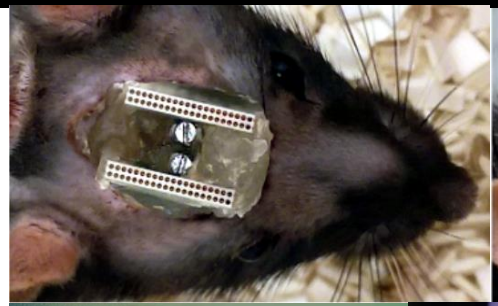
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Chronic Implant Surgery Protocol

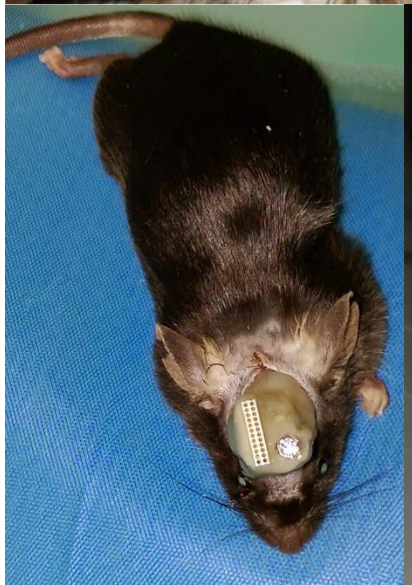
Chronic implants – How to….

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- In this protocol you will learn how to use the nano-Drives and probes to form low-profile compact implants
- A single probe + nano-Drive implant can be completed in < 2hrs
- The method can be easily adapted to implant multiple targets
- For OPTRODE implants please see the highlighted “OPTO” specific steps









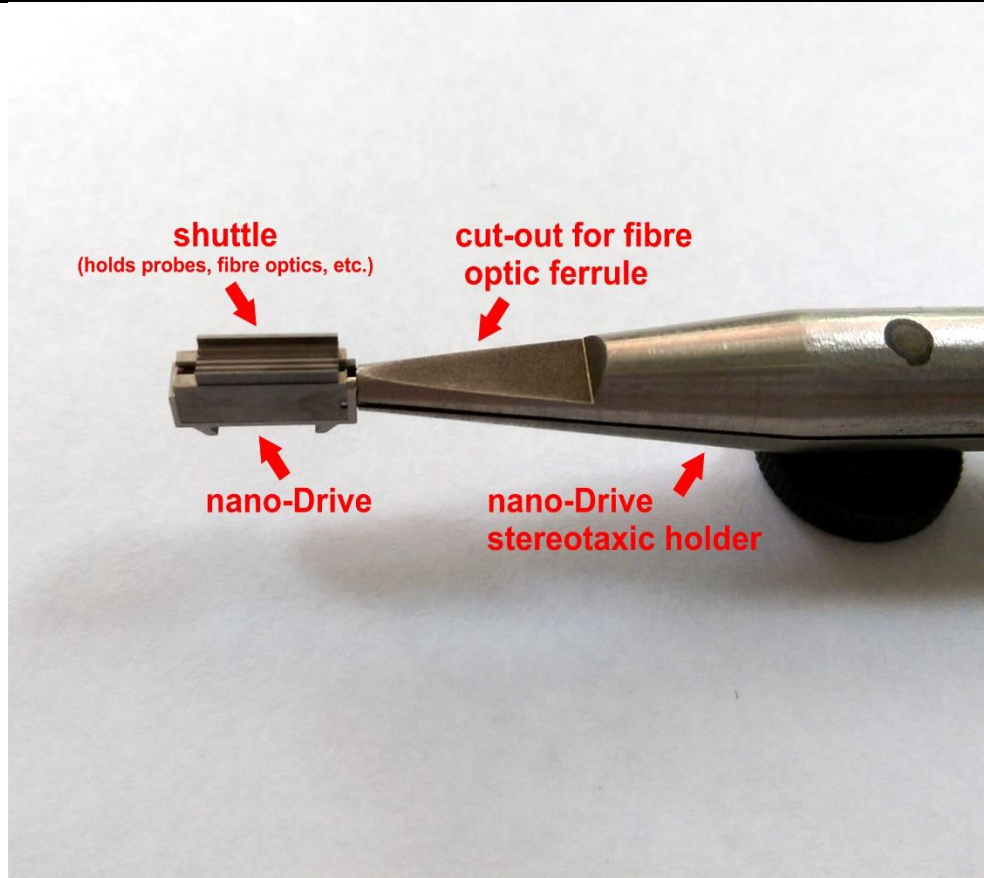
Surgery Protocol – Step 1a [see also Step 1b – OPTO]

