Approximating Surface Matrix Band
Progress report #8

BME 200/300
Team Name: Dual Matrix
Fall 2026
11/06/2026

Client: Dr. Donald Tipple
Advisor: John Puccinelli

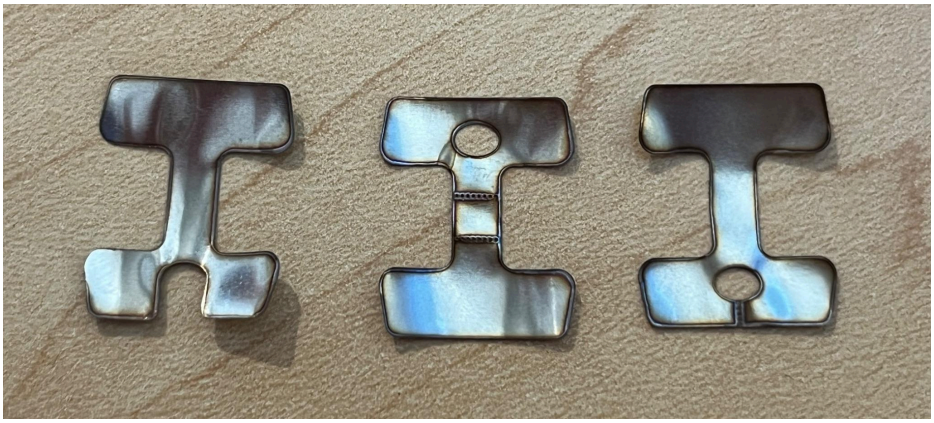
Team Members:
Leader: May Kennelly
Communicator: Olivia Kallas
BSAC: Nicholas Miles
BPAG: Luca Benedetto
BWIG: Samuel Zakaib
BWIG: Justin Schwartz

Problem statement

Surface matrix bands are devices used by dentists to separate adjacent teeth during restorations of inter-proximal cavities (cavities found in-between two teeth). The matrix band serves to support the restoration material, to provide shape and contour to the tooth being restored, and to protect the adjacent tooth. Ideally, the width of the space between the two adjacent teeth is just large enough to fit one matrix band in order to ensure close proximal contact area, which prevents food impaction and decay. In the case of two cavities on two adjacent teeth, this process is tedious, as the dentist must complete the process from start to finish for each adjacent tooth individually. The goal of this project is to create a dental matrix band that effectively partitions adjacent teeth for more efficient tooth restoration procedures on interproximal cavities by making it possible to complete two adjacent restorations simultaneously.

Brief status update

The Fall 2026 team is working to develop the design ideas into prototyping. They are conducting MTS testing on their fabricated models from Sector 67 last week. The team has been gaining great hands-on experience in the machine shop and technical communications. The team has also received dental materials to begin testing with composite filling; as soon as the 3D printed teeth w/ cavities are finished.



Current design

The current design is from spring semester 2026. It successfully reduces procedure time, but the manufacturing methods and testing need to be improved and expanded upon to increase quality and ease of use. The current design is 0.0254 mm thick fully annealed 316 SS with a hole for tight proximal contact and a tab for easy handling. To cut the flats a template was used and then the flat was molded with a 3D printed mold.

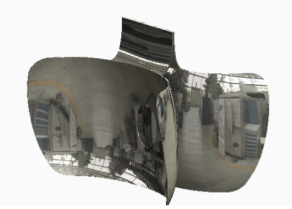


Figure 1. SolidWorks model of Dual Matrix courtesy of the Spring 2026 team.

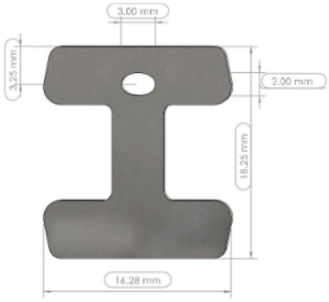


Figure 2. Flat cutout of matrix courtesy of the Spring 2026 Team.



Figure 3. Dual Matrix with filling in tooth model courtesy of the Spring 2026 team.

