were **digitized using a tabletop scanner** and **superimposed** onto their corresponding **reference models** using manual and best-fit alignment. **The intaglio surface** was **segmented** into **denture-bearing area** (DBA), **denture border** (DB), and total area (DBA+DB). **Trueness** was quantified using **root mean square** (RMS) deviation values, and **precision** was **assessed as intra-group variability**. Data were analyzed using generalized linear models with a Gamma distribution and log link function. Statistical significance was set at a = 0.01.



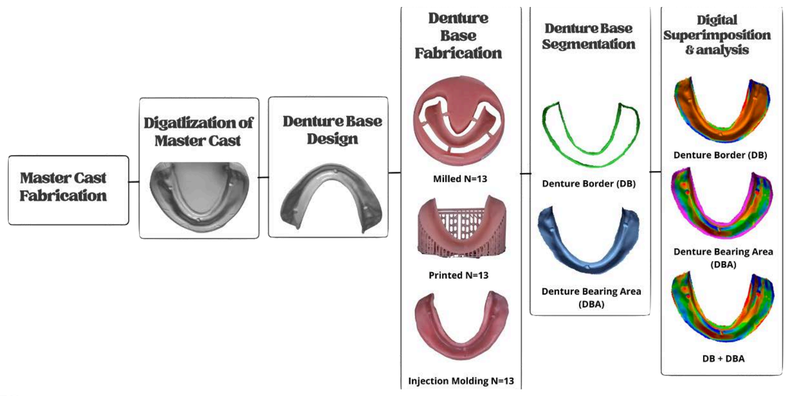
Model A: Anterior Class III / Posterior Class IV; LT class III



Model B: Anterior Class III / Posterior Class III; LT class II



Model C: Anterior Class III / Posterior Class V; LT class I



3 Results

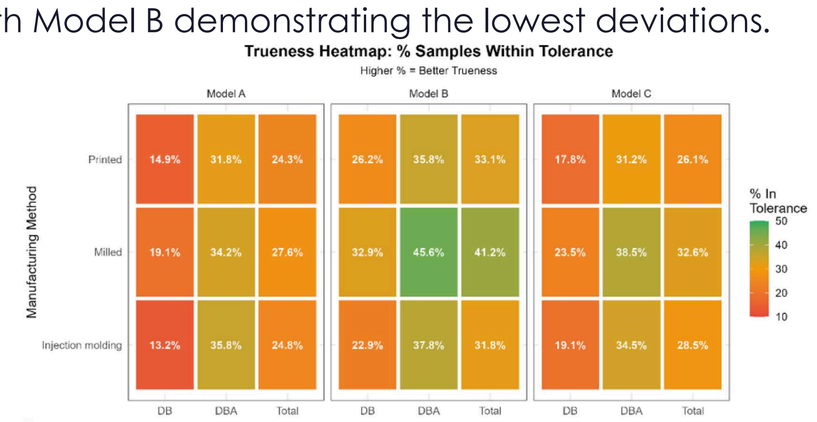
DBA: Mean RMS 0.269–0.400 mm across all groups. No significant differences among fabrication techniques within any morphology (P > .05). **Ridge morphology significantly influenced DBA accuracy — Model B demonstrated the lowest deviations.**

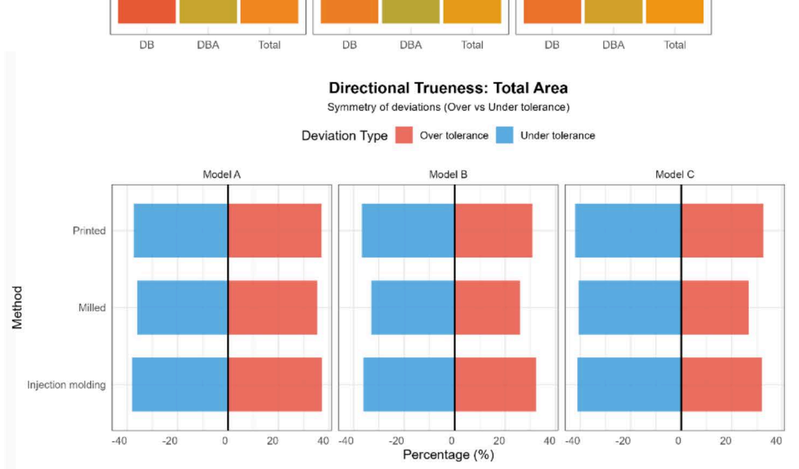
BORDER—INJECTION
1.323 mm
Model A (Post. IV)
vs 0.923 milled · 1.000 printed
P < .001

