

A Comparative Study of Fiber Post Removal Made by Traditional Freehand, Static Surgical Guides, and Dynamic Navigation Methods

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Statement of Problem

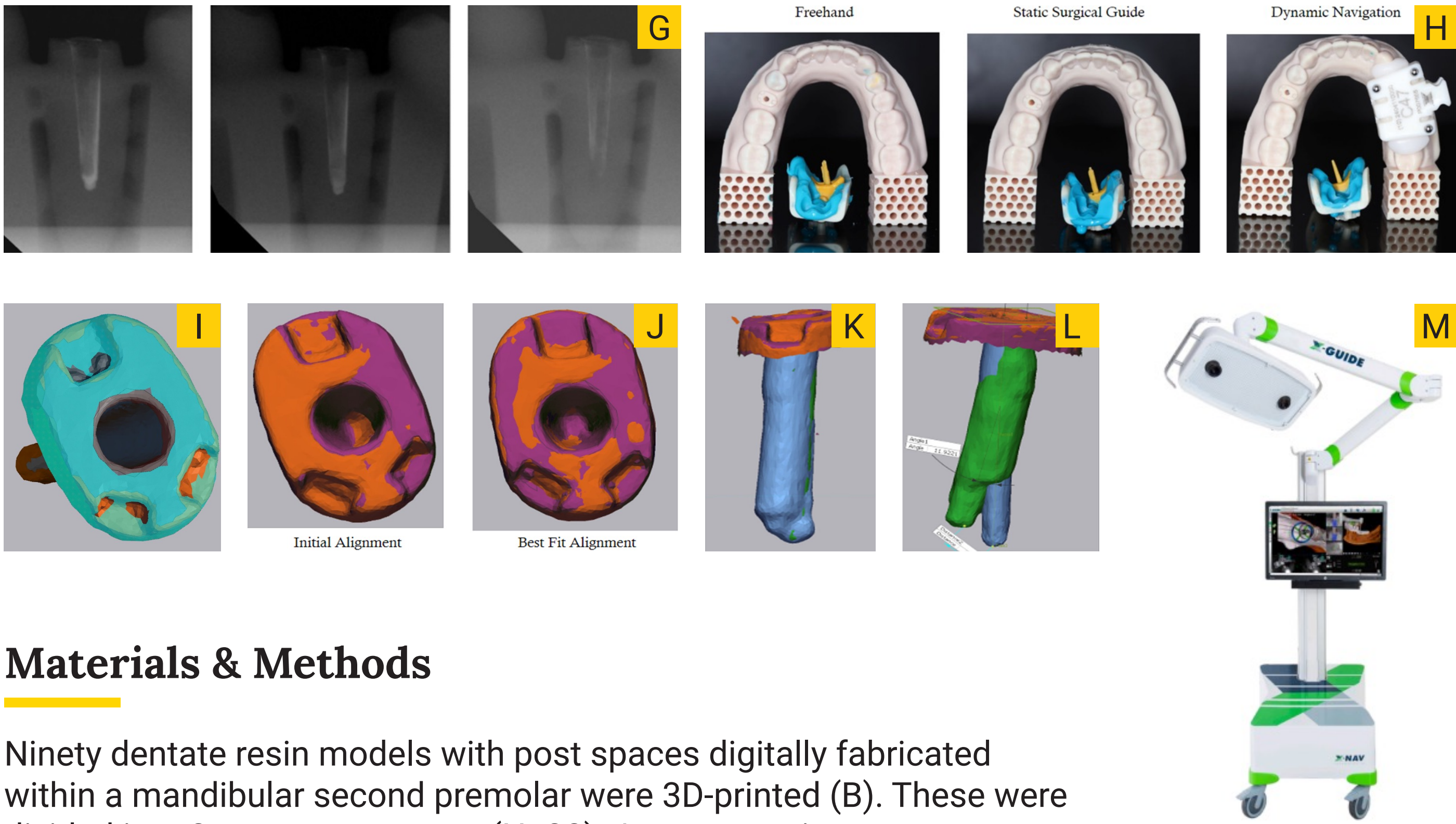
