

BME Design-Fall 2020 - SPENCER STOWELL

Complete Notebook

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LEAH GAUSE

on

Apr 28, 2021 @11:13 AM CDT

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Team contact Information

Melanie Sona - Oct 07, 2020, 9:54 AM CDT

Last Name	First Name	Role	E-mail	Phone	Office Room/Building
		Advisor			
		Client			
		Leader			
		Communicator			
		BSAC			
Sona	Melanie	BWIG	sona@wisc.edu		
		BPAG			



Project description

Melanie Sona - Dec 08, 2020, 5:50 PM CST

Course Number: BME 400

Project Name: APPROXIMATING SURFACE MATRIX BAND FOR DENTIST TO USE FOR PATIENTS

Short Name: Easy Tooth Contact

Project description/problem statement:

Matrix bands are a commonly used dental tool that assists dentists by providing a wall to maintain a tooth's structure and shape during restorative procedures, such as cavity fillings. During typical filling procedures--particularly filling cavities on interproximal surfaces--dentists must fill one tooth at a time since matrix bands cannot be placed adjacent to one another, as the thickness of two bands exceeds the tooth contact diameter between the teeth. The resulting process of placing matrix bands for both teeth is cumbersome and time inefficient. The proposed design should alleviate the need to repeatedly place bands by employing a dual-band system that is thin enough to securely and comfortably fit in between the affected teeth and able to simultaneously fit the appropriate convex/concave contour of each tooth. The finalized product should also maintain the tensile strength, malleability, and space efficiency of current matrix bands.

About the client: Our Client, Dr. Donald Tipple, is a dentist at Nakoma Dental in Madison.



Client Meeting 1

Melanie Sona - Dec 08, 2020, 10:39 PM CST

Title: Client Meeting 1

Date: 9/11/2020

Content by: Leah Gause, Melanie Sona, BME 400 Group

Present: BME 400 Group

Goals: We should get a better idea of what the device's purpose is, what the client requirements are, what existing products fail to work for him and any other information that may be pertinent to our proceeding design steps.

Content:

see attached

Conclusions/action items: Based on the items the client has stressed to be of utmost importance, we can begin drafting the PDS and start brainstorming some potential solutions.

Melanie Sona - Dec 08, 2020, 10:39 PM CST

Questions:

1. Can you give an overview of what a matrix band is, how it works etc.
 - a. Right now, made of stainless steel -> or aluminum
2. Can you give a detailed description of the challenges encountered with the current matrix band? How would you like to see it improved?
 - a. Partially removable fence (fence with window)-
 - b. Fence which employs force to shift tooth
3. Are there any alternative tools you have used in place of the matrix band? What do you like/dislike about these alternative options?
 - a. Materials are not strong enough or thin enough
4. What device criteria are you unwilling to compromise?
 - a. There shouldn't be any space between the tooth filled and adjacent tooth
 - b. Account for different size teeth, different sized band widths, adjust diameter of band
 - c. Non-toxic materials
 - d. Right now, it is a cheap system, keep cheap
 - i. Save time and money
5. What is your goal for this project?
6. What is the budget for the project?
 - a. Not a set budget, but let him know what the materials are being used for
7. Do you have any other associated uses for us - people or objects we can use?
 - a. Model of plastic tooth with holes drilled in them (one a set of teeth with prep, hand arm(s), band and retainer)
8. How often do you want to meet with us to talk about the project?
 - a. Ask lots of questions -> always willing to meet
 - b. Check in later

Filing -> cavity between the teeth, when removing decay, you have hole. (easy to fill) if on biting surface just a hole, but if on a surface adjacent, it is a L shape. prep position (looking from side) when you fill you're longer have wall keeping filing in

- Need fence around tooth
 - o Retainer holds fence around tooth and allows you to tighten it around tooth
 - o Steel filings could push down into biting surface and condense material to fence, once fixed, you could take fence off
 - o Composite: filings when you push down on material it goes towards fence but also pushes outward around it -> don't get a tight contact
 - o if cavity on other surface too (both right next to one with a cavity): you would have to take the fence off and put around the other tooth

Look into:

- Is there a way to have a matrix go on both teeth? Something that provides a better contact between the teeth
- What has been created so far

[9_16_20_Client_Meeting_1.pdf\(47.3 KB\) - download](#)



Client Meeting 2

Melanie Sona - Dec 08, 2020, 10:44 PM CST

Title: Client Meeting 2

Date: 10/29/2020

Content by: Melanie Sona

Present: BME 400 group

Goals: We should update the client on the final design we have chosen, get his feedback on any revisions or adjustments that should be made, clarify any uncertainties we have about his expectations, and briefly outline our intended next steps until the end of the semester. We will essentially just brief him on our current and future plans

Content:

*** See attached***

Conclusions/action items: We will ruminate over some of the design ideas the client gave us and see whether it could be incorporated into our double hug design.

Melanie Sona - Dec 08, 2020, 10:45 PM CST

Discuss

- Current + final design
 - ↳ any potential flaws?
 - ↳ failures to address problem at hand?
- Show & tell
 - ↳ Clarify what the problem at hand is
 - can't perform restorative procedure on 2 adjacent teeth w/o putting bands on each tooth
 - ↳ Solution: essentially to have a double band matrix?
 - ↳ call to action: what makes this unique/desirable? Can I copy it? Does it stand out? Is it interesting in some way?

Client Notes

- most popular designs used now which attempt to reduce the time of placing 2 different bands prevent the issue of fillings getting stuck to one another

[Client_Meeting_2.pdf\(1.4 MB\) - download](#)



9|11 Advisor Meeting

Melanie Sona - Oct 07, 2020, 10:01 AM CDT

Title: 9/11 Advisor Meeting

Date: September 11, 2020

Content by: Melanie Sona

Present: BME 400 team

Goals: Discuss our progress on preliminary research and questions the group may have as we begin the PDS.

Content:

****See Attached****

Conclusions/action items: We will continue to work on the PDS due on 9/18 and discuss how we can break the project into phases (for designing, prototyping, redesigning (if necessary), and manufacturing which will span over the next two semesters. We will also work on getting a model of teeth from Dr. Tipple to better visualize the problem with matrix bands.

Melanie Sona - Oct 07, 2020, 10:02 AM CDT

Discuss

- Client meeting topics of discussion
- any particular notes / things the advisor likes to see for PDS ?
- How should we ultimately address design / manufacturing ...
- more info on volunteering portion of 400?

Advisor Notes

- PDS should represent realistic year long-time frame
- Resources available for getting access to the maker space

[_9_11_Advisor_Meeting.pdf\(475.9 KB\) - download](#)



9|18 Advisor Meeting

Melanie Sona - Oct 07, 2020, 10:10 AM CDT

Title: 9/18 Advisor Meeting

Date: September 18, 2020

Content by: Melanie Sona

Present: BME 400 team

Goals: Discuss our concerns about visualizing the client's problem; potentially set up a time to speak with another dentist about their experience with matrix bands.

Content:

See Attached

Conclusions/action items: To gain a deeper understanding of how matrix bands are used and the problem, we will watch some videos demonstrating how they are used. We will also conduct a patent search to gain more design inspiration (in order to generate some design ideas for the matrix report due on 9/25).

Melanie Sona - Oct 07, 2020, 10:12 AM CDT

Discuss

- possibly set up a time to speak w/ another dentist to get a broader view of the problem

Advisor notes

- look up some videos of the procedure to get some idea of how the device works
- * Do patent search related to matrix bands to gain some ideas for design
- * Come up w/ some design ideas/evolutions prior to meeting w/ another dentist.

[_9_18_Advisor_meeting.pdf\(432.2 KB\) - download](#)



10|9 Advisor Meeting

Melanie Sona - Dec 08, 2020, 10:12 PM CST

Title: Advisor Meeting

Date: 10/9/20

Content by: Melanie Sona

Present: BME 400 team

Goals: We will get feedback on our prelim presentation, talk through our next steps in designing, set up another meeting to discuss any flaws of our design, and discuss the outreach project.

Content:

See Attached

Conclusions/action items: We should start generating a detailed protocol for functionality and mechanical testing. If we want to do MTS testing, we must devise a plan to do that prior to thanksgiving.

Melanie Sona - Dec 08, 2020, 10:12 PM CST

Discuss

- feedback on prelim presentation/report?
- next steps... Revisions to final design, examine for any potential flaws/obstacles
- set up meeting to discuss other policies of the music band
- 400 volunteering expectations?

Advisor Notes

- Think about how to test the device
- what data needs to be collected, how would we collect the data & how to interpret those results...
 - ↳ see about functionality testing which can be ranked
 - look into quantitative measures
- Look into Solid works simulations to "prototype" and test our design
- MTS testing: material must withstand pulling & placing in the teeth

[_10_9_Advisor_Meeting_2.pdf\(911.3 KB\) - download](#)



11|6 Advisor Meeting

Melanie Sona - Dec 08, 2020, 10:18 PM CST

Title: Advisor Meeting

Date: 11/6/2020

Content by: Melanie Sona

Present: BME 400 Group

Goals: We would discuss our progress made so far, what criticisms and tips we received from our client meeting, get advisor feedback on the practicality of our design, and tentatively layout proceeding steps up to the presentation.

Content:

See Attached

Conclusions/action items: If there is no time to conduct MTS testing, resort to doing a SolidWorks analysis of the band, fix typo on page 3 of the final report, make a concrete plan for the method of fabrication.

Melanie Sona - Dec 08, 2020, 10:18 PM CST

Discuss

- Progress made so far... design finalization
- client feedback
- get advisor feedback on the practicality & mechanics of the design
- Plan out loud our future steps up until presentation date

Advisor Notes

- look into Solidworks testing simulation
- As of now we should have a Solidworks design in place
 - ↳ look into protocol to do physical testing
- use testing as a method to reiterate designs in Semester 2
- Next steps...
 - ① Solid works
 - ② Solid works design simulations
 - ③ Prototype... methods of fab?
 - ④ Testing... I don't physical assessment
 - II mechanical testing
 - *must be prior to thanksgiving when facilities are closed*
- look @ pg 3 of report typos...

[_11_6_Advisor_Meeting_.pdf\(949.1 KB\) - download](#)



11|13 Advisor Meeting

Melanie Sona - Dec 08, 2020, 10:22 PM CST

Title: Advisor Meeting

Date: 11/13/2020

Content by: Melanie Sona

Present: BME 400 Group

Goals: Go over our progress made with the solid works design and testing, discuss brainstormed options to manufacture a band with varying thickness

Content:

see attached

Conclusions/action items: We should test points of maximum stress and strain on the band in the solid works simulations (particularly in the thin part of the band), potentially create a stress-strain curve to graphically depict the strength, formulate an outreach plan

Melanie Sona - Dec 08, 2020, 10:23 PM CST

Discuss

- Progress made on testing Protocol/plans
- moving forward w/ SW testing results
- how we can actually manufacture a band which varies in thickness ...

Advisor Notes

- Resort to solid works testing
 - ↳ test points of σ/ϵ
 - plot σ/ϵ to see how the concentration of stresses varies at thinner/thicker parts of the band.
 - formulate plan for outreach



11|20 Advisor Meeting

Melanie Sona - Dec 08, 2020, 10:31 PM CST

Title: Advisor Meeting

Date: 11/20/2020

Content by: Melanie. Sona

Present: BME 400 Group

Goals: We should discuss: progress made since the at week, any feedback on functionality testing protocol, manufacturing plan, draft of outreach plan

Content:

see attached

Conclusions/action items: It is advisable to add a comments section in the questionnaire for the client to express any observations not accounted for in the provided question list, outreach plan is due on Dec. 9th

Melanie Sona - Dec 08, 2020, 10:31 PM CST

Discuss

- ✓ Progress made since last week
 - ↳ thoughts on testing protocol
 - ↳ manufacturing plan
- draft of volunteering Plan

Advisor Notes

- questionnaire should include one for client to include feedback on what should have also been covered
- Have volunteering plan done on date for deliverables

Preliminary Designs_Wedge Guard Design

Melanie Sona - Oct 07, 2020, 10:42 AM CDT

Title: Preliminary Designs_Wedge Guard (Potato Wedge) Design

Date: September 23, 2020

Content by: Melanie Sona

Present: BME 400 team

Goals: Design an alternative to the matrix band which functions as a contour for dentists to follow when forming the filling materials, and maintains a tight but flossable tooth contact. This design will be proposed to my BME 400 group and assessed on whether it satisfies the client requirements.