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a) Place a nano-Drive into the stereotaxic holder by inserting the drive screw in to the gripper

b) Ensure correct and straight alignment of shuttle surface with respect to the cut-out on the stereotaxic holder

c) Tighten the thumb-wheel to grip the drive securely



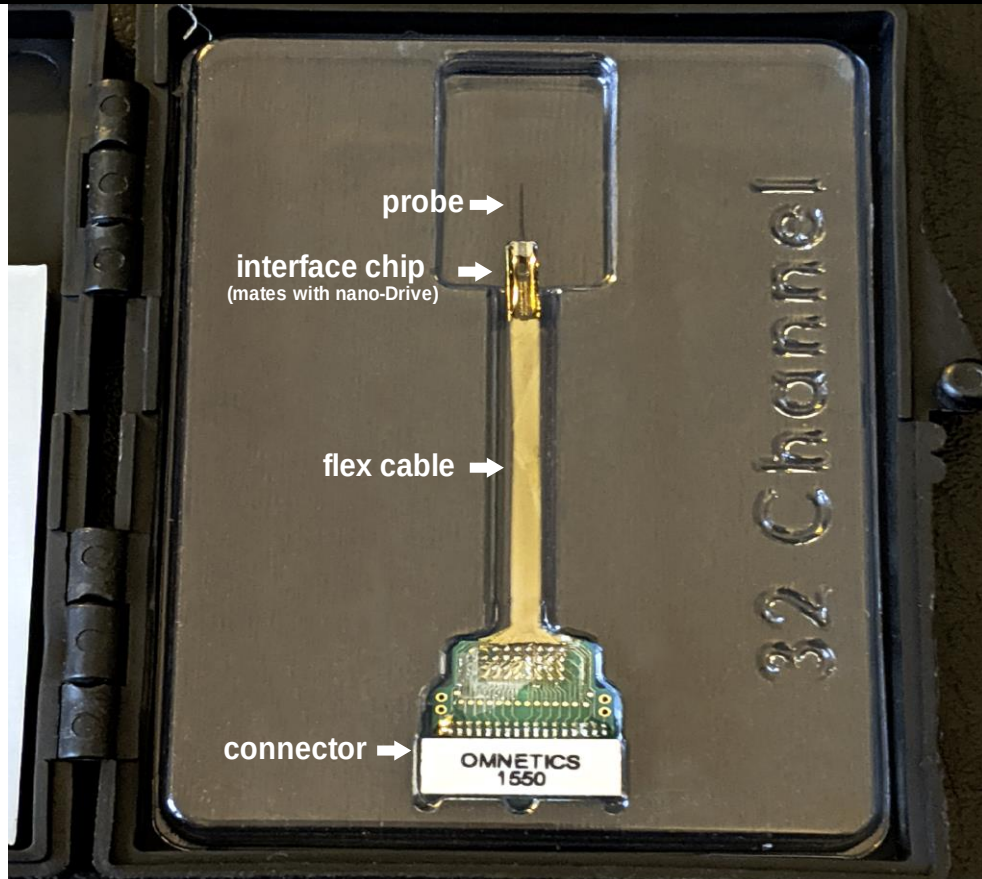
Surgery Protocol – Step 2a [see also Step 2b – OPTO]

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a) Carefully open the shipping tray containing the probe, ensuring you correctly orient the tray upwards before opening

b) Gently prize the connector free from its secure housing and carefully remove protective adhesive tape covering the interface chip

c) Hold the probe by the connector and flip the tray upside down to allow the probe to fall free from the tray