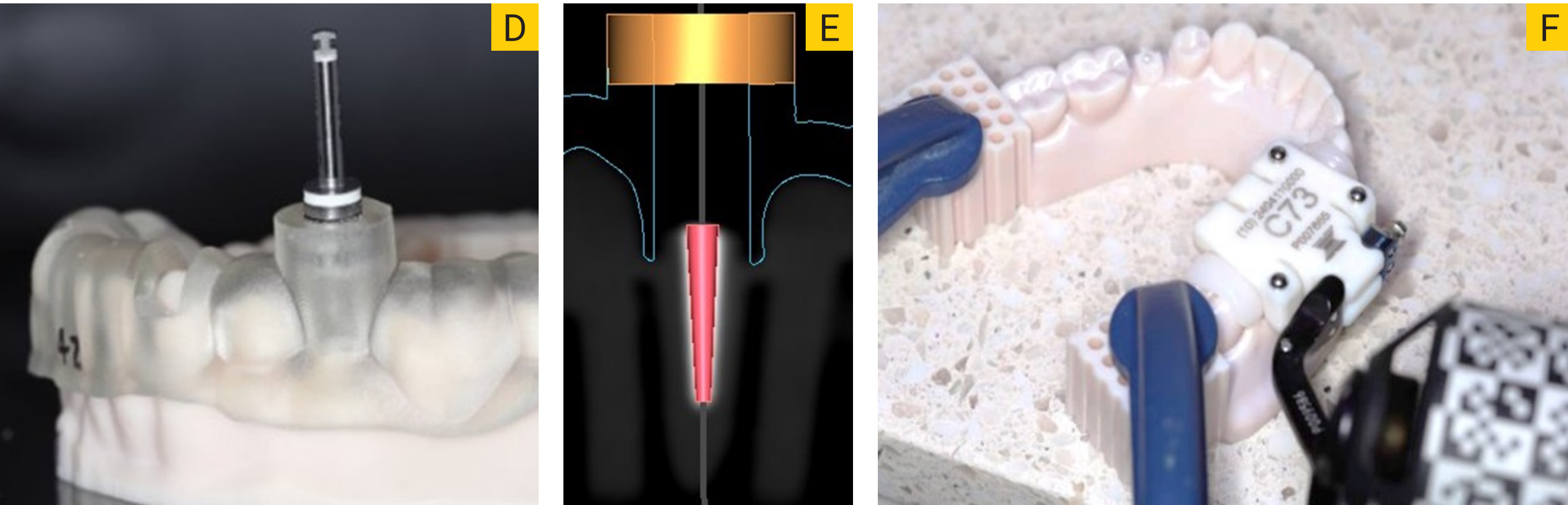
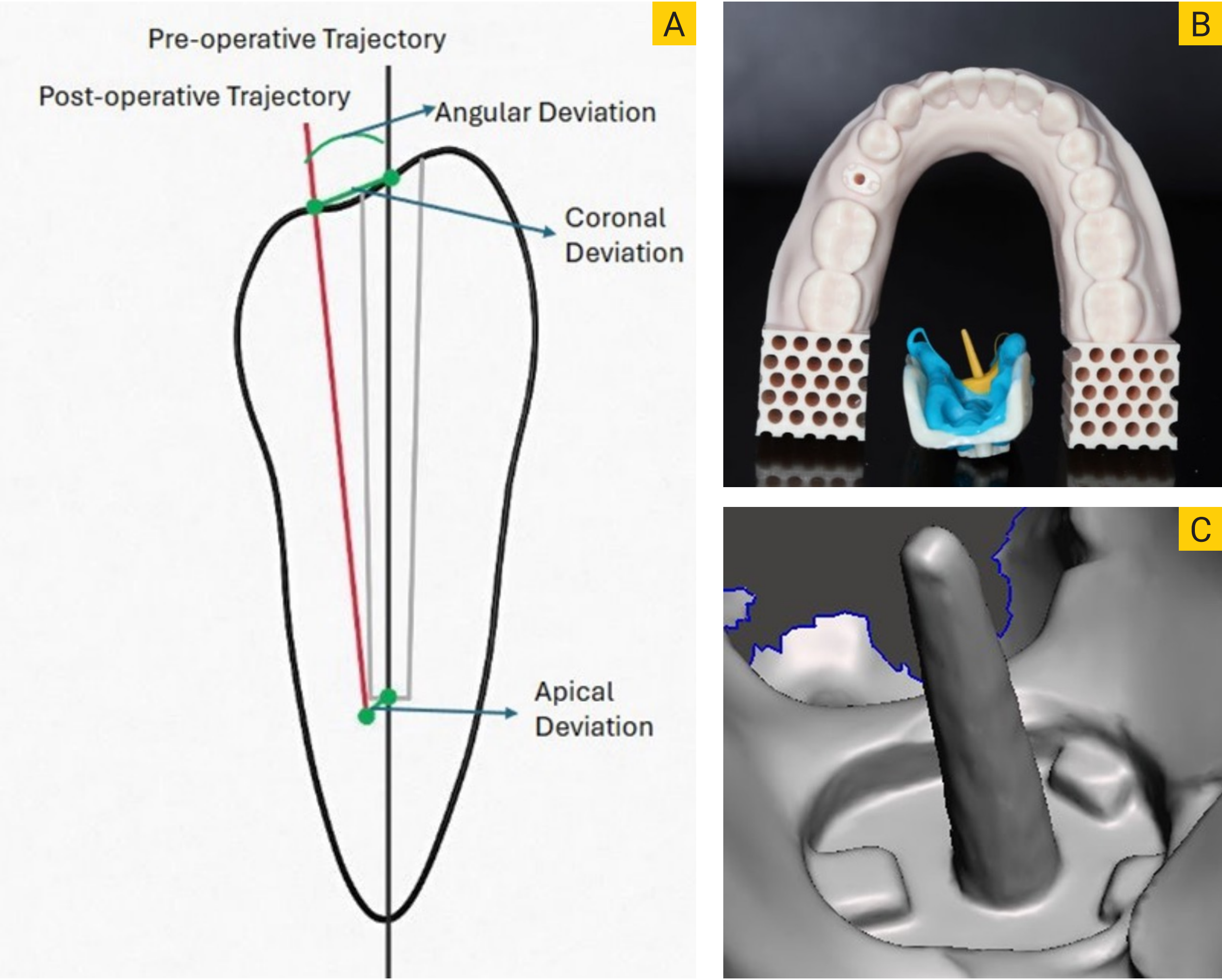
The removal of fiber posts cemented within teeth is technically difficult. Novel technologies for their removal have sparsely documented evidence comparing the different methods.

