Design Matrix

Approximating Surface Matrix Band for Dentists

Client: Dr. Donald Tipple

Advisor: Dr. Tracy Puccinelli

Team Matrix Band

Tara Boroumand - Team Leader
Grace Johnson - Communicator
Matthew Fang - BSAC
Draeson Marcoux - BWIG
Trevor Silber - BPAG

September 30, 2021

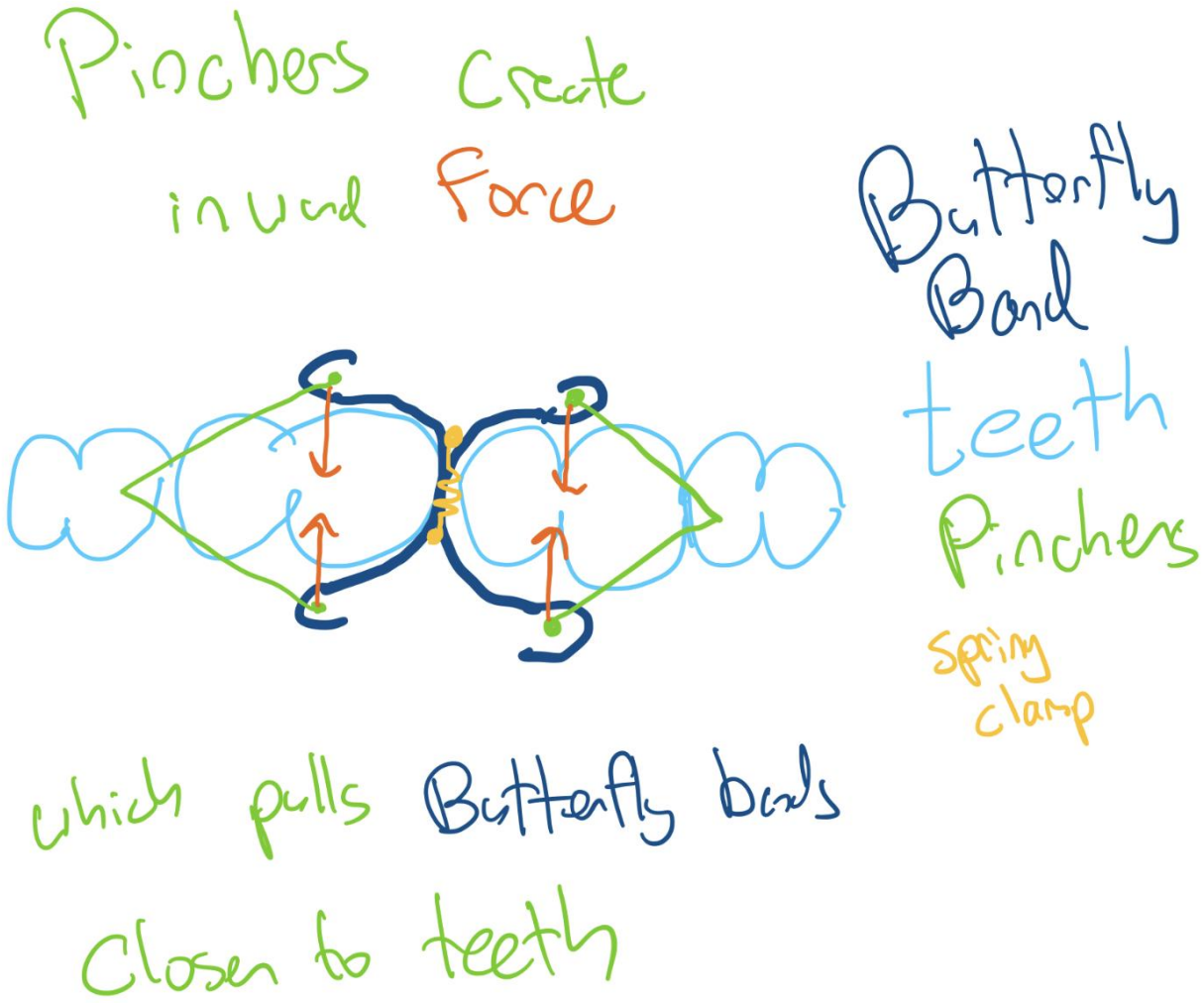
Dental Matrix Band Design Matrix						
Design Criteria (Weight)	Design 1 (Handcuff)		Design 2 (Butterfly)		Design 3 (Butterfly + U pinchers)	
Functionality (30)	3/5	18	2/5	12	5/5	30
Ease of Use (20)	2/5	8	4/5	16	4/5	16
Fabrication (15)	4/5	12	3/5	9	3/5	9
Ease of Sterilization (15)	3/5	9	3/5	9	3/5	9
Safety (10)	4/5	8	5/5	10	5/5	10
Cost (10)	4/5	8	3/5	6	2/5	4
Total (100)	63		62		**78**	

**The six design criteria on the far-most left column were evaluated for each preliminary design. Each design was given a number score out of 5 for each category. Finally, each design's ratings were totalled to determine which design was best (described under each design section below). Shaded sections indicate the highest ranking design for each criteria. The lighter shading indicates ties between designs.