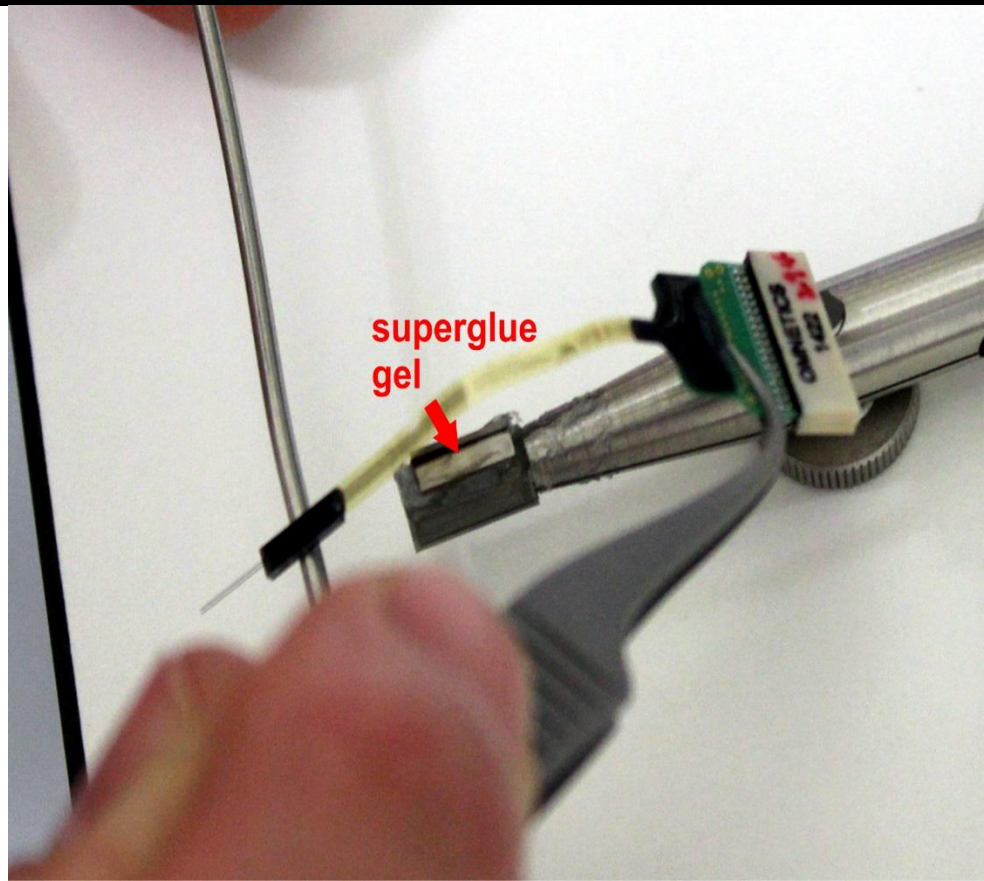
Surgery Protocol – Step 3

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a) Apply a small amount of superglue gel to the nano-Drive shuttle surface

b) Carefully drag the ‘interface chip’ of the probe in to position on the shuttle

c) Gently nudge the ‘interface chip’ in to alignment with the shuttle

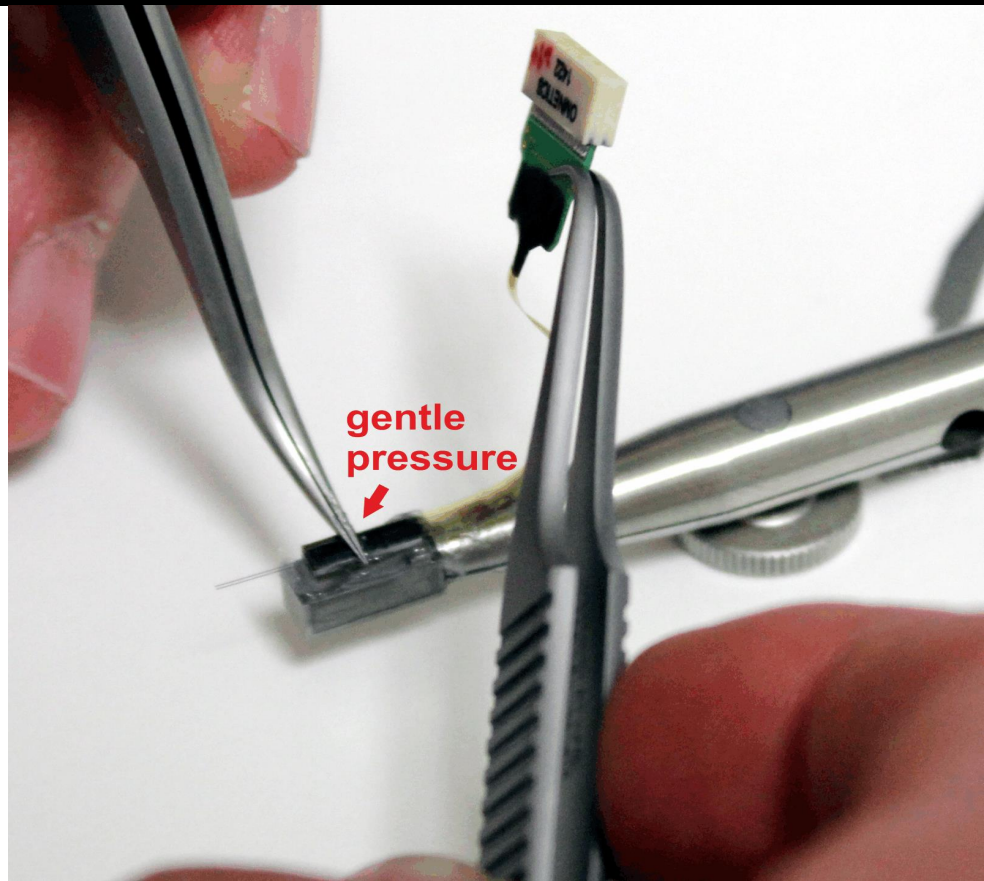


Surgery Protocol – Step 4a [see also Step 4b – OPTO]

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a) To bond the probe to the nano-Drive shuttle, apply gentle downward pressure to the probe ‘interface chip’

b) Take care to support the connector during this step



Surgery Protocol – Step 5a [see also Step 5b – OPTO]