Purpose

The purpose of the study is to compare the three methods for resin-fiber post removal, which are, freehand, static surgical guided (SSG), and dynamic navigation (DN) for accuracy and conservation of tooth structure.

Accuracy was measured by coronal and apical deviations (mm) between pre-operative trajectory and post-operative trajectory, while angular deviation was the maximum angle between the two trajectories (A).

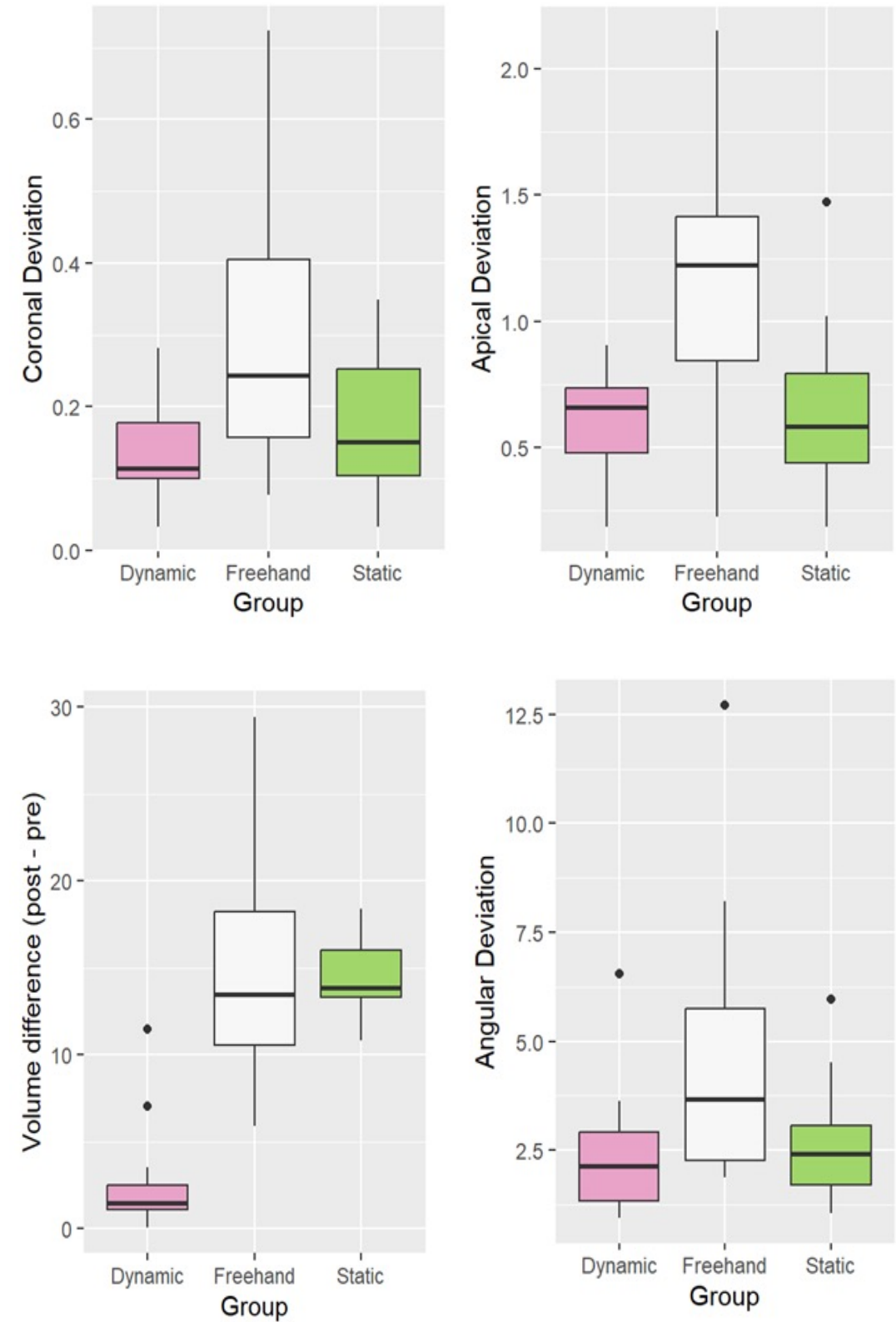
Conservation of tooth structure was measured by post op volume - pre-op volume = raw volume difference (mm³).