Content:

**** See attached design draft****

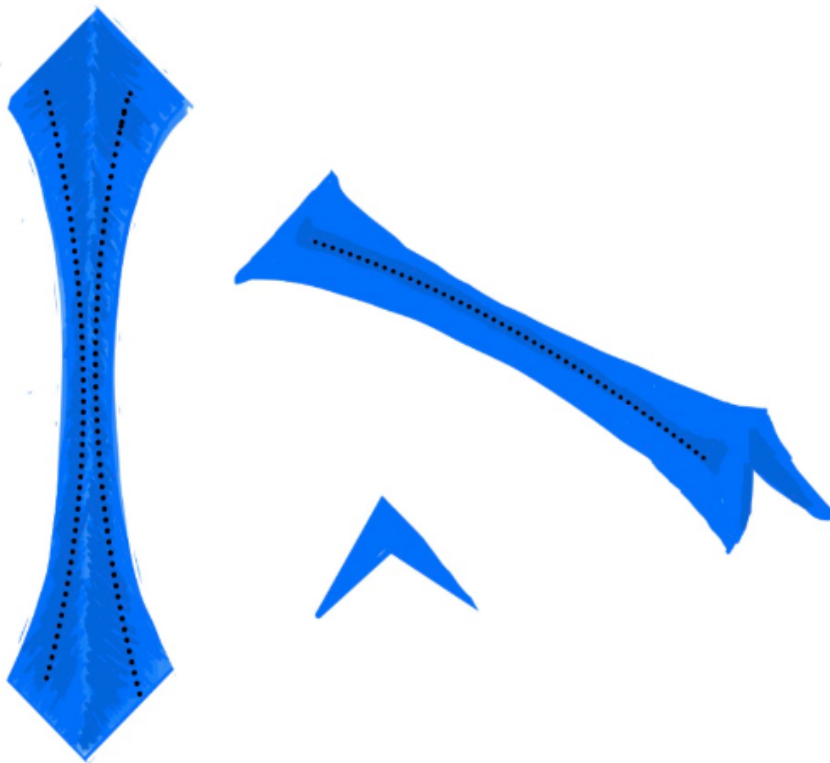


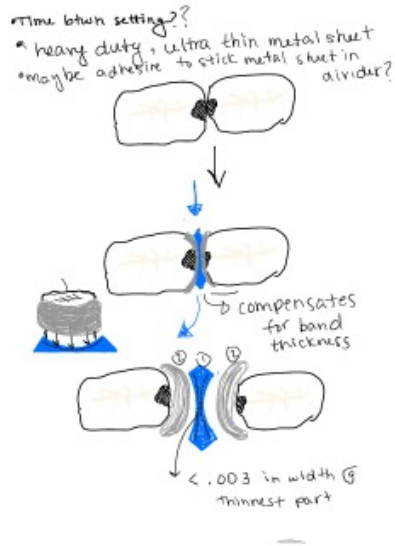
Figure 1: Wedge Guard (potato wedge) band design

In figure 1, the wedge guard is depicted as a small rubber-like wedge that can easily slide in between the teeth, similar to a toothpick. The device is flexible and is designed to easily bend or fold for better adjustment to ease insertion and removal. The wedge pick also incorporates two slots (depicted as the black perforated lines in the sides) which can ideally restrain a sectional matrix band in place. The design was inspired by the Palodent wedge guard and sectional matrix system currently on the market. The Palodent wedge guard's ease of assembly was the central character I attempted to emulate in the Potato Wedge design. The design, in theory, addresses the matrix band's inability to support two adjacent teeth simultaneously, as the curvature of the wedge is customized to fit to the convex and concave contour of each tooth. In addition, since the wedge is thinnest in the middle (where it would be pinched in between the teeth), a tight and flossable contact is encouraged. Furthermore, thinner sectional matrix bands could be used with this device because the slits on the side would serve as a deep and secure foundation to keep the band sturdy and firmly shaped around the tooth (this also encourages tight contact). Lastly, considering the minimal effort necessary to insert the wedge and sectional matrix bands, the preparation and set up time would be minimized and reduce the overall procedure time.

Conclusions/action items: Upon presenting my design to my group, it was suggested that I could instead create a wall attachment which adheres to the end of the wedge guard (pointing inside the oral cavity) to which the sectional bands anchor to, as opposed to the bands attaching to the

side slots. After our group discussion, it is evident that the dimensions may not warrant two bands being placed into slots on the sides of the wedge. The wall attachment described is one possible solution. Further design revision is underway.

Melanie Sona - Oct 07, 2020, 10:43 AM CDT



[_Design_Sketces.pdf\(1.9 MB\) - download](#)



2020/12/08 - Materials for Mechanical Testing and outreach

LEAH GAUSE - Dec 08, 2020, 11:44 PM CST

Title: Materials

Date: 12/08/2020

Content by: Leah

Present: N/A

Goals: Decide on a material to use for mechanical testing

Content:

- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5445689/>
 - 316L stainless steel
 - medical grade steel
 - used often in biomedical implants
 - biocompatible
 - corrosion resistant
 - smooth
 - option in SolidWorks
- Most likely will outsource to fabricate for the first prototype as making the cut will be very difficult as the dimensions are extremely small

Conclusions/action items:

Start mechanical testing and look for options for fabrication.



2020/4/12 - Gauge Receipt

LIAM GRANLUND - Apr 28, 2021, 10:12 AM CDT

Order Details

Ordered on April 16, 2021 | Order# 114-3074953-9772242

[View or Print invoice](#)

Shipping Address Liam Granlund 2308 UNIVERSITY AVE APT 11 MADISON, WI 53726-5811 United States <input type="button" value="Change"/>	Payment Method Debit **** 4989 <input type="button" value="Change"/>	Apply gift card balance <input type="text" value="Enter code"/> <input type="button" value="Apply"/>	Order Summary Item(s) Subtotal: \$6.99 Shipping & Handling: \$0.00 Total before tax: \$6.99 Estimated tax to be collected: \$0.38 Grand Total: \$7.37
Transactions			

Arriving Sunday

ZUZUAN 1 Pack Feeler Gauge with 32-Blade, Steel Feeler Gauge Dual Marked Metric and Imperial Gap Measuring Tool, 0.04-0.88mm & 0.0015-0.035inch

Sold by: ZUZUAN Direct

\$6.99

Condition: New



Band and retainer fabrications plans

SPENCER STOWELL - Dec 08, 2020, 9:27 PM CST

Title: Band and retainer fabrication

Date: 12/8/20

Content by: Spencer Stowell

Goals: Explain our fabrication plans for next semester

Content:

Current bands on the market seem to be made of stainless steel, so that's what were performing our testing with.

Fabrication should start with determining the required thickness of the double-sided band through material testing. Once this thickness is determined, bands can be produced at the dimensions required. For the retainer, we must reverse engineer the current design to determine how it functions, and then design a mirrored version in order to wield two independent bands. Finally, we will have to outsource our design for production in the spring semester, as we lack the machining skills and the 3D printer quality to do it ourselves.

Conclusions/action items: Reverse engineer current design so we can mirror it

Reference: R. H. White and M. J. Geissberger, "Additional Uses for the Classic Matrix Band," *Operative Dentistry*, 01-Jul-2007. [Online]. Available: <https://meridian.allenpress.com/operative-dentistry/article/32/4/412/107238/Additional-Uses-for-the-Classic-Matrix-Band>. [Accessed: 08-Dec-2020].



2021/03/03 - Fabrication plans

LEAH GAUSE - Mar 03, 2021, 12:09 PM CST

Title: Big Blue Saw Manufacturing

Date: 03/03/2021

Content by: Leah/Melanie

Present: All

Goals: To get the fabrication started with a company

Content:

Here is an email from a company that was sent back to Melanie after she reached out to them.

This would be a special material order. Special material orders have a lead time of 10-12 days and a \$200.00 minimum. I was only able to find one shim stock that was available with that thickness. Unfortunately, I still have not located a shim stock of the .0007 inch thick material. Also with how thin this material is we would have to cut it between sacrificial material. Here is your quote:

Quantity 4 parts Waterjet cut from your design "MATRIX BAND NEW 2-21-21.dxf.dxf".

Finish: Remove Tabs

sandwich material

Material: 18-8 Stainless Steel Shim Stock, Thickness: 0.0015 inch. Size:

Piece (1): 2.480 x 0.349 inches.

\$43.30 each

Quantity 20 parts Waterjet cut from your design "MATRIX BAND NEW 2-21-21.dxf.dxf".

Finish: Remove Tabs

sandwich material

Material: 18-8 Stainless Steel Shim Stock, Thickness: 0.0015 inch. Size:

Piece (1): 2.480 x 0.349 inches.

\$8.66 each



Would you like this invoiced ? If so, all I need is your shipping address. Please let us know if you have any questions.

Conclusions/action items:

Respond back and get in touch with Dr. Tipple about the finances.



2020/12/01 - Mechanical Testing Protocol

LEAH GAUSE - Dec 08, 2020, 9:04 PM CST

Title: Mechanical testing protocol

Date: 12/01/2020

Content by: Leah

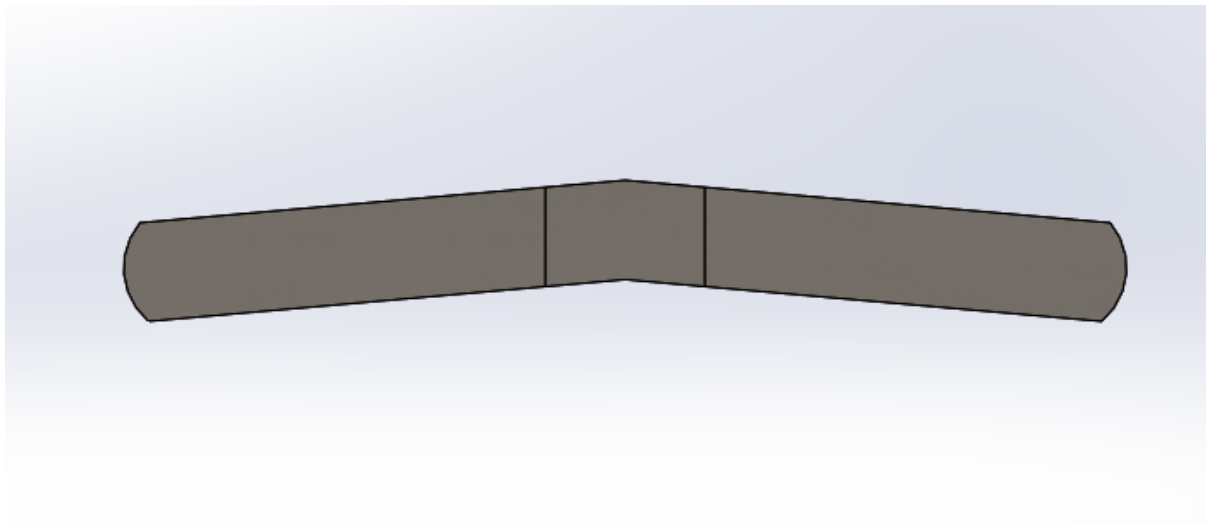
Present: N/A

Goals: Set up a protocol of how testing will be done on SolidWorks

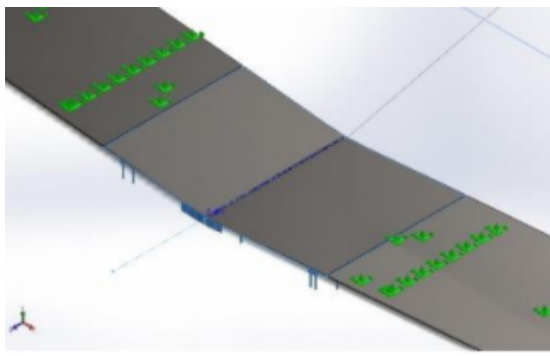
Content:

- Create two bands - one control and one of our design
 - our design (last two points apply to both bands)
 - make cut in middle of band to half the thickness
 - use 0.0015 in thickness for full thickness part
 - 3 cm wide, 0.62 cm height
 - round corners at both ends and add fillets
 - 316L Stainless Steel
- Do static tests on bands
 - elastic support
 - force of about 1.2 pounds on the area in contact with adjacent tooth
 - fix both ends of band to prevent movement
 - get analysis of test and add to report

Control band:



prototype band: same top view, here is the side view



Here, you can see the slope that leads to the half thickness in the middle.

Conclusions/action items:

Put results of this test in lab archives and in the final report. Based on findings, either redesign prototype or start fabrication.