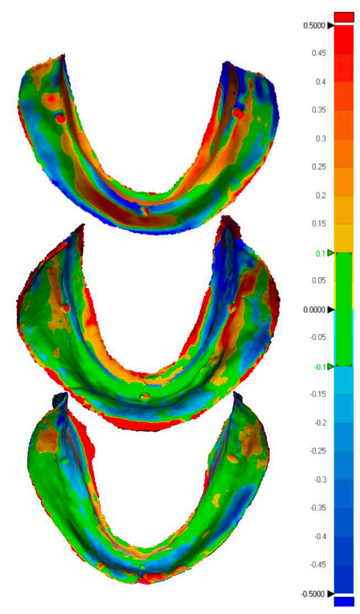
BORDER—INJECTION
0.946 mm
Model B (Post. III)
vs 0.685 milled · 0.708 printed
P < .01

BORDER—INJECTION
1.138 mm
Model C (Post. V)
vs 0.754 milled · 0.769 printed
P < .001

In the DBA, mean RMS values ranged from 0.269 to 0.400 mm, with no significant differences among fabrication techniques within any morphology (P > .05). **In the DB and total surface regions**, **injection-molded** bases demonstrated **significantly greater deviations** and variability than milled and printed bases across all morphologies (P < .01). **Ridge morphology** significantly **influenced DB & total area** accuracy, with Model B demonstrating the lowest deviations.







4 Discussion

The null hypothesis was partially rejected. **Injection-molded PMMA** undergoes **polymerization shrinkage** (up to −6.94% volumetric) disproportionately affecting peripheral regions (El Bahra et al.; Einarsdottir et al.), **explaining significantly greater border deviations. Digital methods** eliminate this through **pre-polymerized blanks** or **controlled photopolymerization** (Lee et al.; Faur et al.). **Ridge morphology** significantly **influenced DB & overall adaptation**, compromised ridges amplify peripheral distortion (Nakanishi et al.). Border seal is clinically critical for mandibular denture retention and stability.

Table 1 — Trueness: Mean RMS Deviation (mm)

Model	Method	DBA	Border	Total
Model A (Post. IV)				
	Injection	**0.323**	**1.323**	**0.862**
	Milled	0.315	0.923	0.554
	Printed	0.331	1.000	0.600
Model B (Post. III)				
	Injection	**0.285**	**0.946**	**0.569**
	Milled	0.269	0.685	0.385
	Printed	0.285	0.708	0.408
Model C (Post. V)				
	Injection	**0.400**	**1.138**	**0.762**
	Milled	0.392	0.754	0.515
	Printed	0.346	0.769	0.508

Table 2 — Precision: Mean Standard Deviation (mm)

Model	Method	DBA	Border	Total
Model A (Post. IV)				
	Injection	**0.323**	**1.385**	**0.892**
	Milled	0.315	0.900	0.562
	Printed	0.346	0.725	0.592
Model B (Post. III)				
	Injection	**0.269**	**0.892**	**0.562**
	Milled	0.269	0.685	0.385
	Printed	0.285	0.677	0.408
Model C (Post. V)				
	Injection	**0.362**	**1.108**	**0.754**
	Milled	0.346	0.746	0.523
	Printed	0.346	0.762	0.500

Red = highest (injection molding) · Teal = lowest within model · All values in mm

5 Conclusion

Manufacturing technique and ridge morphology significantly influenced denture border and overall adaptation. Digitally fabricated denture bases demonstrated improved peripheral trueness and precision compared with injection-molded bases.

Reference List