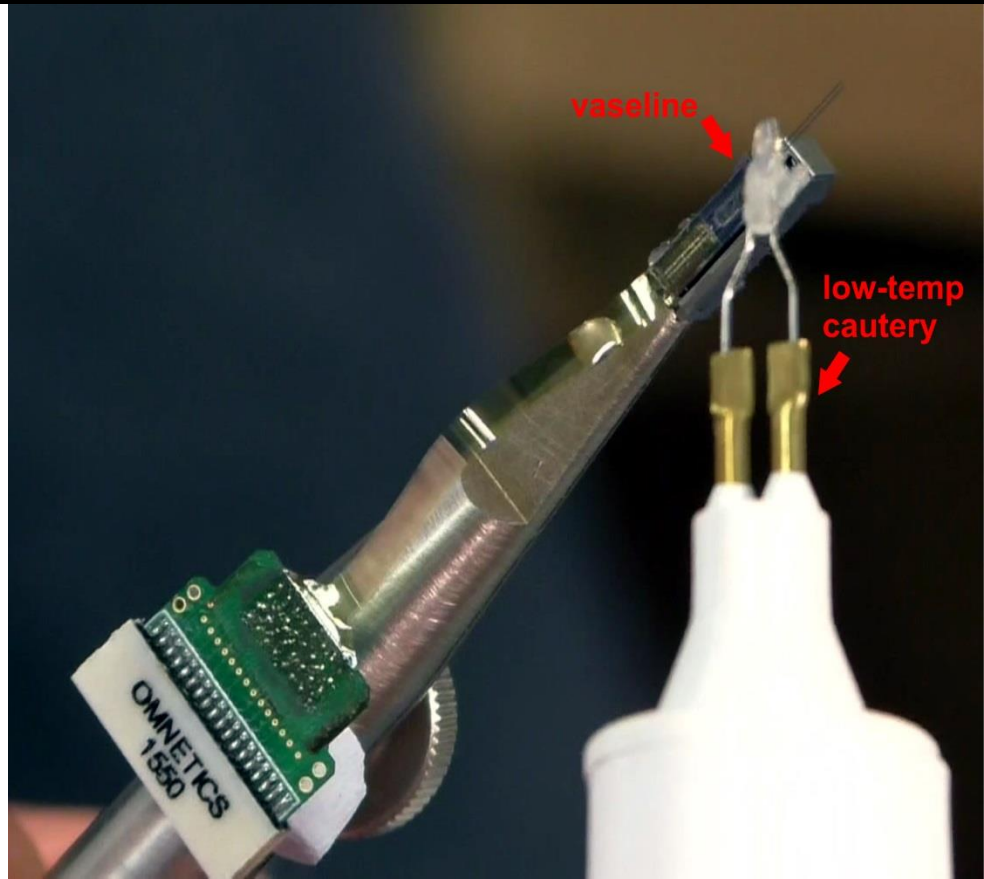
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a) Secure the probe connector to the stereotaxic holder by means of tape or adhesive putty

b) Apply a **thin** film of Vaseline to any surface of the assembly that is required to be moveable, once implanted

c) Apply a thin-film of vaseline to the to the stereotaxic holder tool (this will prevent cement sticking to it – see later)