2020/24/11-Functionality Testing Protocol

Melanie Sona - Dec 08, 2020, 9:35 PM CST

Title: Functionality Testing Protocol

Date: 11-24-2020

Content by: Melanie Sona

Present: BME 400 Group

Goals: Create a testing protocol that assesses the ease of use and functionality of the double hug band as compared to the toeffelmeir band.

Content:

***See attached file ***

Conclusions/action items: We will conduct functionality testing next semester one we have created a successful prototype. The results of the functionality test will dictate whether we will undergo redesigning or more forward with finalizing the prototype.

Melanie Sona - Dec 08, 2020, 9:49 PM CST

** insert images of procedure once we have prototype
 ** clarify the demarcation of the thinner portion of the band

Premise: These tests will be used as an assessment to qualitatively determine the overall functionality, structural integrity, and ease of use of the "double hug" matrix band.

Materials:

1. Doublehug matrix band prototype
2. Universal to Florida matrix band (# D015 thickness)
3. 2. standard universal matrix band retainers
4. Palodont wedge guard-400 th wedge
5. Standard adult tooth model

Procedure:

1. Place the palodont wedge guard in between the molars undergoing mock extraction
2. Take one of the double hug bands and bend it to the appropriate shape of one molar making sure the area of the band marked with a rectangle (the portion with the thinner cross section/area) is placed in between the tooth contact gap
 - a. Make note on the provided questionnaire how strenuous it is to bend the band to shape (1-much effort and force is required, 5-very little effort and force is required)
 - b. Make note on the provided questionnaire how much force is required to fit the band between the contact gap (1- much force is required to fit the band between the teeth-very light fit, 5-very little force is required to fit the band between the teeth-seemingly appropriate fit)
3. Tighten the 1st band using the retainer (as typically performed in a clinical setting)
4. Take the second double hug band and, again, bend it to the appropriate shape of the adjacent molar making sure the area of the band marked with a rectangle is placed in between the teeth
 - a. Make note on the provided questionnaire how strenuous it is to bend the band to shape (1-much effort and force is required, 5-very little effort and force is required)
 - b. Make note on the provided questionnaire how much force is required to fit the band in between the contact gap (1- much force is required to fit the band between the teeth-very light fit, 5-very little force is required to fit the band between the teeth-seemingly appropriate fit)
 - c. Make note on the provided questionnaire if there is a distortion of the band shape once both bands are placed next to each other (1- there is severe bending/distortion of the curvature of one/both bands upon inserting the second band, 5-there is no bending/distortion of the curvature of one/both bands upon inserting the second band)
5. Tighten the 2nd band using another retainer (as typically performed in a clinical setting)
6. On the questionnaire, provide any other comments pertaining to the ability of the interproximal part of the band (1- the band is relatively firm and the contour is easily

[Functionality_Testing_Protocol_1_.pdf\(54.7 KB\) - download](#)



2020/1/12- Functionality Testing Survey

Melanie Sona - Dec 08, 2020, 9:57 PM CST

Title: Functionality Testing Survey

Date: 12/1/20

Content by: Melanie Sona

Present: BME 400 team

Goals: Create a survey that presents clear criteria by which the client will evaluate the functionality of the double hug band.

Content:

See attached

Conclusions/action items: Each question will be awarded a score (1-5 possible points), so the maximum number of points to be awarded is 65. Should the device receive a total score of 62/65 or above (indicating top 5%), then we can continue to proceed with finalizing the prototype. Scoring is used as a method to quantitatively assess whether the design truly meets the expectations of the client.

Melanie Sona - Dec 08, 2020, 9:59 PM CST

Qualitative Dog (Double Hug) Functionality Performance Assessment

Dog Double Hug Band One

- 1. How strenuous is it to bend the band to shape? (1-much effort and force is required, 5-very little effort and force is required). Circle one.

1	2	3	4	5
---	---	---	---	---
- 2. How much force is required to fit the band in between the contact gap? (1-much force is required to fit the band between the teeth-very tight fit, 5-very little force is required to fit the band between the teeth-seemingly appropriate fit). Circle one.

1	2	3	4	5
---	---	---	---	---
- 3. Assess the rigidity of the intra-proximal part of the band (1-the band is subtly floppy and the contour is easily disrupted by placing light force against it, 5-the band is appropriately rigid and the contour is not disrupted by placing light force against it)

1	2	3	4	5
---	---	---	---	---

*Additional Comments:

[Functionality_Testing_Questionnaire.pdf\(33.1 KB\) - download](#)



2020/4/20 - Testing Protocol

LIAM GRANLUND - Apr 28, 2021, 10:10 AM CDT

Functionality Testing

- Premise:
 - These tests will be used as an assessment to qualitatively determine the overall functionality, structural integrity, and ease of use of the "doublehug" matrix band.
- Testing targets:
 - Ease of banding the device
 - Ease of securing the device between the teeth
 - Ease of removal
 - Subjective structural integrity of the band (particularly the interproximal part)
- Method of Measurement:
 - Questionnaire asking the client to assess the various physical characteristics on a scale of 1-5.

Mechanical Testing

- Premise:
 - These tests will be used as an assessment to quantitatively determine if the bands are physically able to undergo the stresses necessary in the procedure.
- Testing Targets:
 - Test so that the modified matrix band matches up to the matrix band traditionally used.
 - Use the original band as a baseline, goal is to achieve a factor of safety of 1 when compared to the original force required to tear the band.
- Method of Measurement:
 - Placing the various band thicknesses and prototypes into the grips of an MTS machine
 - Measure force required to rip the matrix band
 - Compare this value with the force required to tear a modified matrix band, with the goal of the force being equal.

[Mechanical_Testing.pdf\(31.1 KB\) - download](#)



2020/12/01-Mechanical Testing Results

LEAH GAUSE - Dec 08, 2020, 9:09 PM CST

Title: Mechanical Testing results

Date: 12/01/2020

Content by: Leah

Present: N/A

Goals: To get some preliminary tests done to see if design is practical.

Content:

After tests were completed, the simulations showed the proposed final design tearing in the middle where the thickness was half. The control band never surpassed the yield strength of the material.

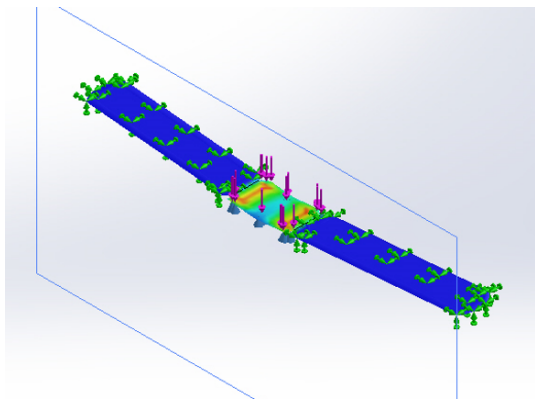
Yield strength of material: 170 MPa

max stress of the control: 90.46 MPa (note: less than yield)

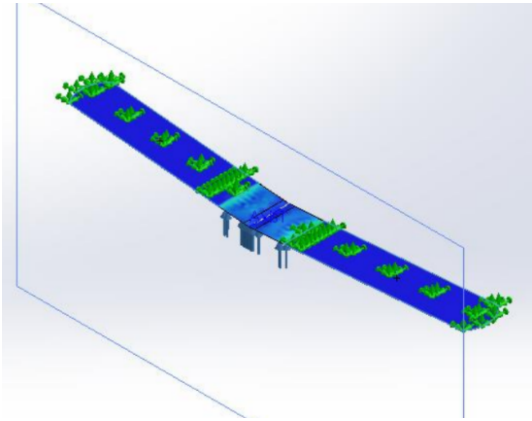
max stress of design: 249 MPa (note: larger than yield stress) -> model had tear in middle after test

- Points to think about
 - Was this test accurate?
 - 1.2 pounds used based on our own findings, maybe do tests to get more accurate value
 - does an elastic support really represent what the band would feel against an adjacent tooth?
 - We could increase band thickness to 0.002 in to see if the extra thickness would reduce the max stress enough
 - We could also keep that thickness and reduce the slope so it doesnt go to half thickness and instead goes to 0.001 in
 - We could change the factor of safety to less than 2
 - If none of these changes make a difference (or we decide we want to make changes regardless), we should reconsider our final design and redo mechanical testing with this new design.

Control band results:



prototype results:



You can't really see the tear here, but that is why the stresses look less in this picture. The area that ripped would have had stresses in the red zone, but since that part is gone, you can no longer see them.

Attached are the generated reports from SolidWorks with more information.

Conclusions/action items:

This showed that our design is not viable unless some changes are made. In the next few weeks/next semester, we need to either change some of the dimensions or the factor of safety or update the design entirely so this does not happen.

LEAH GAUSE - Dec 08, 2020, 9:08 PM CST

Simulation of matrixband new11-28-20solvedfail

Date: Sunday, November 29, 2020
Designer: Subhanshu
Study name: Static_refined_mesh-force
Analysis type: Static

Table of Contents

- Study Properties.....
- Units.....
- Material Properties.....
- Loads and Fixtures.....
- Contact Information.....
- Resultant Forces.....
- Study Results.....
- Conclusion.....

SOLIDWORKS Analyzed with SOLIDWORKS Simulation Simulation of matrixband new11-28-20solvedfail 1

matrixband_new11-28-20solvedfail-Static_refined_mesh-force-1.docx(709.1 KB) - [download](#)



Simulation of matrixband NO CUT11-29-20solved

Date: Wednesday, December 2, 2020
Designer: Solidworks
Study name: Static 2
Analysis type: Static

Table of Contents

- DESCRIPTION.....
- Assumptions.....
- Model Information.....
- Study Properties.....
- Units.....
- Material Properties.....
- Loads and Fixtures.....
- Connector Definitions.....
- Mesh Information.....
- Sensor Details.....
- Resultant Forces.....
- Reactions.....
- Study Results.....
- Conclusion.....

Description
No Data

 SOLIDWORKS Analyzed with SOLIDWORKS Simulation Simulation of matrixband NO CUT11-29-20solved 1

[matrixband_NO_CUT11-29-20solved-Static_2-3.docx\(1014.4 KB\) - download](#)



2020/09/18 - Product Design Specifications (PDS)

LEAH GAUSE - Dec 08, 2020, 11:22 PM CST

Title: PDS

Date: 09/18/2020

Content by: All

Present: N/A

Goals: State all specifications given by client and compare to current designs.

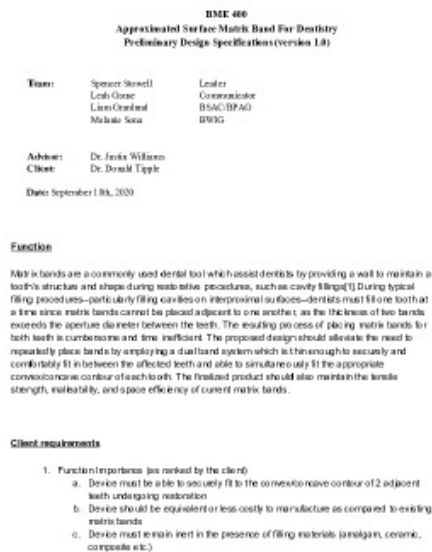
Content:

Attached

Conclusions/action items:

Use this to start preliminary designs and keep in mind while fabricating and testing final design.

LEAH GAUSE - Dec 08, 2020, 11:23 PM CST



ProductDesign_Specification.pdf(228.3 KB) - [download](#)



2020/09/25 - Design Matrix

LEAH GAUSE - Dec 08, 2020, 11:25 PM CST

Title: Design Matrix

Date: 09/25/2020

Content by: All

Present: N/A

Goals: To think of three preliminary designs to compare and analyze using design criteria.

Content:

Attached

Conclusions/action items:

Decide on a final design and start fabrication.

LEAH GAUSE - Dec 08, 2020, 11:26 PM CST

Preliminary Design Evaluation

a. Design Matrix

i. Design Criteria

Safety

This category is weighted the highest, as the device is going to be placed in the patient's mouth, so it must be made of materials that are non-toxic and non-hazardous to the patients and the dentist handling it. The device should not have any sharp features that could harm the patient upon insertion. The double band design received full marks for safety because it can easily be fabricated from the standard stainless steel sheets which are guaranteed to be non-toxic to the patients. Additionally, the design does not have any harsh features which may harm the patient when inserted or removed.