Figure 1: Handcuff Design - The handcuff design is made to be used as a circumferential matrix band that can be used to surround two adjacent teeth. The design consists of a single band of fairly thin width (probably 10 thou or less) with slot fittings on either end that match or are slightly bigger than said width. The idea is that the band would wrap around the two targeted teeth laterally and come together medially at the gap between the two. The band should be thin enough to wedge both through the gap. Once the bands are pulled tight, one pair of the slot fittings (one from each side of the band) would slide over the middle of the band, completing the loops around the teeth and locking the band securely in place. There would be many different slot fittings to account for the variable size of the teeth being worked on. The band would need to be made of a dead soft metal in order to ensure its form-fitting properties. The band would also likely be one time use before needing to dispose of it. The band would have to be used in tandem with a wedge in order to provide more support in driving matrix bands against the wall of the tooth. The design is simple and would be easy to fabricate but it does not have as much adjustability as other models and also is not the strongest at keeping the matrix band tight around the teeth.

Figure 2: Butterfly Design - The “Butterfly” design is a single matrix band that peels at both ends. The peel at both ends would allow this design to wrap around the tooth. The middle would be fully stuck together with the thickness of a standard matrix band used today (around .0015 inches) to ensure proper tooth contact. The ends would have a thickness of two bands, but a thickness of one band after being peeled apart. A wedge would be placed once the band was in to further the separation during the procedure and prevent gingival overhang. This design would be created from dead, soft metal, likely stainless steel.

Figure 3: Butterfly + U Pinchers - This design is similar to the “Butterfly” design in its shape, but it involves metal “pinchers”, or triangular shaped bars. These components function in giving the dentist a piece to hold onto while placing the matrix bands in the patient’s mouth without the need for a tool. They additionally function in creating an inward force that pulls the matrix bands close to the teeth for maximizing surface contact. The design also incorporates an innovative spring clamp to hold the matrix bands in place and widen the gap between approximating teeth during filling. Like the other two designs, this design would be created out of a dead, soft metal, with the portion of the band that contacts both teeth being half the width of the rest of the band. The design would most likely be single-use and although it incorporates a few parts, it should be fairly simple to fabricate given adequate tools.



Functionality: The functionality criteria was based on the design’s ability to allow the dentist to complete the procedure with both quality and time efficiency. The “Butterfly” design received the lowest score in this category (%) due to its lack of adjustability and tightness. The band needs to securely fit around the tooth in order for a quality tooth contact, however, with the “Butterfly” design, some variation in tooth sizes amongst different patients would result in different results.

For example, the greater thickness in the middle of the band may need to be longer for some patients than others. The “Butterfly + U Pinchers” design received the highest score in this category (5/5). This design has pinchers which maintain a close fit between the teeth and matrix across the entire section. This inward force allows the design to be used across varying shapes and sizes of teeth. The spring clamp also improves the design by widening the gap between the teeth if needed. The “Handcuff” design received a score of 3/5 because it may have factors that contribute to increased procedural time. It is a circumferential design, rather than a sectional one, that would require steady placement of the band in its slot fillings. This may be both a frustrating and time consuming task.

Ease of Use: This design criteria outlined how easy the dental matrix band design would be for dentists to place in between teeth and remove from the mouth. It also took into consideration any view obstruction the dentist would encounter from the shape of the design. The “Handcuff” design scored the lowest (⅖) in this area due to it requiring a tedious placement procedure and therefore tedious removal. Both the “Butterfly” and “Butterfly + U pinchers” designs tied for the higher scores of (⅘). Neither design received a perfect rating due to the “Butterfly” design’s slightly more time consuming placement and the “Butterfly + U pinchers” design’s possible view obstruction.

Fabrication: This criteria was graded on how easily the design could be fabricated based on the intricacy of parts as well as characteristics and availability of materials. While it is important to ensure that the design is viable to actually manufacture, and do so on a scale that would allow for the device to be single-use, the function does not require intricacy and there is significant literature available on viable materials. Therefore, this section was given a relatively low weight of 15/100. The “Handcuff” design scored the highest on this criteria (⅘) as it only requires simple modifications to the matrix bands currently used, and the same, single material. Both the “Butterfly” and “Butterfly + U Pinchers” scored lower at (⅗) because of the thin, split, and curved metal structures that must be custom manufactured and accurate on a very small scale.

Ease of Sterilization: All of the designs have the same score for sterilization. This is due to the fact that all are made from the same material and all would react the same to sterilization processes. While all designs are meant to be one time use, they could be sterilized based on the material used and durability of the material.

Safety: Each design ranked very similarly in safety as all designs have little chance of harming the patient during a filling procedure. Also any materials that could be toxic to a patient could be subbed out easily in all designs. However, the handcuff design ranked slightly worse in safety due to a higher chance of the band slipping off or coming undone.

Cost: The cost criteria was scored based on type, and amount of material required, and associated fabrication costs. This section was given a weight of 10/100 as there likely won't be much variability and early cost estimates are not a primary concern. The “Handcuff” design ranked highest in this section (⅘) as it is a modification of the most common current matrix bands which are inexpensive. The “Butterfly” design was given a ⅗ as the fabrication process is more involved. The “Butterfly + U Pinchers” design was given a ⅖ as both the fabrication process is more difficult and more material is required.