d) Remove any excess Vaseline once cooled



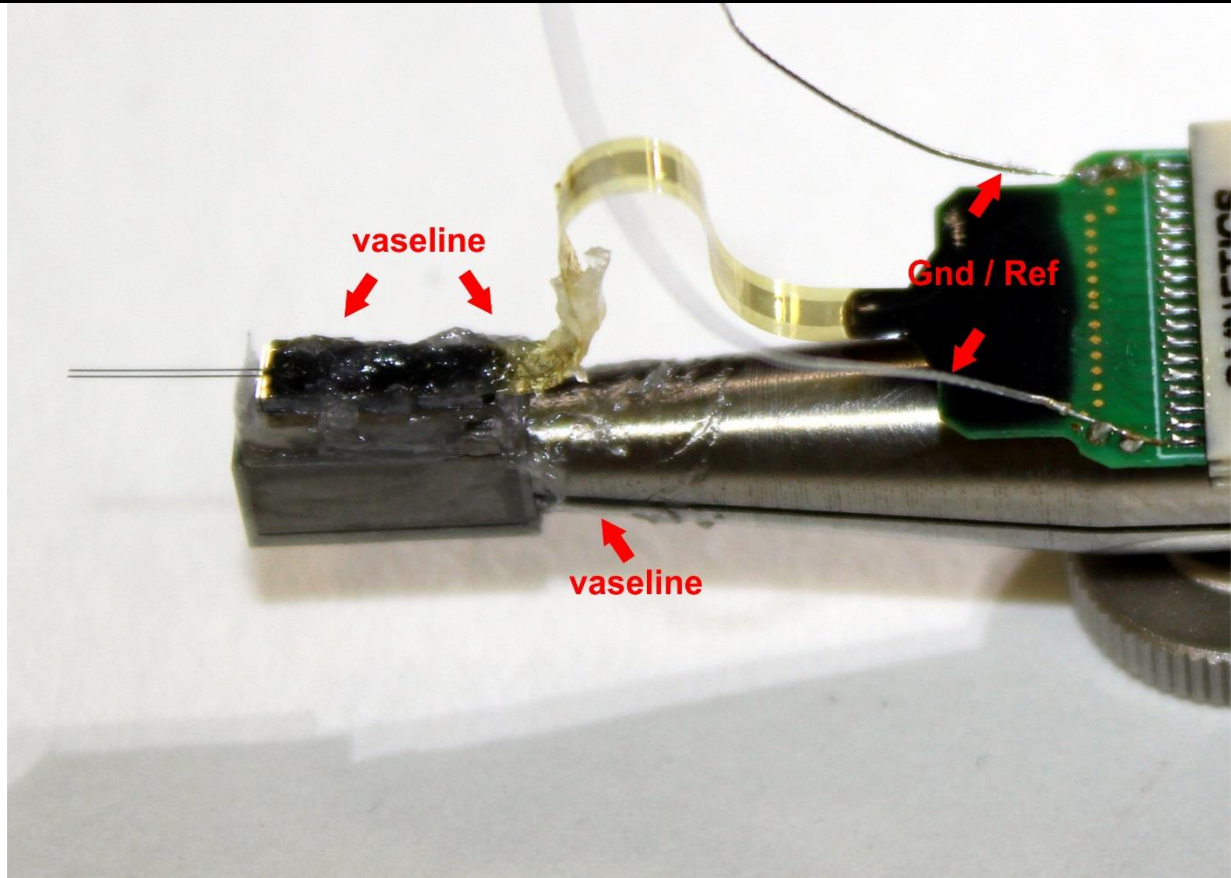
Surgery Protocol – Step 6

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a) This probe and drive are now ready to implant…

b) Immediately prior to implantation, clean the probe shanks by rinsing with 70% ethanol followed by sterile saline

c) Carefully insert the free end of the stereotaxic holder in to your frame



Surgery Protocol – Step 7

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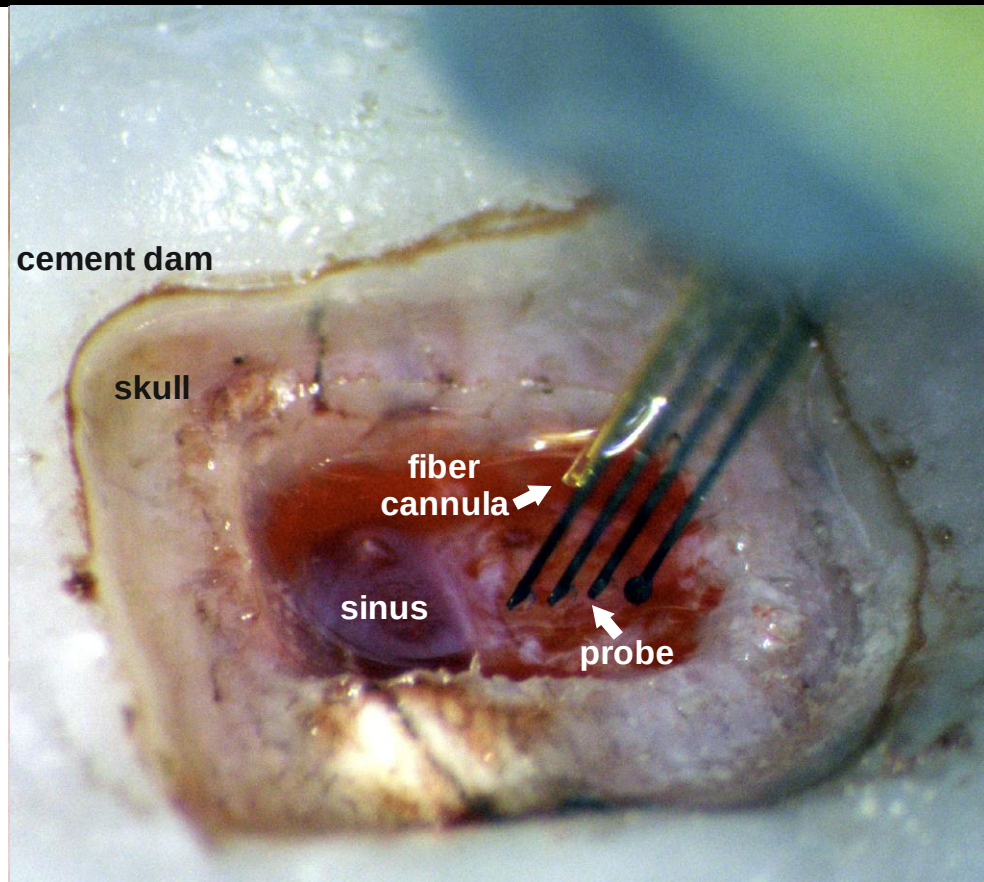
a) Make a small craniotomy