Ergonomics

This category was heavily weighted as the device should not be excessively complicated for experienced dentists to use, and the device should not be cumbersome. The device should not require any additional training to use. The "Polaris Wedge" and "Doug Double Hug" ranked the highest for ergonomics because they are both slightly modified versions of existing products on the market. Both designs were deemed as being straightforward to operate due to their resemblance in structure and function to widely used band matrix and wedge devices.

Effectiveness

The device should make the procedure shorter in some way. Dentists should be able to perform two adjacent class II fillings simultaneously. The Doug was rated highest in this area due to it wrapping around both teeth in a manner that would allow you to work on both teeth at the same time, near the same rate as the current device. The Butterfly and Polaris Wedge were tied for second highest ranking as they work the same way, except a little mechanically different and more obtrusive than the current method, and could extend the time required to use the device.

Cost

Fabrication of the design should not cost more than the current models. However, if the band is more efficient than a slight increase in cost would be fine. The Doug had the highest rating for cost because it is the same thing as our current model with the addition of the cost of a second band. The Butterfly had the second highest ranking due to it requiring the cost of additional adhesives or manufacturing to the bands and handle that would make it cost more than the standard initial cost. Finally, the Polaris wedge had the lowest cost score of the 3 designs, because it required the fabrication of a completely new piece of material, a rubber wedge to be inserted between the teeth.

DesignMatrix_SurfaceMatrixBand.pdf(369.2 KB) - [download](#)



2020/10/07 - Preliminary Report and Presentation

LEAH GAUSE - Dec 08, 2020, 11:28 PM CST

Title: Preliminary Presentation and Report

Date: 10/07/2020

Content by: All

Present: N/A

Goals: Present our preliminary report

Content:

Attached

Conclusions/action items:

Use the feedback for the final deliverables and final presentation and continue working towards fabrication and testing.

LEAH GAUSE - Dec 08, 2020, 11:28 PM CST

APPROXIMATING SURFACE MATRIX BAND FOR DENTIST TO USE FOR PATIENTS

PRELIMINARY REPORT



BME 400

October 7, 2020

Client: Dr. Donald Tipple, DDS

Advisor: Dr. Justin Williams, Visiting Distinguished Achievement Professor

Team Members: Spencer Stowell (Leader), Leah Gause (Communication), Liam Craddock (BPAQ/BSAC), Melanie Sosa (BWIG)

[Easy_Tooth_Contact-Preliminary_Report.pdf\(782.6 KB\) - download](#)

LEAH GAUSE - Dec 08, 2020, 11:30 PM CST



[Preliminary_Presentation.pdf\(3.1 MB\) - download](#)



2020/11/06 - Show and Tell

LEAH GAUSE - Dec 08, 2020, 11:34 PM CST

Title: Show and Tell

Date: 11/06/2020

Content by: All

Present: N/A

Goals: Gain some insight from classmates on what we could change

Content:

Attached

Conclusions/action items:

Use this new information to see if any changes can be made to the current design.

LEAH GAUSE - Dec 08, 2020, 11:34 PM CST

Requirements

This is to take a speed-dating style event in which you will give one-minute elevator pitches to your peers and then have four minutes to gather feedback. This year - you are writing down your elevator pitch and posting it in the on Canvas and responding to others.

- No formal slides or presentation
- You may make **ONLY ONE** graphic (be sure to use a clear blank) of your current prototype and/or representation of your final design or which you are requesting feedback
- Prepare text that you can deliver in 30 seconds on an elevator pitch (see guidance below)
- Post to Piazza once a team is found a leader / leader that best matches your call to action.
- **DUE BY 11:30 pm on WEEK 8: FRIDAY, OCTOBER 30**
- Individually - respond to another team's pitch. You might have to do some research to fully help them - use this an opportunity to develop your skills as well. Remember to be kind to one another!
- **DUE BY 11:30 pm on WEEK 9: FRIDAY, NOVEMBER 6**

- **Call to action:**
- **Prototype:** (please picture of main hand setup with model teeth, and or a tin foil mock model of the drug design)



Show_and_Tell_Pitch.pdf(244.3 KB) - [download](#)



2020/12/04 - Final Presentation

LEAH GAUSE - Dec 08, 2020, 11:37 PM CST

Title: Final Presentation

Date: 12/04/2020

Content by: All

Present: N/A

Goals: Present our findings this semester

Content:

Attached

Conclusions/action items:

Continue work on this project next semester and finish final deliverables

LEAH GAUSE - Dec 08, 2020, 11:37 PM CST



Final_Presentation.pdf(2.6 MB) - [download](#)



Comparison between Sectional and Circumferential Matrix Bands

SPENCER STOWELL - Oct 06, 2020, 7:04 PM CDT

Title: Comparison between Sectional and Circumferential Matrix Bands

Date: 10/6/20

Content by: Spencer Stowell

Goals: Research ways unto which we can improve our current design

Content:

Dentists commonly face the problem of overhanging proximal margins and poor proximal contact points while restoring Class II cavities in posterior teeth. Various matrix band systems are used in dental clinics to avoid such problems. In total, 1200 Class II cavities in teeth were selected for this study, where cavities were randomly divided into two groups. The first group was fully circumferential matrix bands, while the second was sectional matrix bands, which didn't go all the way around the tooth.

They found that all optimum contacts between teeth were found in restorations done using sectional band system.

Conclusion: Sectional matrix band system has been found superior to circumferential matrix band system. I will propose this finding to my team at our next meeting and see how to incorporate this into our design.

.Reference:

M. Z. Ahad, D. E. Sadaf, R. N. Gaikwad, and B. Arjumand, "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: A randomized controlled clinical trial," *Indian journal of dental research : official publication of Indian Society for Dental Research*, 2018. [Online]. Available: <https://pubmed.ncbi.nlm.nih.gov/30127197/>. [Accessed: 06-Oct-2020].



Most popular Matrix Bands in use

SPENCER STOWELL - Oct 06, 2020, 8:47 PM CDT

Title: Most popular Matrix Bands in use

Date: 10/6/20

Content by: Spencer Stowell

Goals: Show what brand of matrix band is most common for dental usage

Content:

621 questionnaires were sent to a multitude of dental practices in Scotland, and a total of 479 questionnaires were returned, representing a response rate of 77%. The Siqveland matrix was the matrix of choice for 96% of respondents. 7% provided a new matrix band for each patient. Most (64%) changed bands only when they were bent or damaged; 29% changed them daily or weekly. Deterrents to use of a new band for each patient were cost (39%) and time (52%). A total of 54% of respondents considered matrix band replacement unnecessary between patients.

Conclusions: The Siqveland matrix band is the most popular among the study group of dental practitioners. Re-use of matrix bands is common. Talk to our client and see if his practice uses these bands so we can get a better idea for dimensions of the band, and see what products we could research to find bands of smaller thickness.

Reference:

A. H. Lowe, F. J. T. Burke, S. McHugh, and J. Bagg, "A survey of the use of matrix bands and their decontamination in general dental practice," *British dental journal*, 12-Jan-2002. [Online]. Available: <https://pubmed.ncbi.nlm.nih.gov/11852897/>. [Accessed: 06-Oct-2020].



SPENCER STOWELL - Dec 09, 2020, 11:44 AM CST

Title: Material Choice

Date: 12/9/20

Content by: Team

Goals: Material choice explanation

Content:

Current bands on the market seem to be made of stainless steel, so that's what we were performing our testing with. We must see if the stainless steel we use is strong enough to cut the thickness down to make space for two bands.

Conclusions/action items: Reverse engineer current design so we can mirror it

Reference: R. H. White and M. J. Geissberger, "Additional Uses for the Classic Matrix Band," *Operative Dentistry*, 01-Jul-2007. [Online]. Available: <https://meridian.allenpress.com/operative-dentistry/article/32/4/412/107238/Additional-Uses-for-the-Classic-Matrix-Band>. [Accessed: 08-Dec-2020].

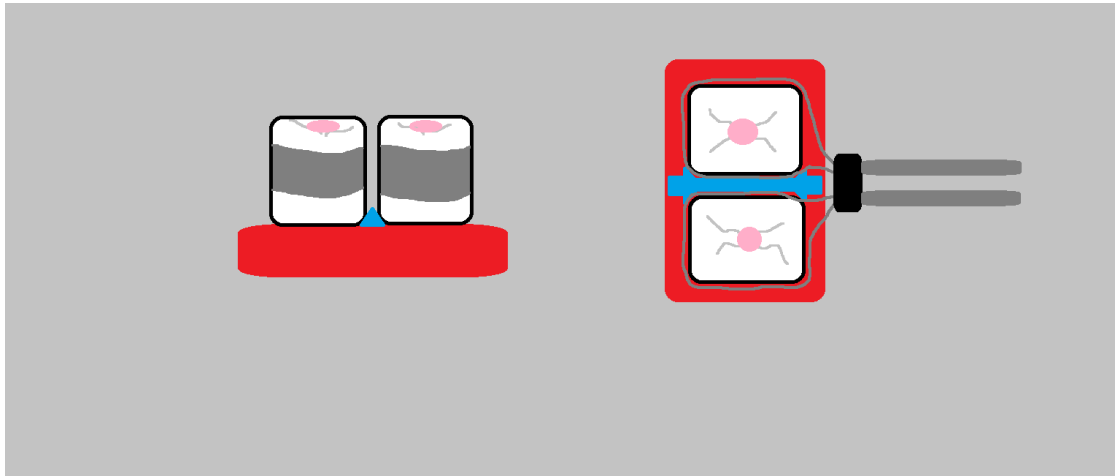
Title: Doug Design

Date: 9/23/20

Content by: Spencer Stowell

Goals: Show my current design idea

Content:



(Doug) DoubleHug design: features similar functionality to current model in use, save the use of two independent bands with two separate actuation systems, allowing for the filling of two teeth simultaneously while keeping the fillings separate.

Conclusions/action items: Find a way to thin the bands to allow for two to fit as well as maintaining good connection between teeth



Ongoing Physiological, Statistical, and Conceptual Research Pertaining to Matrix Bands & Tooth Decay

Melanie Sona - Oct 07, 2020, 10:52 AM CI

Title: Ongoing Research Related to Matrix Bands

Date: September 4, 2020 - Ongoing

Content by: Melanie Sona

Present: BME 400 Teams

Goals: Continue Research on any pertinent information relating to the function, need and use of matrix bands

Content:

APPROXIMATING SURFACE MATRIX BAND FOR DENTIST TO USE FOR PATIENTS

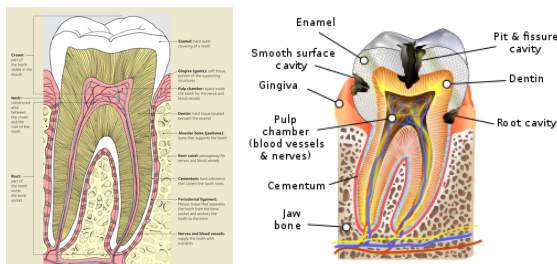


Problem statement: In order to save time when dentists have to work on more than one tooth, we must design a device that allows the dentist to not have to remove the fence/band and apply it to the next tooth surface

Terminology-

- Dental restoration = includes fillings, crowns, root canals, etc used to restore morphology and functionality of a damaged tooth

1. Anatomy of a tooth:



1.

- <https://www.mouthhealthy.org/en/az-topics/t/tooth>

- Steps to fill a cavity: <https://immediadent.com/blog/cavity-filling-questions-answered/#:-:text=How%20dentists%20insert%20them,drill%20to%20remove%20the%20decay.>

3. What is a matrix band?

- A matrix is defined as a properly contoured piece of metal or other material used to support and give form to the material used to support and give form to the restoration during its placement and the restoration during its placement and hardening.

- The art and science of operative dentistry,1995: Mosby-Year Book,Inc

2.