Materials and expenses

Item	Description	Manufacturer	Vendor	Vendor Cat#	Date	QT	Cost Each	Total	Link

						Y			
Materials to Buy									
								$0.00	
Materials Purchased									
3D Mouth Model	3D printed mouth model for testing	DI Lab	DI Lab		10/13/2026	1	$1.18	$1.18	https://making.engr.wisc.edu/minimarts/
304 Stainless Steel	304 stainless steel sheet for prototyping and final design	Wieland	McMaster-Carr	3254K111	10/21/2026	1	$18.24	$18.24	https://www.mcmaster.com/products/3254k111/
Aluminum Shim Stock	Aluminum shim stock for prototyping	The Artus Corporation	McMaster-Carr	9536K48	10/21/2026	1	$30.90	$30.90	https://www.mcmaster.com/products/9536k48/
Super Glue	Super glue for 3D printed teeth model	DI Lab	DI Lab		10/28/2026	1	$0.53	$0.53	https://making.engr.wisc.edu

									/minimarts/
Tooth Cavity Print	Teeth with cavities for testing	DI Lab	DI Lab		11/12/26	1	$0.47	$0.47	
							TOTAL:	**$51.32**	

Goals

Major team goals for the next week

1. Finish the fabrication and testing plans document
2. Continue testing

Next week's individual goals

May…

- Determine testing and document fiber laser fabrication
- Determine how we want to move forward with fabrication

Olivia

- Read data from the MTS testing and make good graphs
- Update lab notebook

Nicholas…

- Complete testing protocol for MTS testing
- Begin testing on the manufactured prototypes to determine viability of each design

Sam…

- Continue to help with the MTS testing

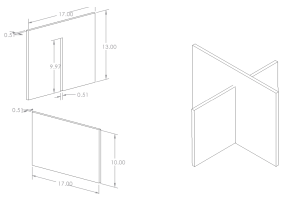
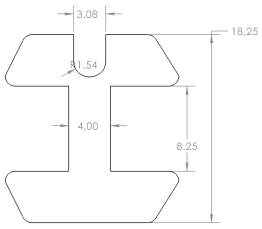
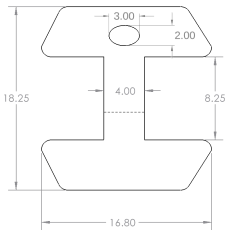
Jusin

- Come up with testing plan for matrices
- Learn how to use dental materials to test matrices

Luca

- Finish writing testing plans document
- Work on Final report

Design Matrix

Design Criteria:	**Design 1: S-Design** 		**Design 2: Half-Oval** 		**Design 3: Perforation** 	
Filling Quality (25)	4/5	20	2/5	10	5/5	25
Ease of Removal (25)	3/5	15	5/5	25	4/5	20
Ease of Use (20)	3/5	12	4/5	16	5/5	20
Ease of Fabrication (10)	5/5	10	4/5	8	3/5	6
Safety (5)	4/5	4	5/5	5	5/5	5
Cost (5)	4/5	4	5/5	5	5/5	5
Total (100)	65		69		81	

Category Definitions:

Filling Quality: Expected filling quality describes the ability of the device to replicate the natural tooth shape. To successfully replicate the natural tooth shape and protect the gums, there must be proper interproximal contact and wedging. Proper interproximal contact prevents food packing, which can lead to gingivitis, tartar, and tooth decay. Adequate wedging prevents gingival margin leakage, protecting the gums.

Ease of removal: Ease of removal is integral to the success of the project because the device aims to be as efficient as possible. Less time removing the device results in the overall restoration time decreasing. The objective of the device is to reduce procedure time. If the dentist must take extra time to remove the matrix, there will be no time saving effect and dentists will continue using two matrices back to back.

Ease of Use: It is crucial that the design is easy for the dentist to use. The design aims to replace the standard of interproximal cavity restorations, and to do this, the design must be user-friendly. A design that is only one piece will be easiest to use because the oral cavity is small and accounting for several pieces would require the dentist to take more steps. Furthermore, the device will arrive flat, and the dentist will fold it into the butterfly shape. It will be more difficult to contour the matrix band if it is made of more than one piece.

Ease of Fabrication: A design that is easy to fabricate will consistently produce accurate dimensions, which is crucial to device functionality. Easier fabrication also reduces the time and cost needed to produce the device. A quick, easy manufacturing process allows the team to spend more time on quality checking, smoothing edges, and testing performance. Together, these benefits make the matrix more practical for dentists to use.