TIP - Create a cement dam around the edge of the craniotomoy – this will contain the dura-gel silicone compound any stray Vaseline in later steps

b) Make a durotomy just big enough to permit insertion of the probe / optrode; or make a chemical durotomy using collagenase

TIP – Our sharpened-tip probes can penetrate rodent dura

c) Insert the probe in to the brain to rest a short distance above your intended target – see next TIP if your target is superficial



Surgery Protocol – Step 8

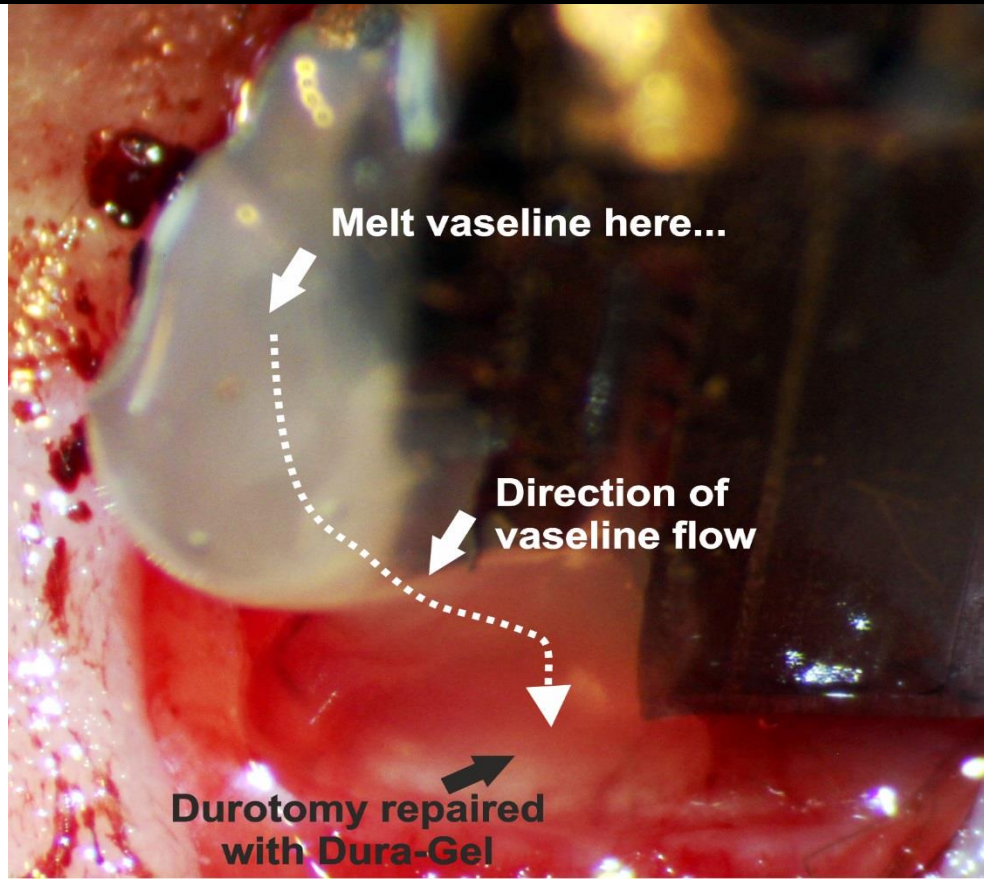
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a) Repair the durotomy using Dura-Gel, mix the component parts 1:1 ratio immediately before use; allow 10 minutes to cure

TIP – if your target is superficial, allow Dura-Gel to fully cure (30 mins) before inserting your probe to rest at brain-surface (see Appendix for schematics)

b) Apply Vaseline to the nano-Drive shuttle, using the low temperature cautery

c) Gently melt the Vaseline to aid in downward flow to underfill the nano-Drive shuttle



For dural repair – see Jackson, N., & Muthuswamy, J. (2008). Artificial dural sealant that allows multiple penetrations of implantable brain probes. *Journal of Neuroscience Methods*, *171*(1), 147–152. http://doi.org/10.1016/j.jneumeth.2008.02.018

