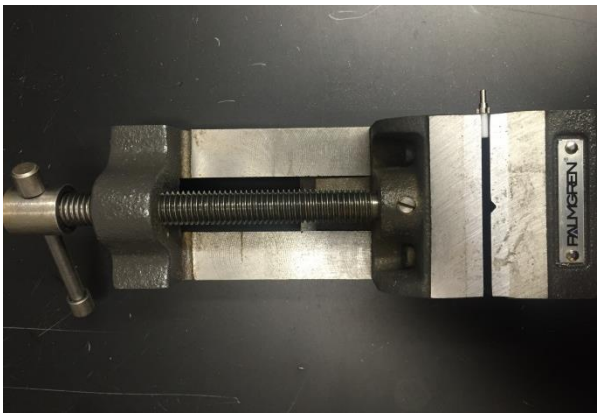
**Protocol:** Ferrule Assembly
McDannald Lab

**Materials:**

- Canned Air
- Dremel with Circle Top
- Epoxy 353ND Kit, Parts A and B
- Ferrule
- Heat Gun
- Hemostat
- Insect Pin
- Ceramic Sleeve
- Scribe
- Metal Vice
- Micro-Strip
- Optical Fiber
- PFP Polishing Films
- Light Meter
- Metal Ruler
- Helping Hands
- Safety Glasses

## Part I: Cut Ferrule

1. Wear safety glasses and cover work area with Versi-Dry sheet.
2. Secure white portion of ferrule in the metal vice as shown in the figure. Position the metal vice so that the knob faces away from you.
3. Set the dremel to the "low" setting. Slowly run the edge of the blade perpendicularly along the silver potion where the larger diameter region meets the thinner cylinder. Once this piece is removed the ferrule should look like the one shown in the figure below.
    - ✓ Be careful when sawing off the smaller metal piece. Move slowly, as the piece tends to go flying in random directions.
4. Use an insect pin and canned air to clean out the inside of the ferrule.
5. Examine the inside of the ferrule underneath the microscope to ensure no metal remains and you can see through to the other side.




## Part II: Cut Fiber

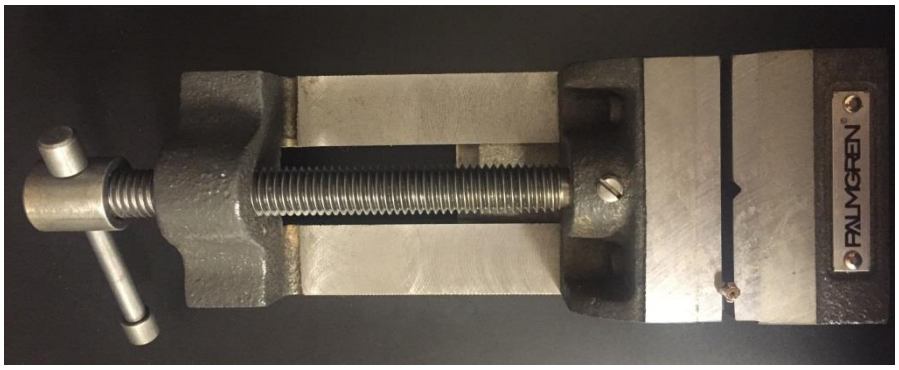
1. Lay out the white mat. Perform all cutting on the mat.
2. It is best to measure and strip fiber while it is still around the spool. The spool is able to hold the fiber and give you some resistance to strip the fiber. The most efficient way to make ferrules is to strip and cut fiber for one ferrule at a time.
    - ✓ Note: You can do repeat this multiple times until you have enough pieces of fiber for the number of ferrules you are making.
3. Measure **30 mm** of fiber. This will be enough for even the longest ferrule we make. Insert the fiber into the stripping tool to the number 30 and strip the cladding off.

- ✓ Clean the stripping tool with canned air and remove any cladding before stripping a new piece of fiber

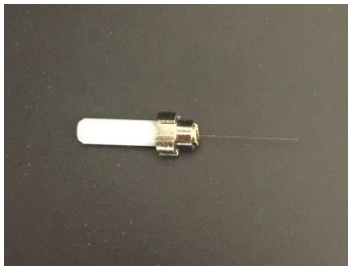
4. Run your fingers gently along the bare fiber to remove any leftover cladding.
5. Once stripped, use the scribe tool to cut off the bare fiber from the rest of the fiber spool.
    - ✓ To cut: First score the fiber by lightly sliding the scribe blade perpendicularly across the fiber one time with even pressure. After a small notch has been made use your fingers to gently bend the fiber until it snaps. Make the cut at clean as possible!
6. Examine both sides of the fiber underneath the microscope. The cleaner, less jagged end will be the end that is inserted into the brain. The more jagged end will be inserted into the ferrule and polished at the end of assembly.