Safety: Safety is of the utmost importance to ensure patient comfort during and following the restoration. Thin metal bands can easily slice gingival tissue, so it is important to choose a design that fits snug to the contour of the tooth without needing to force it into the gumline. Additionally, the metal needs to be burnished carefully to avoid sharp edges or burrs which can also cut the soft tissue during placement or removal. Removing the device in the least amount of pieces possible will also ensure no metal components are left in the oral cavity.

Cost: The cost is imperative as the design requires functionality but also must remain at a competitive price relative to competitors in order to sell. Despite this importance, it does not take precedence over other categories as the primary function of the device is to save time and not money.

Ranking Explanations:

Filling Quality: Expected filling quality is weighted 25 because filling quality is integral to the device. This is because the purpose of the device is to reduce restoration times by performing two restorations at once. The device must produce a quality filling otherwise it will not replace current devices. The Perforation design is ranked 5/5 for quality because it provides good tooth contact with a tooth-like shape while allowing for proper

wedging. The S-design is ranked 4/5 because it allows for mostly good contact and wedging; however, its use would not result in a tooth-like shape. The Half-Oval design is ranked 2/5 because although its contact on the upper part of the tooth is good, the opening on the bottom will result in the composite resin leaking into the gum area and onto the wedge.

Ease of Removal: Ease of removal is weighted 25 because the client indicated removal difficulties as the largest issue with previous design iterations. The Half-Oval design earned a score of 5/5 because there is no bottom to the circle, allowing the matrix to slide straight up and out of between the teeth. It also has a tab. The Perforation design is ranked 4/5 because breaking the matrix into two pieces should allow the dentist to remove one side after the other. However, the side with the circle cutout could still get stuck on filling. The S-Design is ranked 3/5 because there could be a gap between the two metal sheets either causing a lip or one filling to connect to another which would make it difficult to remove. It also has no tab to grab.

Ease of Use: Ease of use is weighted 20 because the device must be easy to shape, otherwise dentists will likely not adopt its use. The Perforation design is the easiest to use because the dentist can simply fold the piece in half to create the butterfly shape, which is why it has a score of 5/5. The wings are also easy to mold because they are connected throughout the bottom. The Half-Oval design is similar to the Perforation design in that the user can simply fold it to create the butterfly shape. However, the Half-Oval design will be more difficult to contour than the Perforation design because the bottom is not connected on one side. So, it earned a score of 4/5. The S-Design is more difficult to use compared to the others because it is made of two pieces, rather than one. This requires more assembly. Additionally, it will be more difficult to contour because it does not taper in towards the gums, resulting in an ease of use score of 3/5.

Ease of Fabrication: Ease of fabrication is weighted 10 because easier fabrication reduces production time and cost, which in turn reduces device cost. A cheaper device is more desirable to dental offices. The Perforation design is rated a 3/5 for ease of fabrication because there are several small pieces that must be cut out and be smoothed. Similarly, the Half-Oval design has several small cut-outs; however, there is no perforation which means fabrication will be easier. So, it is rated a 4/5. The S-Design only requires one slit to be extruded and a chamfering of edges, which is why it is rated a 5/5 for ease of fabrication.

Safety: Safety is weighted 5 because the patient's health and safety is our first priority and as such all designs that are on the matrix are already highly safe. The perforation design was ranked 5/5 for safety because the perforated section allows for a lower risk of tearing into 3 or more pieces, which reduces the likelihood of metal being swallowed by the patient. The half oval design is also 5/5 because there is no lower lip for the matrix to get caught on, so there is minimal tearing likely. The S-design is ranked slightly lower than the others because the 2 pieces sliding together in the middle could pose a higher risk of accidentally cutting the gums.

Cost: The Perforation and the Half Oval designs were rated 5/5 as their material and fabrication costs are relatively low as they are composed of a single piece of metal. For the S-Design however, it is rated a 4/5 because it is composed of two separate pieces and would require more cutting and material costs compared to the other two designs.

Timeline

Task	September				October					November	December		
	10	11	18	25	2	7	9	16	23	6	4	9	11
Project R&D													
Empathize													
Background…													
Prototyping													
Testings													
Deliverables													
Progress Reports	X	X	X	X	X	X	X	X	X	X	X	X	
PDS			X										
Design				X			X						
Presentations					X						X		
Report						X						X	
Final Poster												X	
Meetings													
Client		X											
Advisor													
Website													
Update	X	X	X	X	X	X	X	X	X	X	X	X	
Course Requirements													
								LDR	Training Show + tell	Tong			Schedule advisor meeting

Filled boxes = projected timeline
X = task was worked on or completed

Activities

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
May Kennelly	2026/09/07	Did general research about cavities and their causes/treatments Organized team materials and inputted future assignments into group calendar Created the team notebook and added several required documents for upcoming meetings	3.5	3.5	3.5

		Messaged group members to coordinate work			
May Kennelly	09/16/2026 09/17/2026	● Completed function, performance requirements, and safety portions of the PDS ○ Researched across standards and articles for pertinent information ● Messaged 200 students with specific feedback on their completed sections which they edited ● Completed final edits on the overall PDS, compiled sources, and formatted the PDS	2 2	4	7.5
May Kennelly	9/23/2026 9/24/2026	- Did research and took notes in lab archives - Did my sections of the design matrix and edited all design matrix sections, made two of the designs on solidworks and labeled them with dimensions	1 3.5	4.5	12
May Kennelly	9/30/2026	- Edited design matrix from Dr. P's comments - Created my slides for the preliminary presentation - Practiced slides with the team - Recorded and inserted video of my slides asI will be absent for the presentation - Added competing designs to my labarchives, also edited team sections of labarchives	2.5	2.5	14.5
May Kennelly	10/08/2026	- Worked on the preliminary report and editing - Updated my labarchives per simon's feedback	5	5	19.5
May Kennelly	10/15/2026 10/20/2026	- Emailed with sector 67 to determine feasibility of using fiber laser cutter for fabrication - Worked on designing a device to perforate the matrix	1.5	1.5	21
May Kennelly	11/05/26	- Went to Sector67 and worked on fabrication	3	3	24
Olivia Kallas	09/11/2026 09/20/2026	-Completed lab archives research entries.	2 1	3	6

		- Completed personal sections of the PDS -Client meeting			
Olivia Kallas	09/24/2026	-2 more research entries -Emails with client -Zoom design meeting	1 20min 2	3.25	11.25
Olivia Kallas	10/01/2026	- Research entries - Team rehearsal - Video watching	1 2 1	2	14.25
Olivia Kallas	10/09/2026	-Worked on my section of the preliminary report	3	3	17.25
Olivia Kallas	10/23/2026	Met with Jesse at the design fabrication lab to get advice and talk about fabrication struggles. Met with Eric in the machine shop to get advice.	3	3	20.25
Sam Zakaib	09/10/2026	● Researched different types of matrices ○ Sectional ○ Tofflemire ● Researched 2 different research articles about class II cavities and how they form ○ Current treatments ● Completed 4 research entries in LabArchives (2 competing, 2 Bio/Phys sources) ● Updated team website to display group picture, names, roles	2	2	2
Sam Zakaib	09/16/2026	● Worked on sections of PDS ○ Materials ○ Accuracy and Reliability ○ Operating Environment ● Found 2 new sources	3	3	5
Sam Zakaib	09/25/2026	● Developed 2 creative designs for the design matrix ● Researched Sector 67 for potential manufacturing ● Uploaded Design Matrix to website	3	3	8
Sam Zakaib	10/01/2026	Prepared for presentation by working on testing section. Began working on slide show	3	3	11

		designs			
Sam Zakaib	10/09/2026	Finished Preliminary Report Began thinking about future goals for the semester	3	3	14
Sam Zakaib	10/17/2026	Met with Jesse in design lab to brainstorm ways to fabricate product both initial and final out of amuminum and steel	3	3	17
Sam Zakaib	10/24/2026	Began working on how to present show and tell. Coninuted looking for places to fabricate	3	3	20
Sam Zakaib	10/30/2026	Used a Cricut machine to fabricate initial prototypes out of 0.001-inch aluminum for show and tell	3	3	23
Sam Zakaib	11.06.2026	Went to sector 67 and fabricated 10 each design (2 different perferation designs, half oval design)	3	3	26
Sam Zakaib	11.13.2026	Began MTS testing in ECB. Created baseline stress strain curves for 304 stainless 0.001in	3	3	29
Nicholas Miles	09/07/2026 09/15/2026 09/24/2026	-Completed lab archives research to learn more about the topic -Attended the first BSAC meeting to learn more about my role and started thinking about ways to improve the course and the overall BME program -Met with the client to learn more about the project and the project requirements -Completed personal sections of the PDS -Prototyped a design for the project and met with team to create the design matrix	10	10	10
Nicholas Miles	10/02/2026	-Contributed to the preliminary report and preliminary presentation -Conducted research to fill in the gaps for the preliminary report and presentation Attended BSAC with faculty to discuss the BME program	3	3	13