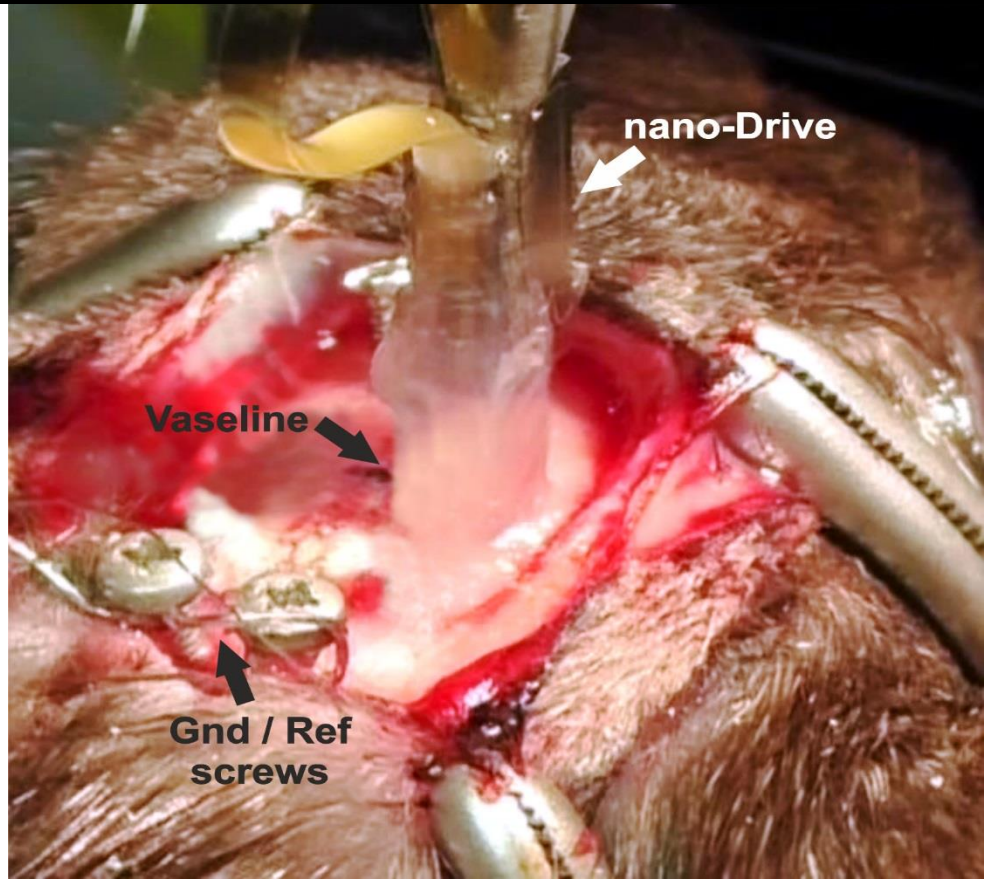
Surgery Protocol – Step 9

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a) Continue the process of melting Vaseline to form a column which surrounds the probe and drive shuttle

b) Carefully remove any excess Vaseline

TIP – create a small cement dam around the edge of the craniotomy (see earlier) to contain any stray Vaseline.



Surgery Protocol – Step 10a [see also Step 10b, 13-14 – OPTO]

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a) Apply a small amount of cement to the back and sides of the nano-Drive to bond to the skull surface

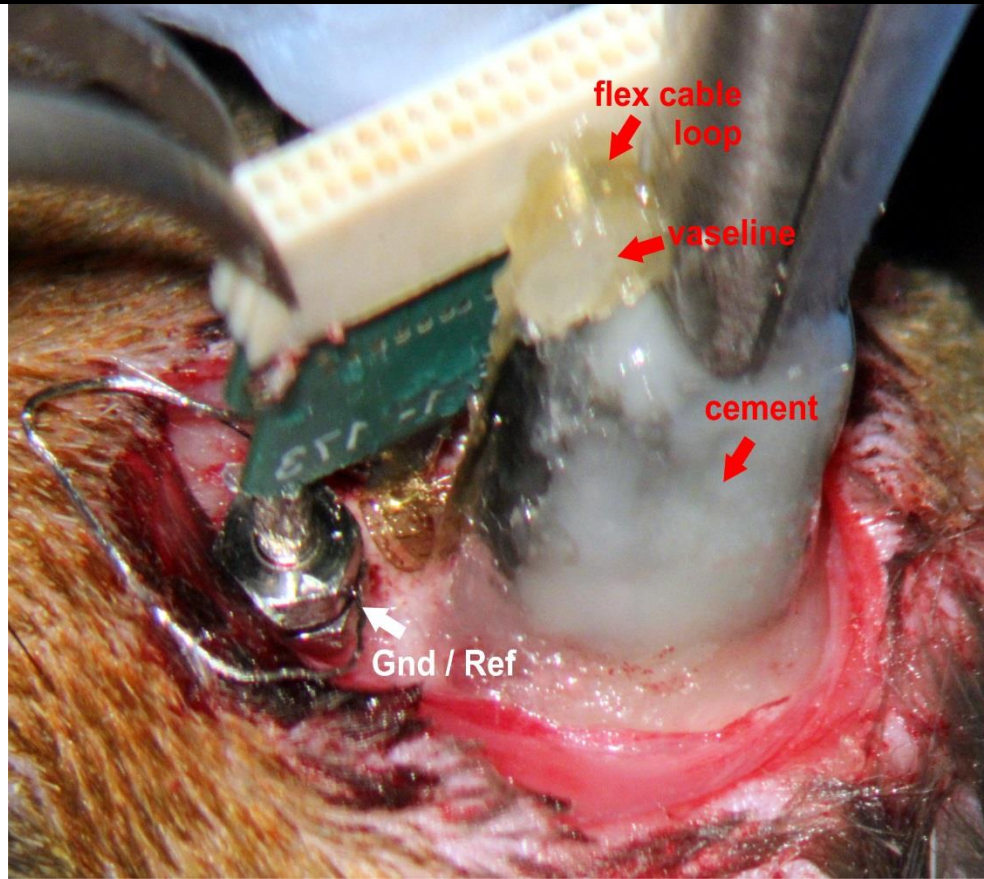
b) Release the probe connector and position such that the flex cable forms an S-bend (take care not to crimp the flex) – tack the connector in place with a small amount of cement