**Part III: Fiber and Ferrule Assembly**

1. Wearing gloves, make the epoxy solution by weighting 1.0 gram Part A solution in a small weigh dish. Zero the scale and add 0.1 g of Part B solution. Use two different plastic pipettes to transfer the solutions to the weigh dish.
2. Thoroughly mix the two solutions using an insect pin.
3. Place the ferrule in the metal vice with the silver part facing up and the white part clamped.




4. Gather a small amount of epoxy on an insect pin and carefully drop the epoxy into the ferrule hole. Do not let extra epoxy gather around the hole.
5. Insert the fiber, jagged end first, into the ferrule until the desired length for the specific brain area protrudes above the metal collar and about 1-3 mm comes out of the convex end. To measure the fiber above the flat end, line the rule up next to the fiber and measure from the top of the metal collar to the top of the fiber.
    - <u>Brain Region:</u>
        - PAG: 8 mm
        - DRN: 10 mm
        - RRF: 9.5 mm
6. Turn the heat gun on high and position it directly above the ferrule. Heat the ferrule until the epoxy turns a dark red/brown color, about 30 seconds. Let cool.
7. Carefully remove the ferrule and cut the extra fiber off from the ceramic portion of the ferrule using the same technique as earlier.

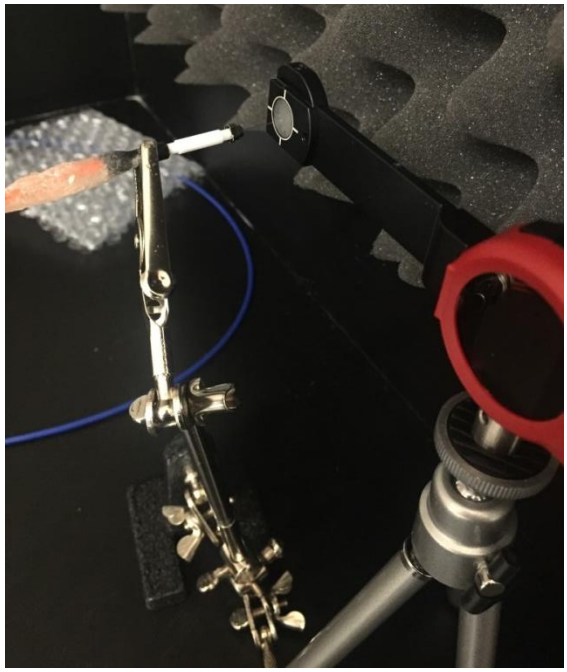


## Part IV: Polishing

1. Watch the video for proper polishing technique: Polishing Video
2. Select the 70 durometer rubber mat and place it on top of the glass polishing plate.
3. Next, gather your polishing films. You will polish the ferrule from coarsest to finest films:
   - 12 µm (yellow)
   - 3 µm (pink)
   - 0.3 µm (white)
   - 0.05 µm (yellowish white)
4. Secure the upper white part of the ferrule, just below the silver region, in the hemostat.
5. Place the first film on the rubber mat and applying light, even pressure, slowly create circles on the top of the film.
6. Repeat with each polishing film and clean the ceramic portion with an alcohol wipe when done.
   - ✓ Note: Polish on only one piece of paper at a time.

## Part V: Testing

1. Laser safety glasses must be worn during this procedure and the laser sign must be placed on the door!
2. Turn the power source of the laser on and insert the laser key to "off."
   - ✓ This can be done before assembly to ensure the laser is warmed up.
3. Using a ceramic sleeve, connect the ferrule to the laser cord. The sleeve should be equally on the cable and the ferrule.
4. Place laser cord in arm clamp holder and position it about 1 mm away from the center of the laser detector so that the ferrule fiber is pointed directly at the center of the optic reader.
5. Turn the laser light on by turning the key to "on."
6. Observe the mW value. Adjust the knob on the laser until the value reads about 25 mW.
7. Lock the knob at this laser output value. Turn the key so the laser is in the OFF mode.
8. Remove the ferrule and ceramic sleeve from the laser cord.



9. Move the laser to about 1 mm away from the center of the optic reader. Turn the laser back on. Observe the mW value on the iPad. This value should be between the range of 25-50 mW, with lower values strongly preferred.
10. If the value is in the high thirties or forties, select the thinnest film, place it on the glass plate and the rubber and repolish the bottom of the ferrule by circling it 20 times.
11. Repeat the testing procedure above to measure the light output.
12. Once the output is in the range of 30-40 mW, wrap ferrule in a kimwipe and place in ferrule holder.
13. Label the ferrule box with the ferrule length, your initials, and the number corresponding to the mW of light needed out of the cable to get 25 mW out of the implant.