Nicholas Miles	10/09/2026	-Finished preliminary report -Brainstormed ways to manufacture final design	3	3	16
Nicholas Miles	10/16/2026	-Met with people in the shop to determine ways to manufacture our product -began solidworks for the die	2	2	18
Nicholas Miles	10/23/2026	● Completed Intro to Machining Training ● Met with Jessie from Wendt to discuss ways to fabricate our prototype ● Ordered materials for prototype and final model	5	5	23
Nicholas Miles	11/06/2026	● Manufactured several copies of our 3 designs ● Met with team to discuss next steps and determine plans for testing ● Attended the Tong Lecture	4	4	27
Nicholas Miles	11/13/2026	● Developed MTS protocol ● Conducted MTS testing and produced stress-strain curves	3	3	30
Justin Schwartz	9/07/2026 9/15/2026	● Did research on competing designs ● Watched a video on one way to do back-to-back class II fillings ● Worked on PDS\ ○ Shelf life ○ Appearance and aesthetics ○ Competing design	2 1	3	5
Justin Schwartz	9/24/2026	● Met to discuss Design matrix ● Filled out Ease of removal description and ranking explanation ● Researched how matrices are removed	1.5	1.5	6.5
Justin Schwartz	10/02/2026	● Came up with two design ideas ● Practiced presenting ● Worked on preliminary report ● Met to decide final design	1 1 2	4	10.5
Justin Schwartz Justin Schwartz	10/02/2026 10/23/2026	● Worked on preliminary report ● Did the machining, laser, 3d printing training ●	5	5	15.5

Justin Schwartz	10/30/2026	● Went to wendt to use cricket to make aluminium prototypes ● Talked to dad to get all dental materials needed for testing matrix ● Prepared for show and tell	4	4	19.5
Jusitn Schwartz	11/06/2026	● Researched how to test matrix ● Came up with testing plan ●	2	2	21.5
Luca Benedetto	09/07/2026	● Completed research entries to better understand the subject matter of the project	2	2	2
Luca Benedetto	09/16/2026	● Found sources for research ● Worked on PDS sections ○ Life in Service ○ Production Characteristics	2	2	4
Luca Benedetto	09/24/26	● Brainstormed 3 different design ideas ● Researched possible production options as well as societal impact. ● Added to the Design Matrix	2 2 0.5	4.5	8.5
Luca Benedetto	10/02/26	● Worked on presentation ● Brainstormed new designs ● Worked on preliminary report	3 1 1	5	13.5
Luca Benedetto	10/08/26	● Worked on Preliminary Report	4	4	17.5
Luca Benedetto	10/16/26	● Explored various fabrication techniques for our design	2	2	19.5
Luca Benedetto	10/23/26	● Chemical Safety Training ● Biosafety Training ● Intro to Machining Canvas Course ● Meeting to discuss fabrication plans and purchased materials	1 1 1 1	4	23.5
Luca Benedetto	10/30/26	● Intro to Machining Training ● Prototyping ● Show and Tell	4 2 1.5	7.5	31
Luca Benedetto	11/06/26	● Tong Lecture	1.5	1.5	32.5
Luca Benedetto	11/09/26	● Finding Help for MTS ● Testing MTS	1 1	2	34.5

Previous week's individual goals

May…

- Work on buying materials

Olivia…

- Buy materials this week
- Work on notebook and adding entries
- Find a fabrication plan

- May…
  - Learn more about the water jet and how to minimize breakage during fabrication
  - Continue communication with Brian about the fiber laser cutter and communicate with team
  - Prepare for show and tell
- Olivia
  - Update the lab archives
  - Pick up the 3D print
- Nicholas…
  - Utilize the cricut to develop an aluminum prototype of the dual matrix band
  - Complete training (if necessary) to utilize the water jet at Wendt
  - Create prototype with waterjet using steel
  - Prepare for show and tell
- Sam…
  - Go to sector 67 and fabricate!
- Jusin
  - Learn more about laser cutting and creating perforations.
    Prepare for show and tell
- Luca
  - Find Testing Help
  - Help with Testing