BME 402

DEPARTMENT OF

Biomedical Engineering

UNIVERSITY OF WISCONSIN–MADISON

Dental Matrix Band

February 5th, 2026

Background

- Matrix bands are used to support the filling material and provide shape to the tooth during interproximal fillings [1].
- Large proximal contact area must be achieved to prevent food impaction [2].
- To ensure sufficient proximal contact, must use one sectional matrix per filling [2].
- Long process; involves pre-wedging, wedging, and matrix insertion [2].

Figure 1: Sectional matrix band with tension ring [3].

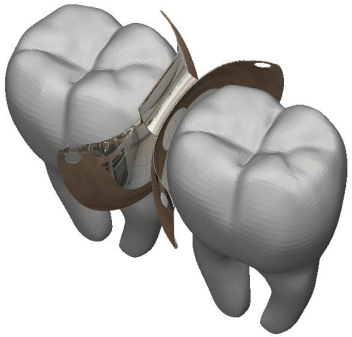

Figure 2: Current Solidworks model interproximal to molar model.

Speaker: Tanya

Problem Statement

- Surface matrix bands are devices used by dentists to separate adjacent teeth during restorations of interproximal cavities.
- Matrices support the restoration material, provide shape and contour to the tooth, and protect the adjacent tooth.
- In the case of two adjacent cavities, two separate matrices must be used, which is a tedious process.
- **Goal:** design a device which allows simultaneous filling of two adjacent cavities without compromising the proximal contact area.

Speaker: Joseph

Current Design

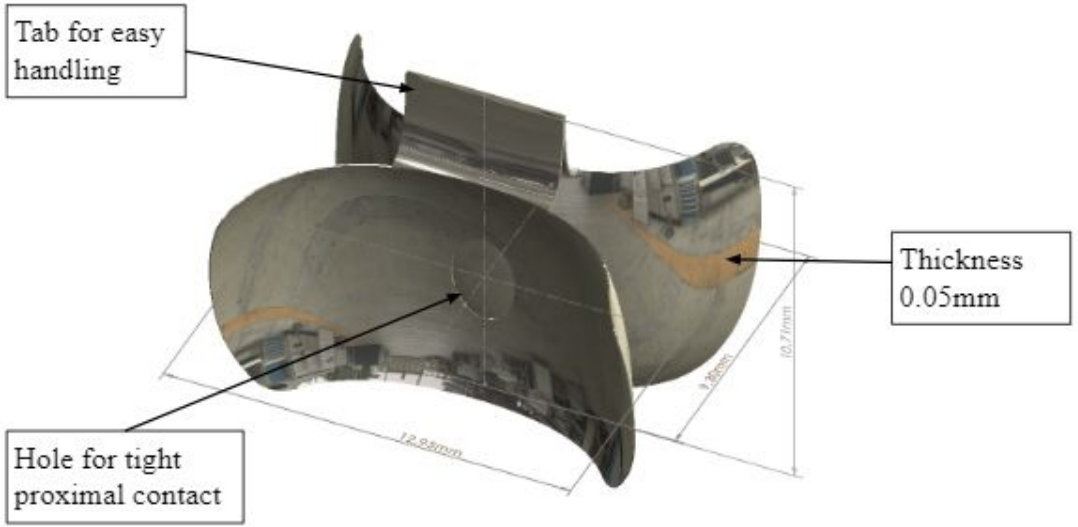

Figure 3: Current design made from 18-8 SS using dremel and HDF templates

Speaker: Joseph

Design Changes

- Laser Cutter
  - Improved resolution
  - Better finish
  - More design iterations
- Changes
  - Size
  - Material
  - Geometry
  - Films
- Find what will work best for recreating natural topography of tooth

