All-on-X surgical guide for obtaining accurate implant scan without photogrammetry: A novel process based on calibrated intraoral scan protocol (CISP)

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Background

Accurate implant impressions are essential for the long-term success of implant-supported fixed prostheses. Conventional splinted open-tray impressions remain the gold standard. While **photogrammetry** systems have emerged as a popular solution for **capturing predictable, full-arch implant scans during implant surgery**, they require integration with intraoral scanners to capture mucosal detail and come with **additional cost and workflow complexity**.

To address these challenges, the **Calibrated Intraoral Scan Protocol (CISP)** was developed, **offering accuracy comparable to, or exceeding, conventional implant impressions** without the need for photogrammetry (Li 2024).

This technical report presents a novel workflow that eliminates the need for photogrammetry by integrating a **custom CISP calibrator** into the full-arch surgical guide, enabling accurate intraoral scans (IOS) during implant surgery. This innovation simplifies the digital workflow, reduces dependence on specialized equipment, and enhances the efficiency of implant-supported fixed prostheses.

Calibrated intraoral scan protocol (CISP)

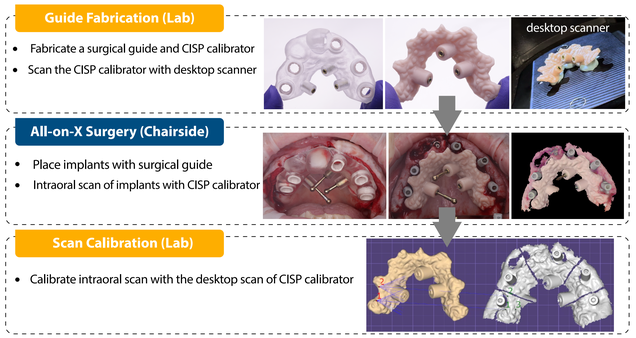


Figure 1. **Overall workflow**. Before surgery, a CISP calibrator was designed in Blender (v2.83, The Blender Foundation, Amsterdam) as part of the full-arch implant surgical guide, 3D printed using a P30 printer (Straumann AG, Basel) with ModelX resin, and scanned with a desktop scanner (LS3, Kavo). During surgery, after implant placement, the calibrator and scan bodies were scanned intraorally. The intraoral scan was then calibrated against the desktop scan to generate a full-arch implant scan with improved accuracy.

Photogrammetry-free workflow for accurate full-arch implant scans immediate after placement

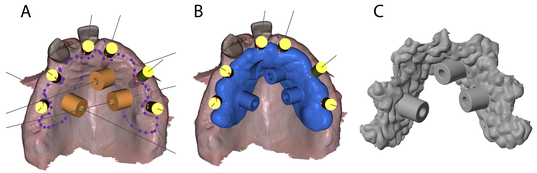


Figure 2. **Pre-surgery: (A-C)** Digital implant planning performed to fabricate both **(B)** the surgical guide and **(C)** the custom CISP calibrator. The calibrator was designed to match the curvature of an edentulous dental arch and features a unique, non-repetitive 3D pattern on its outer surface to enhance intraoral scanner detection.

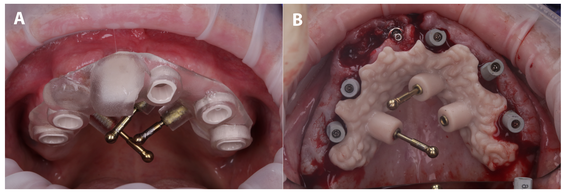


Figure 3. **During surgery: (A-B)** After implant placement, the calibrator was scanned intraorally together with the scan bodies.