4. What is a Class 2 restoration/cavity?

1. A Class II restoration has to recreate not only the natural contour of the tooth, but also the corresponding proximal contact. Many dentists consider this point, in particular, to be the most demanding part of the treatment
 1. <https://news.dentsplysirona.com/en/business-units/restorative/2017/class-ii-fillings--routine-but-still-challenging.html#:~:text=A%20Class%20II%20restoration%20has,demanding%20part%20of%20the%20treatment.>
2. **Class II:** Cavity on proximal surfaces of premolars and molars (Class II corresponds to surfaces of a posterior tooth you cannot see clinically)
 1. <https://www.dentistryiq.com/dental-hygiene/student-hygiene/article/16352162/mustknow-classifications-of-dental-caries-for-the-national-dental-hygiene-boards>
 - 2.
5. How Many people undergo procedures which require matrix bands (i.e. fillings)?
 1. According to the American Dental Association, about 175 million filling operations are performed in the United States every year.
 1. <https://www.nytimes.com/2011/11/29/health/a-closer-look-at-teeth-may-mean-more-fillings-by-dentists.html>
 2. Approximately 91% of U.S. adults aged 20–64 had dental caries in permanent teeth in 2011–2012
 1. <https://www.cdc.gov/nchs/products/databriefs/db197.htm>
 3. Dental caries (tooth decay) remains the most prevalent chronic disease in both children and adults, even though it is largely preventable
 1. <https://www.nidcr.nih.gov/research/data-statistics/dental-caries>
 4. By characterizing dental caries as a pandemic, symposium organizers have focused attention on caries as a highly prevalent disease around the globe. They have also implied that it has profound individual and societal significance because of its often severe, though non-fatal, consequences.
 1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2147591/>
 5. Fillings, also called restorations, are the main treatment option when decay has progressed beyond the earliest stage. Fillings are made of various materials, such as tooth-colored composite resins, porcelain or dental amalgam that is a combination of several materials.
 1. <https://www.mayoclinic.org/diseases-conditions/cavities/diagnosis-treatment/drc-20352898>
6. Video Links to Denta filling procedures...
 1. <https://www.youtube.com/watch?v=UdY2jZBBwhM-> palodent wedge guard
 2. <https://www.youtube.com/watch?v=hbEOeLhXjY-> Class II restoration
 3. <https://www.youtube.com/watch?v=upzeWfgvpQ8-> Setting up a Toffelmeier

Conclusions/action items: Continue research throughout the semester as necessary



Existing Products_Sectional Matrix Band

Melanie Sona - Oct 07, 2020, 11:38 AM CDT

Title: Sectional Matrix Band Information

Date: 9/14/20

Content by: Melanie Sona

Present: BME 400 team

Goals: gain a better understanding of the function, use and advantages of the sectional matrix band.

Content:

1. What is the sectional matrix band?

1. The Palodent **Sectional Matrix System** is a **sectional matrix system** for use during placement of interproximal amalgam or composite restorations or temporary fillings.



- 2.
3. Surrounds only the affected portion of the tooth
4. typically made of stainless steel sheets
5. fairly effective in maintaining tight tooth contact
6. used with tooth ring to keep the band in place

2. Cost

1. The palodent sectional matrix band system (ring) retails for about \$200.00 the matrix bands are approx. \$60.00

3. Patent: **See Attached**

Reference:

1. <https://www.dentaladvisor.com/evaluations/palodent-sectional-matrix-system/>
2. https://www.net32.com/ec/palodent-plus-sectional-matrix-system-ring-refill-d-136058?gclid=EAlaIqobChMizfHkt_Ci7AIVDNvACh0OSQECEAAAYASAAEgJn4fD_BwE



Existing Products_Toffelmier Matrix Band

Melanie Sona - Oct 07, 2020, 11:34 AM CDT

Title: Sectional Matrix Band Information

Date: 9/14/20

Content by: Melanie Sona

Present: BME 400 team

Goals: gain a better understanding of the function, use, and advantages of the Toffelmier matrix band.

Content:

1. What is the Toffelmier matrix band?

1. It is a thin metal sheet which is used as a contour for a variety of restorative procedures
2. when used with a retainer, it is able to be formed to the shape of the tooth



- 3.
4. typically made of stainless steel sheets
5. surrounds the entire tooth undergoing restoration
6. fairly effective in creating tight tooth contact

2. Cost

1. The Toffelmier matrix band system retails for about \$10.00 and the retainer is about \$30.00

3. Patent: **See Attached**

References:

1. <https://www.slideshare.net/masurizvi/matrix-bands>
2. <https://www.nobledentalsupplies.com/toffelmire-matrix-bands-36pk-waterpik>

Preliminary Designs_Wedge Guard Design

Melanie Sona - Oct 07, 2020, 11:05 AM CDT

Title: Preliminary Designs_Wedge Guard (Potato Wedge) Design

Date: September 23, 2020

Content by: Melanie Sona

Present: BME 400 team

Goals: Design an alternative to the matrix band which functions as a contour for dentists to follow when forming the filling materials, and maintains a tight but flossable tooth contact. This design will be proposed to my BME 400 group and assessed on whether it satisfies the client requirements.

Content:

**** See attached design draft****

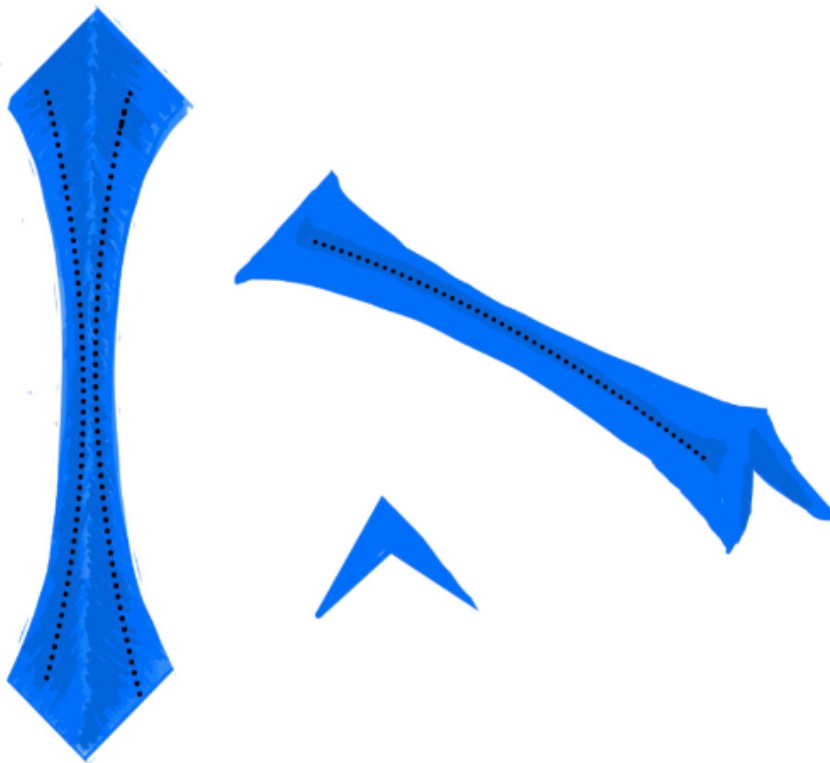
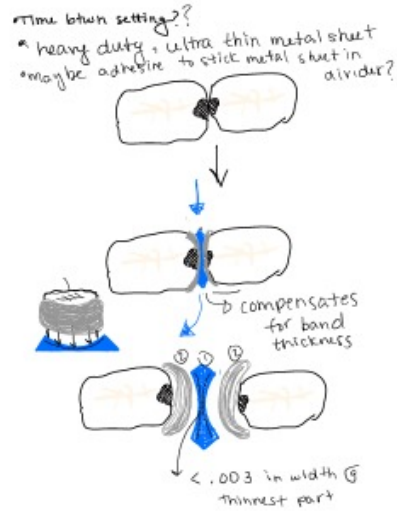


Figure 1: Wedge Guard (potato wedge) band design

In figure 1, the wedge guard is depicted as a small rubber-like wedge that can easily slide in between the teeth, similar to a toothpick. The device is flexible and is designed to easily bend or fold for better adjustment to ease insertion and removal. The wedge pick also incorporates two slots (depicted as the black perforated lines in the sides) which can ideally restrain a sectional matrix band in place. The design was inspired by the Palodent wedge guard and sectional matrix system currently on the market. The Palodent wedge guard's ease of assembly was the central character I attempted to emulate in the Potato Wedge design. The design, in theory, addresses the matrix band's inability to support two adjacent teeth simultaneously, as the curvature of the wedge is customized to fit to the convex and concave contour of each tooth. In addition, since the wedge is thinnest in the middle (where it would be pinched in between the teeth), a tight and flossable contact is encouraged. Furthermore, thinner sectional matrix bands could be used with this device because the slits on the side would serve as a deep and secure foundation to keep the band sturdy and firmly shaped around the tooth (this also encourages tight contact). Lastly, considering the minimal effort necessary to insert the wedge and sectional matrix bands, the preparation and set up time would be minimized and reduce the overall procedure time.

Conclusions/action items: Upon presenting my design to my group, I will determine if any adjustments need to be made to optimize the design. I may also gain further insight into which aspects of the design are /are not physically feasible to create.



[_Design_Sketces.pdf\(1.9 MB\) - download](#)



Testing Protocol_Functionality Testing

Melanie Sona - Dec 08, 2020, 10:06 PM CST

Title: Testing protocol for Functionality Tests

Date: 11/24/2020

Content by: Melanie Sona

Present: BME 400 Group

Goals: Convey my idea for a testing plan which guides the client to assess the bendability, structural integrity, ease of use, and practicality of the band.

Content:

See Attached

Conclusions/action items: Once we create a prototype, I will include images in the protocol visualizing the steps of the procedure outlined. Upon further discussion with my group members, I will also specify the dimensions of the area of the band which is thinner.

Melanie Sona - Dec 08, 2020, 10:06 PM CST

**insert images of procedure once we have prototype
**clarify the demarcation of the thinner portion of the band

Premise: These tests will be used as an assessment to qualitatively determine the overall functionality, structural integrity, and ease of use of the "double hug" matrix band.

Materials:

1. Doublehug matrix band prototype
2. Unrusted stainless matrix band (0.0015 thickness)
3. 2 standard universal matrix band retainers
4. Palodont wedge guard-400th wedge
5. Standard adult tooth model

Procedure:

1. Place the palodont wedge guard in between the molars undergoing mock restoration
2. Take one of the double hug bands and bend it to the appropriate shape of one molar making sure the area of the band marked with a rectangle (the portion with the thinner cross section) is placed in between the tooth contact gap
 - a. Make note on the provided questionnaire how strenuous it is to bend the band to shape (1= much effort and force is required, 5= very little effort and force is required)
 - b. Make note on the provided questionnaire how much force is required to fit the band between the contact gap (1= much force is required to fit the band between the teeth-very tight fit, 5= very little force is required to fit the band between the teeth-seemingly appropriate fit)
3. Tighten the 1st band using the retainer (as typically performed in a clinical setting)
4. Take the second double hug band and, again, bend it to the appropriate shape of the adjacent molar making sure the area of the band marked with a rectangle is placed in between the teeth
 - a. Make note on the provided questionnaire how strenuous it is to bend the band to shape (1= much effort and force is required, 5= very little effort and force is required)
 - b. Make note on the provided questionnaire how much force is required to fit the band in between the contact gap (1= much force is required to fit the band between the teeth-very tight fit, 5= very little force is required to fit the band between the teeth-seemingly appropriate fit)
 - c. Make note on the provided questionnaire if there is a distortion of the band shape once both bands are placed next to each other (1= there is severe bending/distortion of the curvature of one/both bands upon inserting the second band, 5= there is no bending/distortion of the curvature of one/both bands upon inserting the second band)
5. Tighten the 2nd band using another retainer (as typically performed in a clinical setting)
6. On the questionnaire, provide any other comments pertaining to the rigidity of the interproximal part of the band (1= the band is relatively flimsy and the contour is easily

[Functionality_Testing_Protocol_1_.pdf\(54.7 KB\) - download](#)

Qualitative Dog (Double Hug) Functionality Performance Assessment

Dog Double Hug Band One

- 1. How strenuous is it to bend the band to shape? (1-much effort and force is required, 5-very little effort and force is required). Circle one.
1 2 3 4 5

- 2. How much force is required to fit the band in between the contact gap? (1-much force is required to fit the band between the teeth-very tight fit, 5-very little force is required to fit the band between the teeth-seemingly appropriate fit). Circle one.
1 2 3 4 5

- 3. Assess the rigidity of the intra-proximal part of the band (1-the band is relatively firm and the contour is easily disrupted by placing light force against it, 5-the band is appropriately rigid and the contour is not disrupted by placing light force against it)
1 2 3 4 5

*Additional Comments:

Functionality_Testing_Questionnaire.pdf(33.1 KB) - [download](#)



2020/9/6 - Basic Background

LEAH GAUSE - Sep 06, 2020, 7:21 PM CDT

Title: Basic Background

Date: 9/6

Content by: Leah

Present: N/A

Goals: To understand the goals of the project and why it is important

Content:

- proximal contact: "surface area where the proximal faces of neighboring teeth come in contact"
- functions of proximal contact include support, alignment, stabilization, and protection of the interdental gingival papilla
- without proximal contact teeth are susceptible to halitosis, caries formation, and periodontal disease
- Brief history of fillings:
 - 1800s: restorative dentistry began -> started with only taking out the cavity and filling it with either amalgam or gold (but didn't account for structure)
 - late 19th century: recognized the importance of contact and correct contour
 - proximal walls were now filled as well
 - wanted normal contact surfaces
 - 3 devices/techniques evolved to accurately restore form and function
 - separating matrix band
 - placement of wedge
 - mechanical separators for gradual separation
- Matrices (bands)
 - function: provide containment for filling material, create a wall around tooth
 - made from thin, flexible, flat pieces of metal
 - placed around the affected tooth
 - must be stable on band insertion, flat and precontoured, and thin
 - originally made with gold or silver -> now made with tin, brass, copper, stainless steel
 - usually used with class II lesions with dental amalgam along with a wedge
 - Tofflemire retainer and band
 - known as the universal matrix system
 - Class II restorations
- retainerless matrix systems
 - spring-loaded band
 - specific to restoration of proximal surfaces
 - known as automatrices

[https://www.agd.org/docs/default-source/self-instruction-\(gendent\)/gendent_so16_owens.pdf](https://www.agd.org/docs/default-source/self-instruction-(gendent)/gendent_so16_owens.pdf)

- goal is to provide tight contacts, good contours, and proper anatomy
- segmental metal matrices -> provide for all three
- precontoured vs straight matrices
- segmental matrix bands seem to provide better/tighter proximal contacts than the circumferential matrix bands

<https://www.dentaleconomics.com/science-tech/article/16389377/matrix-bands-for-primary-and-permanent-class-ii-composite-restorations>

Conclusions/action items:

Knowing the basic background of the restoration process will aid in our future discussion with Dr. Tipple. After the meeting, we'll know exactly what the project expectations are, so it will be easier to research specific ideas.



10/2/2020 - Class II filling

LEAH GAUSE - Oct 06, 2020, 9:13 PM CDT

Title: Class II fillings

Date: 10/2/2020

Content by: Leah

Present: N/A

Goals: To understand how Class II fillings usually work

Content:

Video 1

- Convex shapes to interproximal walls



- if you tried to fill all three teeth at the same time with this set up, there would be space between the teeth as two band thickness is too much
- Sometimes need extender tab if cavity goes down far -> specialty band
- toffelmire : band around retainer holds band, when you tighten around tooth, flat edge is created in medial and distal, sometimes when you put wedges in but flattens the rest out

Pivot Dental Company. "Class II Fillings," YouTube, June 4, 2018. [Video file]. Available: <https://www.youtube.com/watch?v=hbEOeLhIXjY>

Video 2

- MOD: mesial, occlusal, distal
- OD: just occlusal, distal
- MO: mesial, occlusal
- We are focusing on MO/DO or MO/MOD or DO/MOD class II fillings
- Hard to place ring between two matrix bands
- People use two matrix bands but still fill only one tooth at a time
- Another option is to do only DO side then flip band and put ring in to spread teeth to fill MO portion
- Either way, fillings take twice as long as you can't fill all teeth at once

GarrisonDental. "Top 5 Questions: #1 | Back-to-back Class IIs," YouTube, April 18, 2018. [Video File]

Available: <https://www.youtube.com/watch?v=UADRIGxKRZA>

Conclusions/action items:

Continue to search up different methods dentists have used to do back-to-back class II fillings. Based on this information so far, there isn't a great way to do them simultaneously without risking accuracy.



10/4/2020 - Background on bands/procedure

LEAH GAUSE - Oct 06, 2020, 9:21 PM CDT

Title: Background on bands/procedure

Date: 10/4

Content by: Leah

Present: N/A

Goals: To get a better understand of all the components used in a Class II filling

Content:

- Universal retainer: holds matrix band in position, stays positioned on cheek side
- Matrix bands: made of stainless steel, available in premolar, molar, and universal sizes
 - Longer edge placed on occlusal surface, smaller side placed near gums
- Wedge: made of wood or plastic, inserted between teeth to hold matrix band
- Automatrix system
 - Using no retainer, band has coil auto lock loop, tighten the band with tightening wrench
- Sectional matrices
 - Palodont type band for creating a tight anatomic contact
- http://quondam.csi.edu/facultyAndStaff_/webTools/sites/Bowcut58/courses/552/ch49.ppt

Conclusions/action items:

Use this information to see what items might be needed in our design. Look into specific items if necessary.



2020/12/09 - Matrix Must-haves

LEAH GAUSE - Dec 09, 2020, 11:24 AM CST

Title: What Matrix Systems must be able to do

Date: 12/09/2020

Content by: Leah

Present: N/A

Goals: To see what type of things our band must be able to do

Content:

- A matrix band must:
 - recreate the natural tooth shape and interproximal contact
 - if ours has a flat side, then this point shouldn't be a problem as it will give the same shape
 - seal the proximal and gingival walls of the prep
 - If made with same dimensions, this should be fine
 - overcome the thickness
 - very important point for our project -> need to make sure our band is not too thick
 - thinner bands are usually preferred -> 0.0015 is thinnest
 - wedge and separator ring are usually make this easier
- <https://www.dentaleconomics.com/science-tech/article/16394387/three-things-a-matrix-system-must-do-to-be-successful>

Conclusions/action items:

Keep these points in mind when testing and fabricating the band.



9/25/2020 - Design for design matrix

LEAH GAUSE - Oct 06, 2020, 9:27 PM CDT

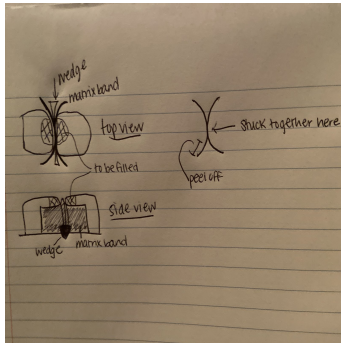
Title: Design 1 "the butterfly"

Date: 9/25

Content by: Leah

Present: N/A

Goals: create a design to present for the meeting



- connected in middle
- sides could peel off
- still use wedge or ring to separate teeth
- thickness of one band in middle

Conclusions/action items:

Present this design to team on design matrix meeting this week. See if any changes might need to be made or if design is even possible.



9/6/20 - Videos on Tool Usage

LIAM GRANLUND - Oct 07, 2020, 1:26 AM CDT

Title: Videos on Tool Usage

Date: 9/6/20

Content by: Liam Granlund

Present: Myself

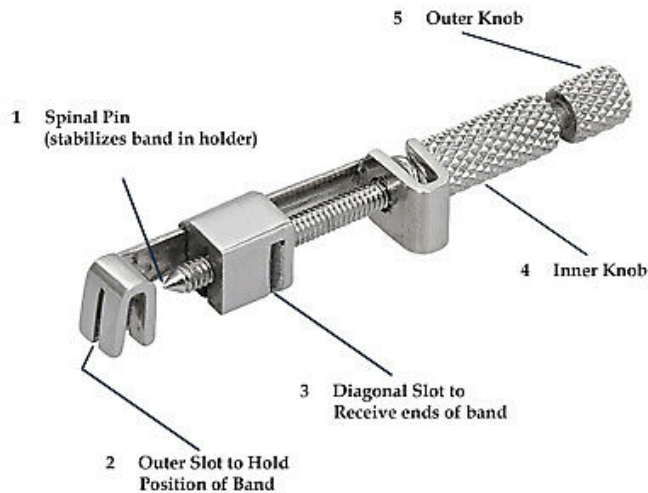
Goals: To do some background research in order to better understand the problem we are addressing and the project we are designing.

Content:

- Here is a good video on how to put a matrix band into the set up handle. Its a simple fold and then a tightening a the bottom of the handle.
- This might be helpful or understanding how we will adjust our matrix bands.
- Additionally I will put a picture layout of the handle here!

CE

Universal Matrix Retainer Tofflemire



<https://i.ebayimg.com/images/g/Us8AAOSwDK9cZ5ge/s-l400.jpg>

Source Title: Tofflemire Matrix Band Setup and Placement

Source Link: [youtube.com/watch?v=XfL7vzfa0gY](https://www.youtube.com/watch?v=XfL7vzfa0gY)

- Below is another video displaying the tool in action
- Does a better job of showing how the matrix band is tightened with the Matrix Retainer
- The Dentist uses a wedge to space out the teeth, is only needed "on the side where the tooth wall is missing". _inserted and removed with the college pliers. These pliers remove the band too.

Source Title: Matrix Band

Source Link: <https://www.youtube.com/watch?v=bcvQR3Yhz8k&t=6s>

Conclusions/action items: These videos will be helpful when reviewing how to design our interface with the matrix bands. Will need to know what the matrix bands are made of and what works with what types of interfaces.



9/16/20 - Matrix Band information

LIAM GRANLUND - Oct 07, 2020, 1:41 AM CDT

Title: Matrix Band Information

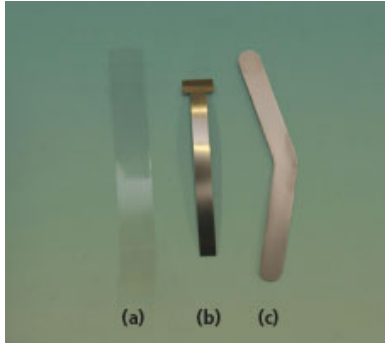
Date: 9/16/20

Content by: Liam Granlund

Present: Myself

Goals: To understand what kind of Matrix Bands exist and what they are made of.

Content:



(a) Celluloid strip

- Used for anterior restorations with composite materials
- Also referred to as clear transparent matrix strip
- Single use

(b) T-band matrix (straight and curved)

- Most commonly used in paedodontics (Childrens Teeth)
- Single use

(c) Stainless steel matrix band (universal)

- Used in conjunction with amalgam restorations and a matrix retainer
- Single use
- Different sizes and shapes available
- Available in pre-contoured shapes

I think that we will most likely be working with either option c (Especially since we are not working with childrens teeth. I will try to gather more information on these two types below.

Source Name: *Pocket Dentistry*

Source Link: <https://pocketdentistry.com/9-matrix-bands-and-matrix-retainers/#:~:text=When%20a%20restoration%20involves%20an,the%20matrix%20band%20in%20place.>

Wanted to put notes here quick on something I found about wedges:

- They are used to compress the matrix band against the tooth. This might be something to keep in mind especially if we are trying to fit more equipment in the same small gap

- Provides slight separation of the teeth (It says compensating for the size of the matrix band itself)

- Here is some information provided about ultra thin bands from Denovo
- They are .0015/.04 mm thick which is extremely thin.
- These are made of stainless steel and are 6.4 mm in height
- Come in prepackaged sizes however so they may not be as adjustable as other matrix bands
- Come w/ wedges, made of stainless steel.

Source Name: *Denovo Dental*

Source Link: <https://denovodental.com/wp-content/uploads/2015/11/Matrix-Band-Instructions1.pdf>

Conclusions/action items: I was able to find some good details on some really thin bands that could be useful. We need to double check this with our client to see how much clearance space we have and how thin our bands can be.