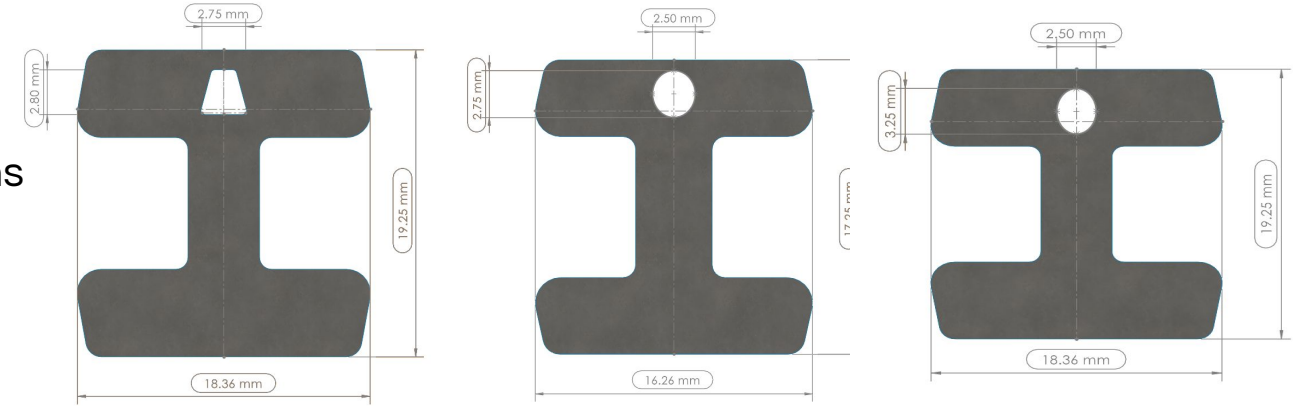

Figure 4: Design iterations with different overall dimensions and geometries

Speaker: Tanya

Force Gauge Testing for Baseline Data

1. Dr. Tipple will use a force gauge to obtain baseline data.
2. A sample interproximal filling will be done on model teeth using a matrix band currently on the market.
3. A force gauge will be attached to the matrix, and the force that it takes to remove the matrix band after filling will be obtained and recorded.
4. This process will be repeated for ten samples.
5. The force obtained from the force gauge measurements will be averaged and used as a threshold.

Figure 5: Force gauge device [4].

Speaker: Anya

Mechanical Testing: Threshold & Tensile Validation

- Removal forces measured using a force gauge will be averaged to establish a clinically-relevant force threshold.
- This threshold will represent the minimum force the prototype must withstand during removal.
- An MTS tensile test will then be performed on ten prototype samples (n = 10) [5].
- Each sample will be loaded in tension until deformation or failure.
- Stress–strain curves will be generated from the test data.
- Mechanical properties (maximum stress and elastic behavior) will be extracted and compared to the threshold force.

Figure 6: MTS machine for testing

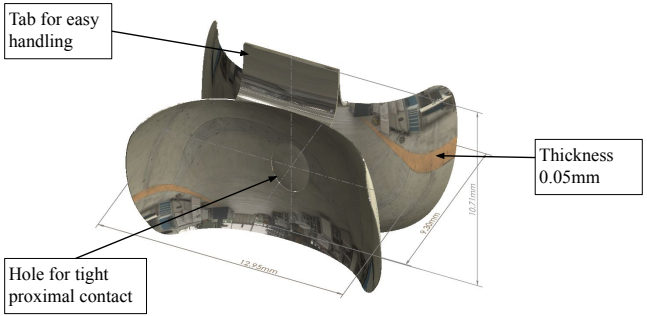

Figure 7: Current design made from 18-8 SS using dremel and HDF templates.

Speaker: Keleous

Statistical Analysis

- A one-sample t-test (n=10) will be performed to determine if the population of maximum stresses (failure forces) obtained from the MTS testing are significantly greater than the established clinical threshold.
  - Confidence Level: 95% (α .05)
- **Null Hypothesis:** the mean failure force of the prototype is equal to the clinical threshold.
- **Alternate Hypothesis:** the mean failure force of the prototype is significantly greater than the clinical threshold.

Acknowledgements

Dr. Donald Tipple

Dr. Beth Meyerand

References

[1] D. Sadaf and M. Z. Ahmad, “Comparison of two different matrix band systems in restoring two surface cavities in posterior teeth done by senior undergraduate students at Qassim University, Saudi Arabia,” http://isrctn.com/, Sep. 2016. doi:10.1186/isrctn18179115

[2] V. A. de la Peña, R. P. García, and R. P. García, “Sectional matrix: Step-by-step directions for their clinical use,” British Dental Journal, vol. 220, no. 1, pp. 11–14, Jan. 2016. doi:10.1038/sj.bdj.2016.18

[3] Community, “How to use a sectorial matrix in order to achieve a functional proximal surface,” Styleitaliano.org, https://www.styleitaliano.org/how-to-use-a-sectorial-matrix-in-order-to-achieve-a-functional-proximal-surface/ (accessed Oct. 1, 2025).

[4] O. Engineering, “High Accuracy Digital Force Gauge | Omega Engineering,” *Dwyeromega.com*, 2020. https://www.dwyeromega.com/en-us/high-accuracy-digital-force-gauge/p/DFG55?srsltid=AfmBOorfyPWDJYaumhnpLSKumiVUIn-5SOXW9NFjxH7DNZeHV2_ff-XM (accessed Feb. 06, 2026).

[5] “MTS Landmark ® Testing Solutions Versatile, high-performance servohydraulic systems for static and dynamic material and component testing.” Available: https://www.mts.com/-/media/materials/pdfs/brochures/mts-landmark-test-system-brochure.pdf?as=1