Materials & Methods

Ninety dentate resin models with post spaces digitally fabricated within a mandibular second premolar were 3D-printed (B). These were divided into 3 treatment groups (N=30). A pre-operative post space PVS was taken and an STL generated using the Trios 5 IOS (B, C). After cementing a fiber post using resin cement, a CBCT scan was made to facilitate planning of removal. SSG's were designed by BlueSkyPlan and printed in-house via SprintRay Printer (D, E). DN removal was planned and carried out by Nobel's X-guide (F, M).

Removal was performed by using each method: FH, SSG, and DN. Final removal was confirmed with direct observation microscope and periapical radiographs (G). A post-operative post space impression was then taken in PVS and scanned (H). Geomagic Control X aligned and compared pre- and post-operative scans to evaluate accuracy and raw volume differences (I, J). Perforations and deviations were removed to generate a reduced dataset (K, L).



Group:	Dynamic N = 16 ¹	Freehand N = 14 ¹	Static N = 21 ¹	p-value ²	q-value ³
Coronal deviation	0.13 (0.06)	0.30 (0.20)	0.17 (0.09)	0.017	0.137
Apical deviation	0.62 (0.19)	1.19 (0.51)	0.64 (0.30)	0.001	0.011
Angular deviation	2.39 (1.41)	4.58 (3.06)	2.59 (1.29)	0.018	0.137
Volume (post - pre)	2.5 (2.9)	14.6 (6.4)	14.3 (2.1)	<0.001	<0.001

¹Mean (SD)

²Kruskal-Wallis rank sum test

³Holm correction for multiple testing

Measurement	Comparison	Z	p-value ^a	q-value ^b
Apical deviation	Dynamic - Freehand	-3.21	0.001	0.009
	Dynamic - Static	-0.16	0.873	>0.9
	Freehand - Static	3.25	0.001	0.009
Volume (post - pre)	Dynamic - Freehand	-4.38	<0.001	<0.001
	Dynamic - Static	-5.18	<0.001	<0.001
	Freehand - Static	-0.33	0.742	>0.9

^aDunn's test of pairwise comparisons

^bHolm correction for multiple testing

Results

Statistical analysis was performed by the Kruskal-Wallis (KW) rank sum test, and pairwise comparisons were investigated using Dunn's test of multiple comparisons ($\alpha=0.05$) (N).

Accuracy: There were statistically significant differences were found between DN and FH (0.009), and SSG and FH (0.009) with FH measurements consistently larger for apical deviation. Coronal and angular deviations were not statistically significant between groups

Volume Difference: Significant differences for volume differences were found for DN when compared with both the SSG and FH groups (<0.001), with the DN group consistently smaller in volume.

Conclusion

- Dynamic navigation and static surgical guides showed significant higher accuracy than the freehand method when removing fiber posts.
- Dynamic navigation was the most conservative method of fiber post removal in comparison to static surgical guided and freehand methods.

References

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