10/1/20 - Sectional Matrix Band with Clamp

LIAM GRANLUND - Oct 07, 2020, 10:14 AM CDT

Title: Sectional Matrix Band with Clamp

Date: 10/1/20

Content by: Liam Granlund

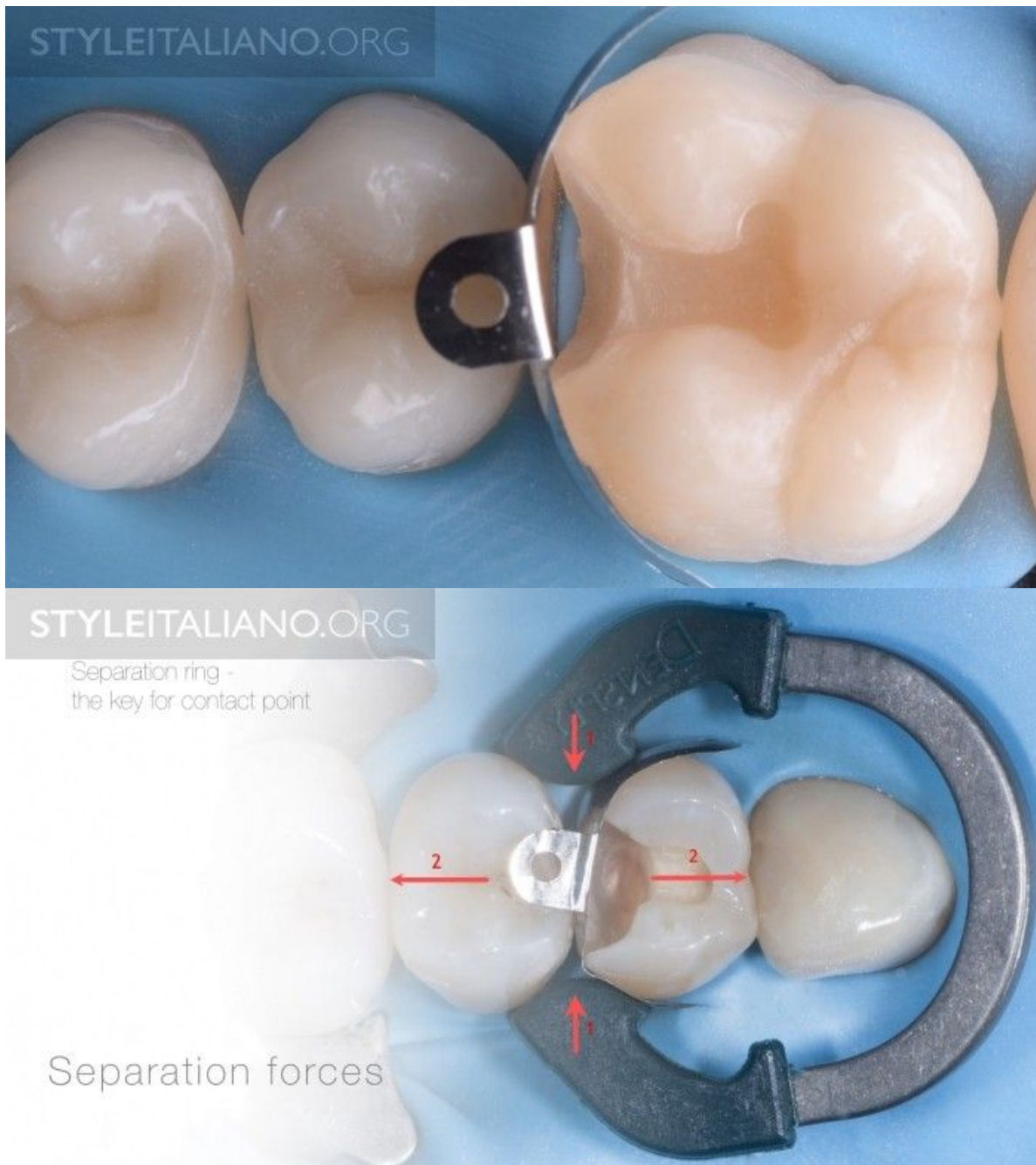
Present: Myself

Goals: Study one alternative to matrix bands, or a device that can be wrapped around multiple teeth

Content:

While I cant find any direct ideas that would solve the exact problem that we are looking for, I did find a sectional matrix device that could be used or warped to fit what we want to do.

- A sectional Matrix does not wrap around the entire tooth, but instead covers just a section of the tooth,
- Is often clamped or wedged in to put more contact on the teeth,
- If we were to change the design of a sectional matrix band we could directly make this usable for what we are doing. Double the sectional matrix in its design.



If we develop new matrix band it might be able to help us with this design, but this might be a harder route than affecting are methods of input. The link below helps describe this method of clamping.

Source Title: Style Italiano

Source Link: <https://www.styleitaliano.org/how-to-use-a-sectorial-matrix-in-order-to-achieve-a-functional-proximal-surface/>

Conclusions/action items: If our chosen design does not work this device might help us approach the problem from a different angle, adapting the matrix band instead of the input, or input and matrix band. Semi similar to our butterfly design.



11/27/20 - Clamps around teeth that don't use bands

LIAM GRANLUND - Dec 09, 2020, 12:56 PM CST

Title: Clamps around teeth that don't use bands

Date: 11/27/20

Content by: Liam Granlund

Present: Myself

Goals: Discuss a design that doesn't use matrix bands

Content:

I was able to find a video about clamps that are independent of both a dental retainer and the sectional matrix clamp. I'm pretty sure that these clamps aren't used for cavity filling, but this design could be used to create a design that would. If we modified a clamp like this to hold a band in the center, we could see it working for what we want.



I'll place both the links for the video I found and the website to buy the clamps here:

Video: https://www.youtube.com/watch?v=hQnyFX_ABX4&ab_channel=COLTENEDental

Link: <https://nam.coltene.com/products/treatment-auxiliaries/dental-dam-clamps/wingless-clamps/>

Conclusions/action items: If the designs we work on we find are too hard to fabricate, these clamps could be changed and edited as another option for the clamp.



10/24/20 - Possible Thoughts on a Double Band Redesign

LIAM GRANLUND - Dec 09, 2020, 12:32 PM CST

Title: Possible thoughts on a double band redesign

Date: 10/24/20

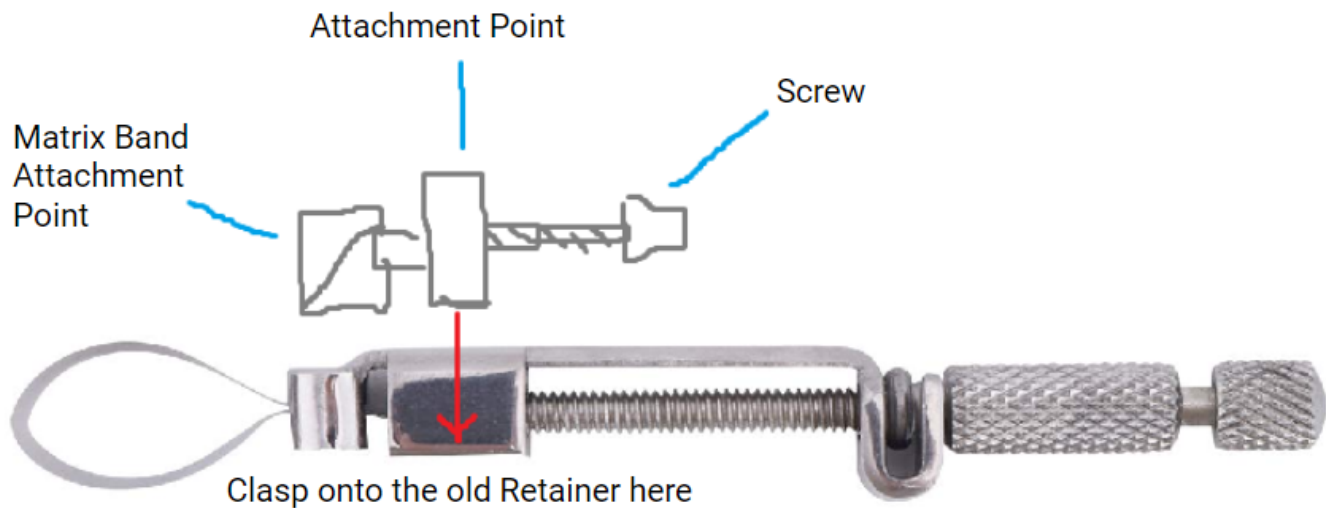
Content by: Liam Granlund

Present: Myself

Goals: Discuss some ideas about our final choice design

Content:

I just wanted to get some thoughts down on a possible design to be released as a product with the redesign. Right now, I think it might be best to modify the retainer to hold the bands, or modified bands. This can be done with a 3D printed attachment designed in solidworks. Ill draw a mock design of it and place it below.



Conclusions/action items: If we do move forward with the Double Hug design, this might be the best way to implement it without having to cut metal or buy a second retainer to use during the procedure. Using 2 retainers at the same time would be difficult, so this is an alternative to a double headed band.



LIAM GRANLUND - Jan 25, 2019, 4:29 PM CST

Course Dashboard | EMU Account Status - EMU - UW | Mail - lgranlund@wisc.edu | BME 201 - Google Drive | Green Shop Pass - Google Docs

https://emu.engr.wisc.edu/emu/users/milestone_tracker.php

You have applied for a Green Permit

Green Permit Application Process

You have **44 days** to complete before the 45 day deadline of: **02/24/2019**

Please review the **Green Permit** information on the **TEAM Lab** website.

Step 1	Apply for Green Permit	✓ Completed
Step 2	Take Green Quizzes	
Step 3	Register for Green Permit Seminar	
Step 4	Attend Green Permit Seminar	
Step 5	Create Green Permit Test Piece	

You may apply for the following upgrades:

Name

https://canvas.wisc.edu/courses/94677/quizzes/57571?module_item_id=980999

Fabrication Lab Training > Quizzes > Module 1 Assessment

Module 1 Assessment

Due No due date | Points 36 | Questions 36 | Time Limit 40 Minutes | Allowed Attempts 3

Take the Quiz Again

Attempt History

Attempt	Time	Score
LATEST Attempt 1	23 minutes	35 out of 36

Quiz results are protected for this quiz and can be viewed a single time immediately after submission.

⚠ Correct answers are hidden.

Score for this attempt: 35 out of 36

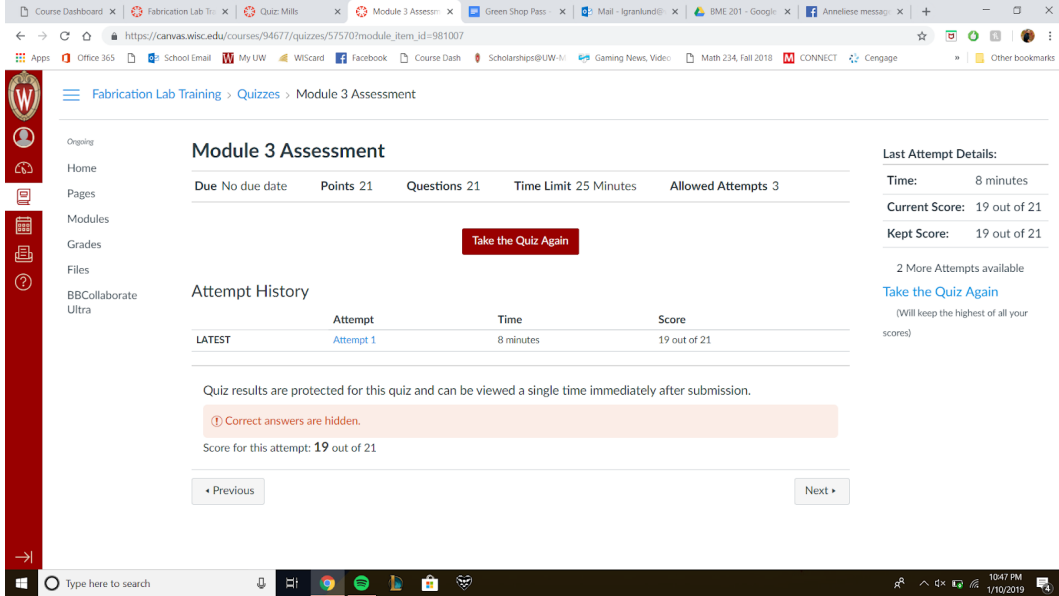
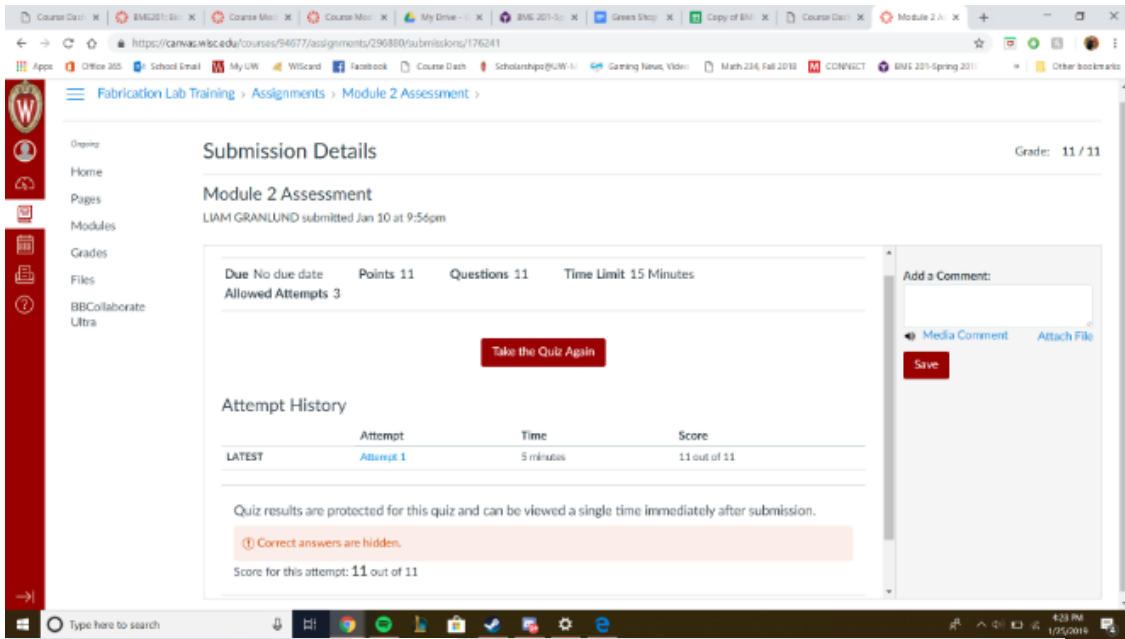
• Previous
Next •

Last Attempt Details:

Time: 23 minutes
 Current Score: 35 out of 36
 Kept Score: 35 out of 36

2 More Attempts available
[Take the Quiz Again](#)
 (Will keep the highest of all your scores)

Type here to search | 10:47 PM 1/10/2019



LIAM GRANLUND - Mar 08, 2019, 3:01 PM CST



Green_Pass.JPG(150.7 KB) - download



LIAM GRANLUND - Jan 30, 2018, 12:21 PM CST

Amazon.com: Mr. Robi... | Mail - lgranlund@wisc... | Course Dashboard | Inter Egr 170 Sp 2018 | InterEGR 170 - Google... | Liam Red Shop Pass... | Fabrication Lab Traini...