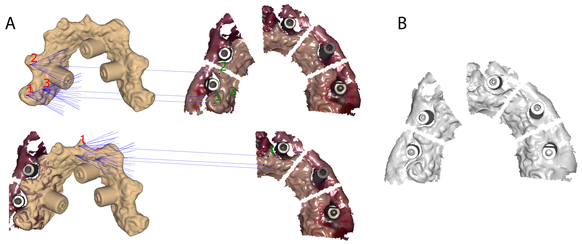
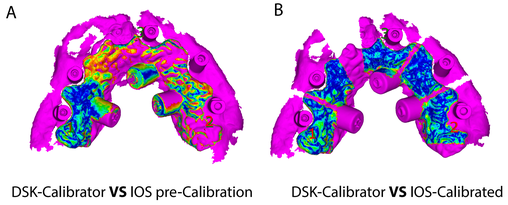


Figure 4. Calibration: (A) Intraoral scan obtained during surgery was segmented (one scan body per segment) using the *Edit Mesh* tool in exocad. Each segment was aligned to the desktop-scanned calibrator using a best-fit algorithm. **(B)** After alignment, all segments were merged into a single STL file, representing the calibrated intraoral scan.



DSK-Calibrator **VS** IOS pre-Calibration DSK-Calibrator **VS** IOS-Calibrated

Figure 5. (A) Color map showing that the intraoral scan obtained during surgery **(IOS-pre-calibration)** exhibited large deviations compared with the desktop scanner reference (DSK-Calibrator). **(B)** After calibration, the intraoral scan (**IOS-calibrated**) demonstrated minimal deviations relative to the DSK-Calibrator, indicating accuracy comparable to the desktop scan**.**

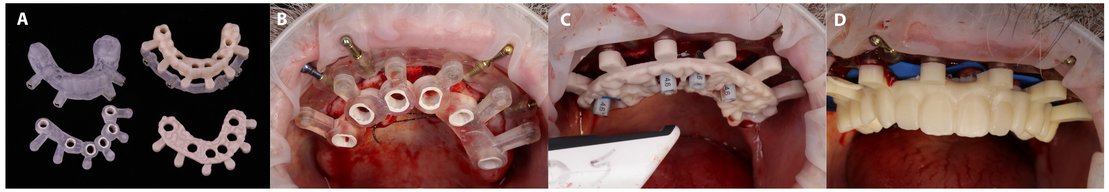
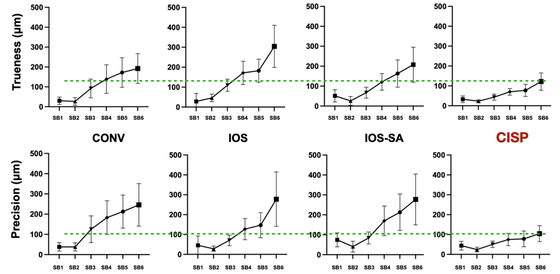


Figure 6. **(A)** Stackable guides, including the CISP calibrator and interim restoration, were fabricated. **(B)** Ridge reduction and implant placement were completed. **(C)** The CISP calibrator with magnetic connectors was snapped into place, and an intraoral scan was performed. **(D)** Intraoral conversion of the interim restoration.

Discussion

- This technical report presents a streamlined workflow using a CISP calibrator with the surgical guide, suitable for any clinic with an intraoral scanner.
- In the CISP workflow, the desktop calibrator scan corrects intraoral stitching errors, improving implant position accuracy (Li 2024 - **see below**).



- The workflow improves full-arch scanning efficiency without photogrammetry but requires 3D software skills. Gaps between scan bodies and the calibrator may disrupt tracking, which can be resolved by connecting them with a rubber dam (Figure 6C).

Conclusion

Fabricating a CISP calibrator with the surgical guide streamlines intraoral scanning during implant surgery. Positioned palatally, around implants, or integrated into a stackable guide, it calibrates the intraoral scan with the desktop scan to deliver highly accurate full-arch implant imperssions. This enables a single intraoral scan during surgery, enhancing accuracy and efficiency of implant-supported fixed prostheses.

Acknowledgements and References

This work is supported by Rackham Conference Travel Grant from the University of Michigan

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