

Influence of finish line design on accuracy of automatic margin detection using AI softwares

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Introduction:

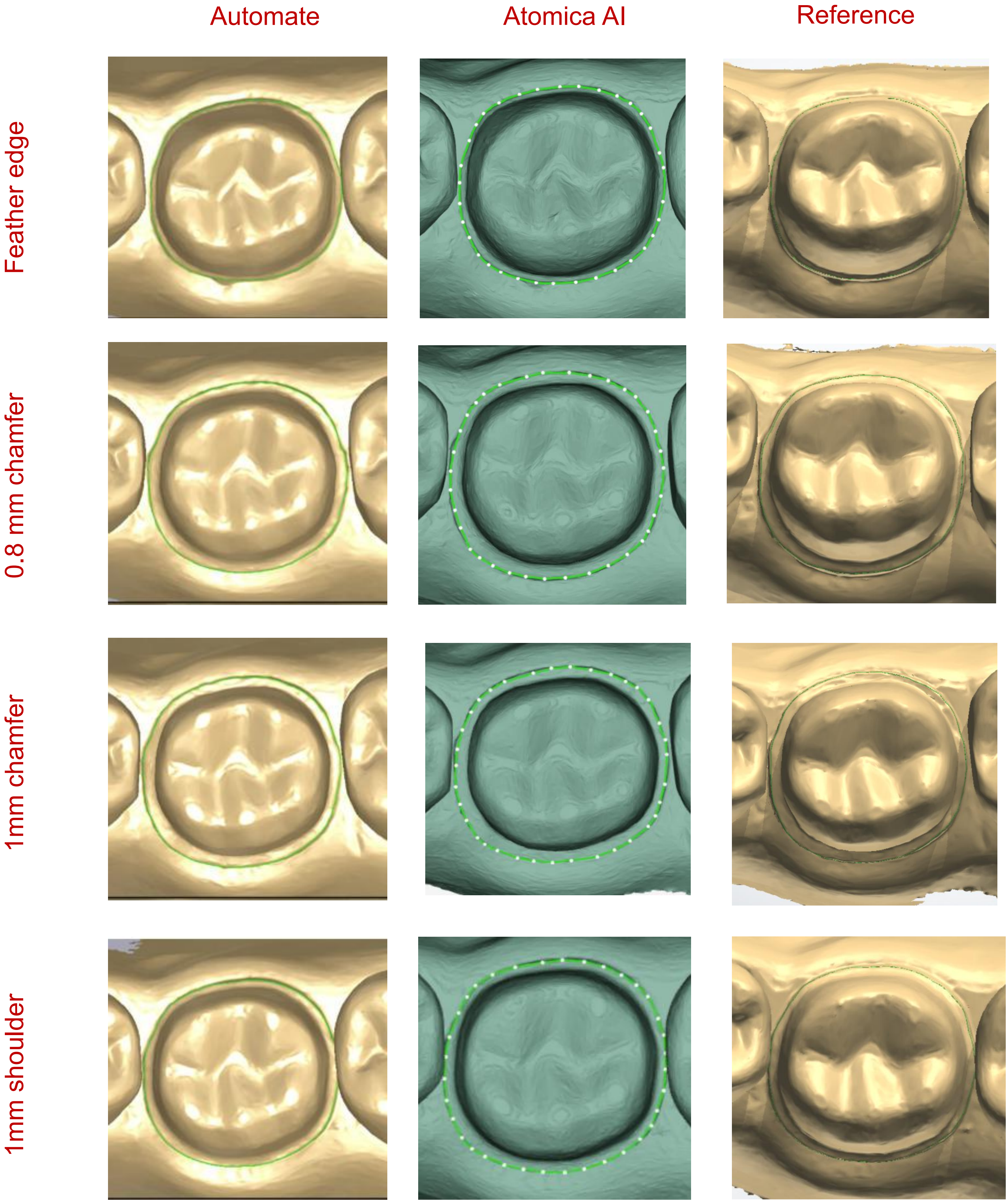
Accurate detection of the finish line is critical for the marginal fit and clinical success of dental restorations. Previous studies have shown that AI-driven and deep learning-based systems can reliably detect finish lines^{1,2}, but their performance may be influenced by margin geometry and software choice. This study aims to evaluate how different finish line designs affect the accuracy of automatic margin detection using various AI-powered dental CAD software platforms.

Purpose:

The aim of this study is to evaluate the impact of finish line design on the accuracy of automatic margin detection by AI softwares

Methodology:

- Four tooth preparations with different finish line designs were created digitally:
 - Feather edge (0.3 mm),
 - Chamfer (0.8 mm),
 - Deep chamfer (1.0 mm),
 - Shoulder (1.0 mm),
- The models were printed and scans were acquired with TRIOS 4 (3Shape A/S).
- Each preparation was analyzed using two dental CAD software platforms: **Atomica AI (Atomica Dental Technology)** and **3Shape Automate (3Shape A/S)** to automatically detect the finish line margin.
- A reference standard margin for each preparation was established by the researcher during the crown design process in Dental System 2024 (3shape A/S).
- The accuracy of the AI-CAD-detected margins was evaluated by comparing them to the reference margins.
- Geomagic was used to calculate the deviation between the detected and reference finish line margins.



Results:

(μm)	Automate		Atomica AI	
	RMS	SD	RMS	SD
Feather edge	84.5	56.2	79.2	56.2
0.8 mm Cham	76.4	39.6	88.4	50.1
1 mm cham	85.0	59.3	72.6	53.1
1 mm Shoulder	95.7	46.2	102.4	65.2

- Two-way ANOVA was used to evaluate main effects of finish line type and software, and interaction effect between finish line type and software.
- RMS values showed no significant differences among the different finish line designs.
- No significant differences were found between the different softwares (p>0.05).

Conclusions:

It was hypothesized that margin detection would be less accurate for the feather margin design. However, there was no significant difference in margin detection across the different finish line designs. There was also no significant difference between the different softwares and the reference margins. It is believed that due to the crown margins being designed digitally they were very clear and easy to detect. In conclusion, AI margin detection is an adequate method for crown design.

References

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