University of Wisconsin Moodle
Ongoing courses

Dashboard > Engineering > Professional Orientation > Fabrication Lab Training > Blue Permit Quizzes/Exam > Safety Quiz

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Welding 1
Welding 2
Ironworker 1
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Course administration

Safety Quiz

You need at least an 80% to pass this prequiz.
You have unlimited tries.
Grading method: Highest grade

Summary of your previous attempts

Attempt	State	Points / 12.00	Grade / 100.00	Review	Feedback
1	Finished Submitted Monday, January 29, 2018, 7:34 PM	11.25	93.75	Pass	

Highest grade: 93.75 / 100.00.
Overall feedback: Pass
Re-attempt quiz

Type here to search

Amazon.com: Mr. Robi... | Mail - lgranlund@wisc... | Course Dashboard | Inter Egr 170 Sp 2018 | InterEGR 170 - Google... | Liam Red Shop Pass... | Fabrication Lab Traini...

University of Wisconsin Moodle
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Dashboard > Engineering > Professional Orientation > Fabrication Lab Training > Blue Permit Quizzes/Exam > Hand Tools Quiz

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Hand Tools Quiz

You need at least an 80% to pass this prequiz.
You have unlimited tries.
Grading method: Highest grade

Summary of your previous attempts

Attempt	State	Points / 19.00	Grade / 100.00	Review	Feedback
1	Finished Submitted Monday, January 29, 2018, 8:50 PM	19.00	100.00	Pass	

Highest grade: 100.00 / 100.00.
Overall feedback: Pass
Re-attempt quiz

Type here to search

Amazon.com: Mr. Robi... | Mail - lgranlund@wisc... | Course Dashboard | Inter Egr 170 Sp 2018 | InterEGR 170 - Google... | Liam Red Shop Pass... | Fabrication Lab Traini... | Why are English...

University of Wisconsin Moodle
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Dashboard > Engineering > Professional Orientation > Fabrication Lab Training > Blue Permit Quizzes/Exam > Power Tools Quiz

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Green Permit Quizzes/Exams
CNC Mill 1
Welding 1
Welding 2
Ironworker 1
Kaltura Media Gallery
My courses

ADMINISTRATION
Course administration

Power Tools Quiz

You need at least an 80% to pass this prequiz.
You have unlimited tries.
Grading method: Highest grade

Summary of your previous attempts

Attempt	State	Points / 5.00	Grade / 100.00	Review	Feedback
1	Finished Submitted Monday, January 29, 2018, 9:35 PM	5.00	100.00	Pass	

Highest grade: 100.00 / 100.00.
Overall feedback: Pass
Re-attempt quiz

Type here to search

Amazon.com: Mr. ... Mail - lgranlund@... Course Dashboard ... Inter Egr 170 Sp 2 ... InterEGR 170 - G... Liam Red Shop P... Fabrication Lab Tr... Why are English ...

Secure | https://special.moodle.wisc.edu/mod/quiz/view.php?id=2290

University of Wisconsin Moodle

Choose a moodle site: Choose... Help Liam Granlund

Safety, Hand & Power Tools Exam

You need at least a 90% to pass this Exam.

Attempts allowed: 3
Time limit: 36 mins
Grading method: Highest grade

Summary of your previous attempts

Attempt	State	Points / 36.00	Grade / 100.00	Review	Feedback
1	Finished Submitted Monday, January 29, 2018, 10:04 PM	33.25	92.36		Congratulations, you passed! If you are working on a red or green permit, proceed to the remaining quizzes & exam(s). If you are working on the blue permit, you're done. After you log into EMU, you can pick up your permit at the shop.

Highest grade: 92.36 / 100.00.

Overall feedback

Congratulations, you passed!
If you are working on a red or green permit, proceed to the remaining quizzes & exam(s).
If you are working on the blue permit, you're done. After you log into EMU, you can pick up your permit at the shop.

Re-attempt quiz

Amazon.com: Mr. Robot... My Drive... Google Drive... Questions For Clients... My CAE Account

Secure | https://my.cae.wisc.edu/tools/account/

CAE Home College of Engineering UW Madison My UW

cae

Liam's CAE Account (Log out)

General Tools

- Find available computers
- CAE Forms
- Directory of Account Management Tools
- Contact CAE

Account Tools

- Account Info
 - Account Details
 - Groups
 - Login History
 - Linux Setup
 - Refresh Campus Sync
 - Building Access
- Email
- Printing
 - Tools/shooting
- Disk Space
 - File Manager
- Groupspace
- Web Tools
 - Personal Web Page
 - Web Logs
 - Repositories

Resources

- Microsoft Imagine

Welcome! This site contains a number of tools for managing your account. We've grouped them into the categories below to help you find what you need. Keep in mind that you can access each tool from the sidebar on the left.

Account Information

View information about your CAE account.

Printing

The Printing tool shows you a history of your printed documents.

Disk Space

The Disk Space tool allows you to:

- View your usage of disk space
- Configure your quota space for Unix and Windows
- Get a detailed analysis of the files in your Unix/Windows home directory

Personal Web Page

You can set up your personal homepage here.

University of Wisconsin Moodle

Ongoing courses

Choose a moodle site: Choose...

Help Liam Granlund

Dashboard > Engineering > Professional Orientation > Fabrication Lab Training > Red Permit Quizzes/Exam > Drill Presses Quiz

Drill Presses Quiz

You need at least an 80% to pass this proquiz.
You have unlimited tries.
Grading method: Highest grade

Summary of your previous attempts

Attempt	State	Points / 5.00	Grade / 100.00	Review	Feedback
1	Finished Submitted Monday, February 5, 2018, 7:26 PM	5.00	100.00		Pass

Highest grade: 100.00 / 100.00.

Overall feedback

Pass

Re-attempt quiz

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 - Safety, Hand & Power Tools Exam
 - Drill Presses Quiz**
 - Saws Quiz
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 - My courses

University of Wisconsin Moodle

Ongoing courses

Choose a moodle site: Choose...

Help Liam Granlund

Dashboard > Engineering > Professional Orientation > Fabrication Lab Training > Red Permit Quizzes/Exam > Saws Quiz

Saws Quiz

You need at least an 80% to pass this proquiz.
You have unlimited tries.
Grading method: Highest grade

Summary of your previous attempts

Attempt	State	Points / 5.00	Grade / 100.00	Review	Feedback
1	Finished Submitted Monday, February 5, 2018, 7:32 PM	5.00	100.00		Pass

Highest grade: 100.00 / 100.00.

Overall feedback

Pass

Re-attempt quiz

NAVIGATION

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 - Power Tools Quiz
 - Safety, Hand & Power Tools Exam
 - Drill Presses Quiz
 - Saws Quiz**
 - Drill Presses & Saws Exam
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 - Ironworker 1
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 - My courses

UNIVERSITY OF WISCONSIN Moodle

Choose a moodle site: Choose...

Help Liam Granlund

Dashboard > Engineering > Professional Orientation > Fabrication Lab Training > Red Permit Quizzes/Exam > Drill Presses & Saws Exam

Drill Presses & Saws Exam

You need at least a 90% to pass this Exam.

Attempts allowed: 3
Time limit: 11 mins
Grading method: Highest grade

Summary of your previous attempts

Attempt	State	Points / 11.00	Grade / 100.00	Review	Feedback
1	Finished Submitted Monday, February 5, 2016, 7:36 PM	10.00	90.91		Congratulations, you passed! If you are working on obtaining a red permit (including for InterEgr 160), you now need to register for a seminar. If you are working on the green permit, complete the remaining quizzes & exam.

Highest grade: 90.91 / 100.00.

Overall feedback

Congratulations, you passed!

If you are working on obtaining a red permit (including for InterEgr 160), you now need to register for a seminar. If you are working on the green permit, complete the remaining quizzes & exam.

Re-attempt quiz

UNIVERSITY OF WISCONSIN-MADISON COLLEGE OF ENGINEERING

WJ Search | MyUW | Map | Calendar | Log out

EMU

Welcome, Liam Granlund
You are logged in to the EMU Reservation System

TEAM Lab My Status

Materials Fee is paid through 2018-06-30.

You are registered for the following seminar(s):

Seminar Name	Date - Time - Duration	Location	Instructor	Cancel Registration
Red Permit Seminar	Tue 02/13 - 11:00 AM - 2:00 hr(s)	TEAM Lab	Paul Kijak	Cancel

You have applied for a Red Permit

Red Permit Application Process

Apply → Take Quizzes → Attend Seminar → Get Permit

1 to 2 weeks

Red Permit

- Check out Tools
- Drill presses
- Band Saws
- Make Purchases



3/22/2019 Biosafety Required Training Quiz Biosafety Required Training

Biosafety Required Training Quiz

Due No due date **Points** 25 **Questions** 25 **Time Limit** None
Allowed Attempts Unlimited

Instructions

You must complete the quiz with a passing score of 18 out of 25 questions correct (70%)
 You may take the quiz more than once in order to achieve a passing score.
[After you submit the quiz and have a passing score, click here to finish the course.](https://canvas.utias.edu/courses/34274/pages/thank_you)
https://canvas.utias.edu/courses/34274/pages/thank_you

[Take the Quiz Again](#)

Attempt History

	Attempt	Time	Score
LATEST	Attempt 1	160 minutes	25 out of 25

🔒 Correct answers are hidden.

Score for this attempt: 25 out of 25
 Submitted Mar 24 at 7:42pm
 This attempt took 160 minutes.

Question 1 1 / 1 pts

Biosafety risk assessment takes into consideration the biological agent, the environment and the host.

True

False

https://canvas.utias.edu/courses/34274/pages/3798 1/2

Biosafety_Required_Training_Quiz_Biosafety_Required_Training_1_.pdf(397.3 KB) - download



2014/11/03-Entry guidelines

John Puccinelli - Sep 05, 2016, 1:18 PM CDT

Use this as a guide for every entry

- Every text entry of your notebook should have the **bold titles** below.
- Every page/entry should be **named starting with the date** of the entry's first creation/activity, subsequent material from future dates can be added later.

You can create a copy of the blank template by first opening the desired folder, clicking on "New", selecting "Copy Existing Page...", and then select "2014/11/03-Template")

Title: Descriptive title (i.e. Client Meeting)

Date: 9/5/2016

Content by: The one person who wrote the content

Present: Names of those present if more than just you (not necessary for individual work)

Goals: Establish clear goals for all text entries (meetings, individual work, etc.).

Content:

Contains clear and organized notes (also includes any references used)

Conclusions/action items:

Recap only the most significant findings and/or action items resulting from the entry.



Title:

Date:

Content by:

Present:

Goals:

Content:

Conclusions/action items: