Fabrication Workflow for Additive Manufactured Solid & Lattice-Structured Titanium Alloy Dental Implant Overdenture Bars

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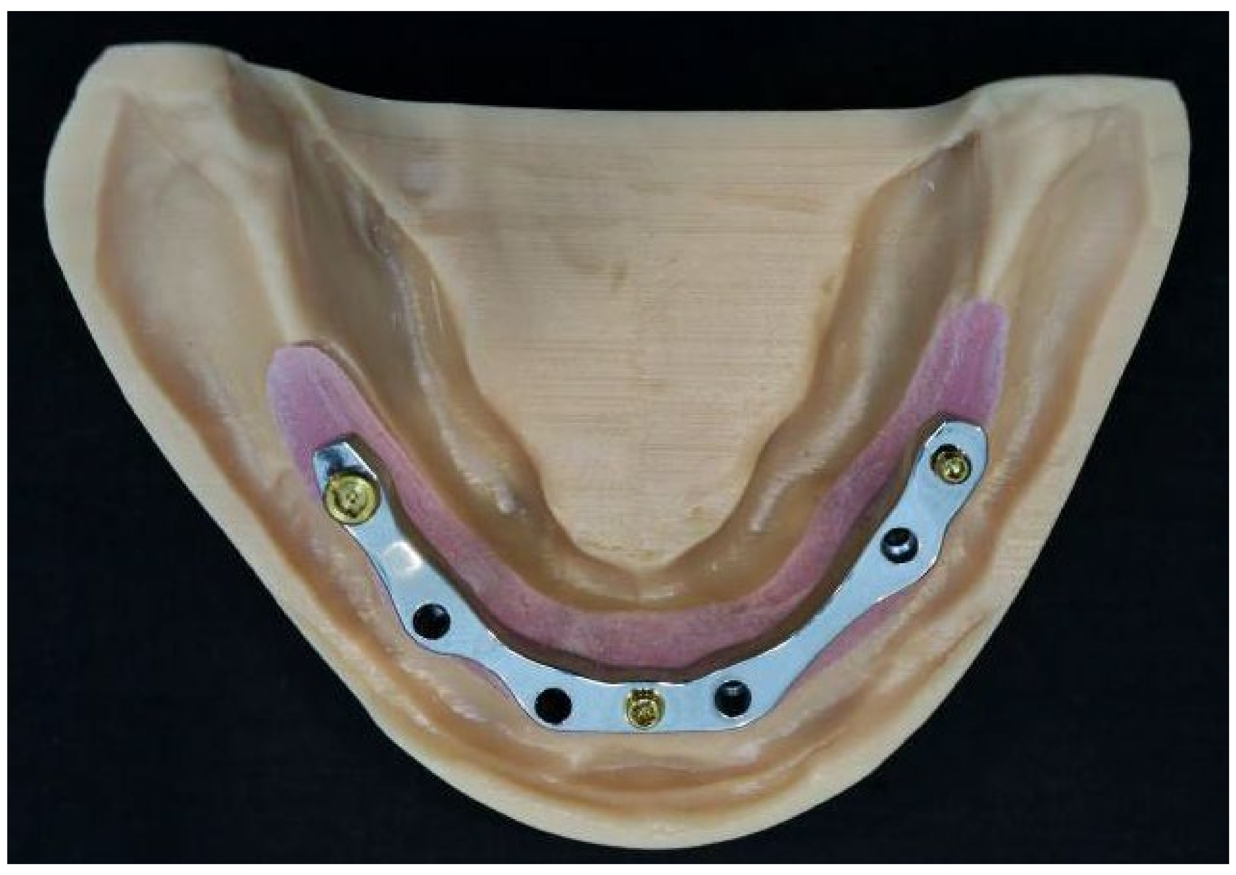


Figure 1. Patient soft tissue model with implants and milled dental implant bar.

Figures 2. Final AM latticed-structured dental implant bar.

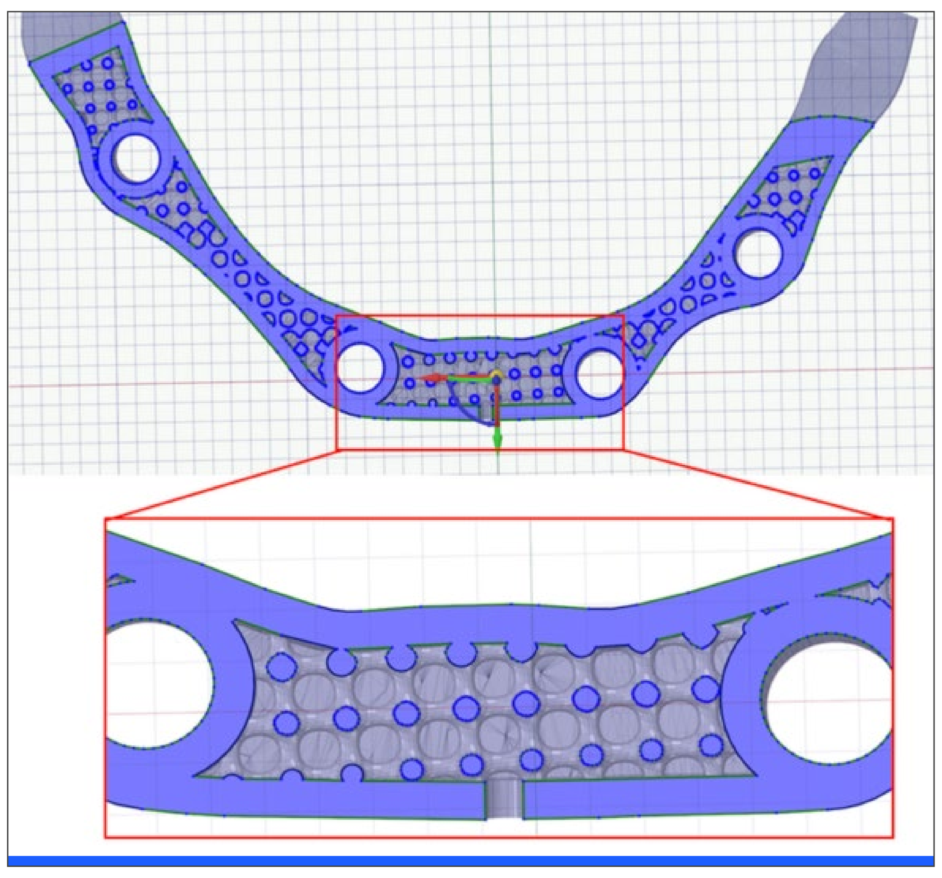
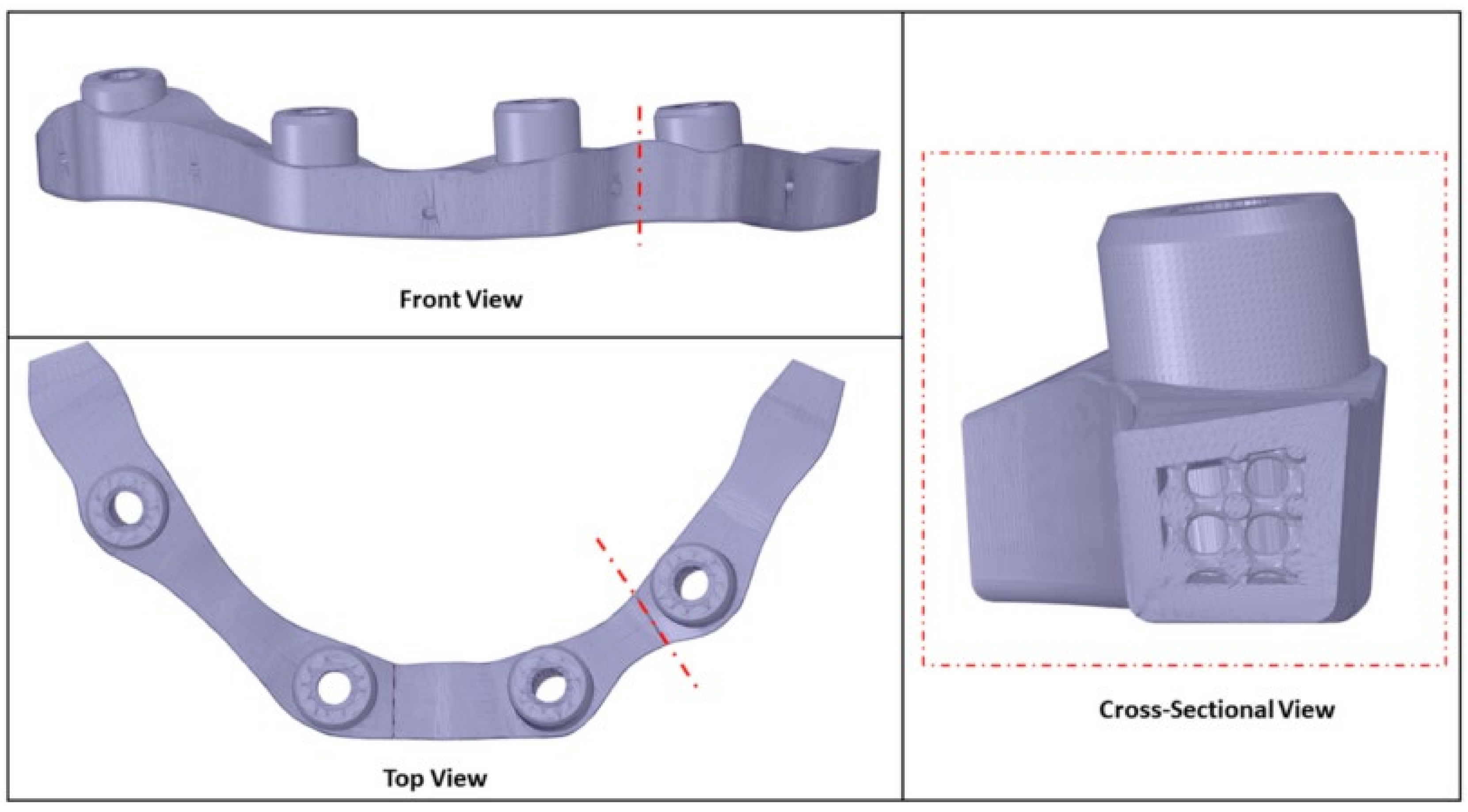


Figure 3. Implant bar model with internal lattice pattern. Image courtesy ADEISS.



Figures 4. Implant bar design with circular cross-section internal lattice pattern. Image courtesy ADEISS.

Figures 5. AM implant bar threaded onto dental implants supporting an Ivotion complete denture.

Figures 6. QR code for video presentation.

INTRODUCTION

Background

- If all the teeth in one arch are entirely missing (edentulous) then rehabilitation with implants improve function, aesthetics and quality of life.
- Implant bars are a predictable and cost-effective option.
- Bar supports and retains the denture without impeding on patient's soft tissue.
- Implant bars are delivered to patients through a complex clinical workflow and fabricated through subtractive manufacturing or milling.
- As additive manufacturing (AM) matures, it presents a novel opportunity for the fabrication of implant bars, which may reduce both the time and cost.

Aim

- Workflow developed for the fabrication of additive manufactured solid & lattice-structured titanium alloy dental implant overdenture bars.

MATERIALS & METHODS

Milled Bar

- Dental bar sourced from Panthera Dental.
- Implant bar was milled from titanium alloy (Ti6Al4V) on a fully robotic CNC machine.
- Bar was monobloc, with no welded areas and no porosity, and had a very accurate and passive fit with the dental implants on the model.

Design

- STL was reviewed by ADEISS.
- STL design required modifications such as the addition of through-holes of 2 mm in diameter for implant placement.
- Overall implant bar structure needed to be thickened to account for AM post-processing where surface finishing was required.
- Two implant bar designs were generated for AM;

1. solid structure to replicate a standard implant bar.
2. design incorporated an internal latticed pattern within the bar component.

- Drainage holes of 0.75 mm diameter were incorporated into the anterior walls, so powder from the AM process could be cleaned from the samples in post-processing for the lattice implant design (Figure 3).

MATERIALS & METHODS

Selective Laser Melting (3D Printing) and Post-Processing

- STL design: Ti6Al4V.
- Printing used selective laser melting technology with the Renishaw AM 400 system.
- After Printing, the build plate with implant bars were cleaned using compressed air.
- Following powder clearance, the implant bars were exposed to standard heat treatment in a vacuum furnace, removed from the build plate, and surface finished.
- Processed to a mirror polished finish (< 1 μm Ra) using hand tooling (Figure 4).
- Cleaning of all implant bars using ADEISS ultrasonic cleaning methods.

DISCUSSION

- AM workflow fabricated dental implant bars that were evaluated to be clinically acceptable, based on the fit with the original patient model and ultimately the fit with the denture.
- AM fabrication workflow suggested advantages over conventional milling based on number of implant bars fabricated, time and cost.
- Through 4-point testing further research is being conducted and will be released in the coming months.

CONCLUSION

- For implant bars fabrication workflows AM workflow for both solid and latticed-structured dental implant bars indicated that AM is a suitable, and may provide significant advantages.
- Further research and metrics are needed for workflows that will improve cost savings, efficiency, the patient experience and sustainability of the profession.

REFERENCES

Available on request

Presented at the 98th Annual Session of the Greater New York Dental Meeting in 2022