c) Melt Vaseline to cover the flex cable surfaces and to fill the 'eye' of the loop formed in the flex cable

d) Attach your Gnd / Ref wires to a nearby skull screw

TIP – pre-apply the vaseline to the flex cable during the probe mounting step – the surface tension helps to 'stick' the cable in to and S-bend position

TIP – leave the 'interface chip' accessible so you can neatly fold away excess flex cable

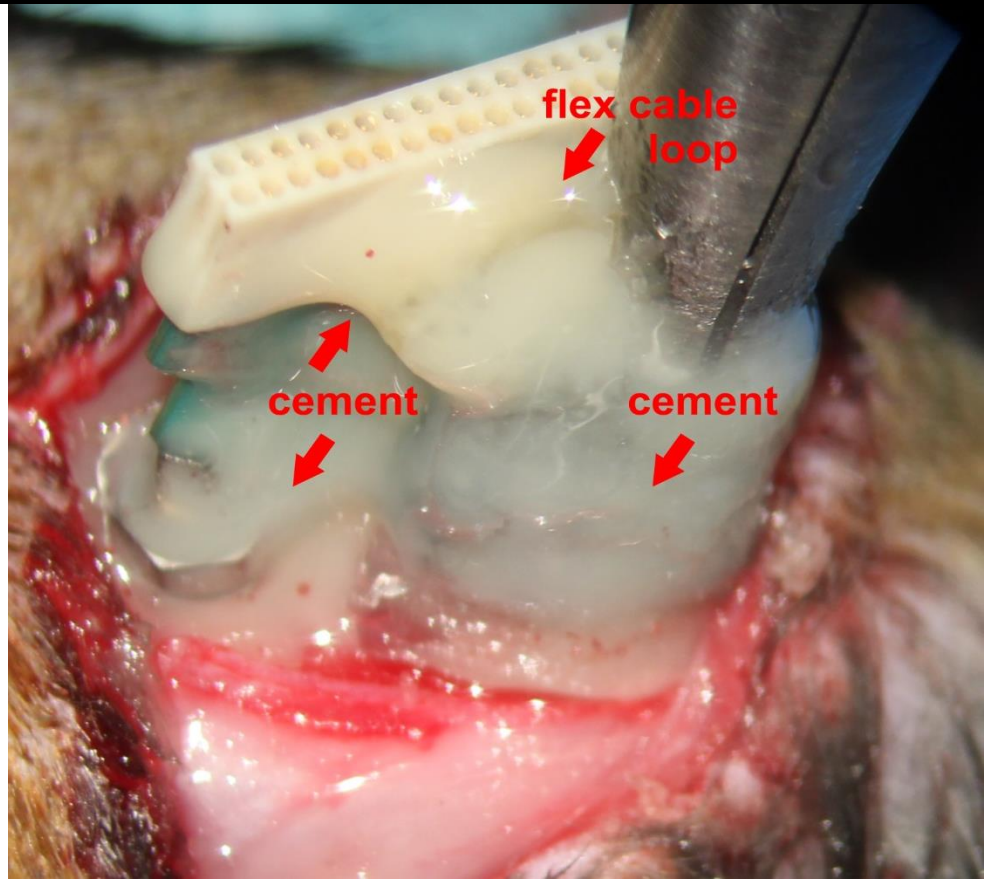


Surgery Protocol – Step 11

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a) Position the probe connector accordingly and apply cement to cover the flex cable and secure the connector; fully surround the nano-Drive and connector printed circuit board

b) Apply cement around the shoulders of the nano-Drive and up the outer surface of the stereotaxic tool



Surgery Protocol – Step 12

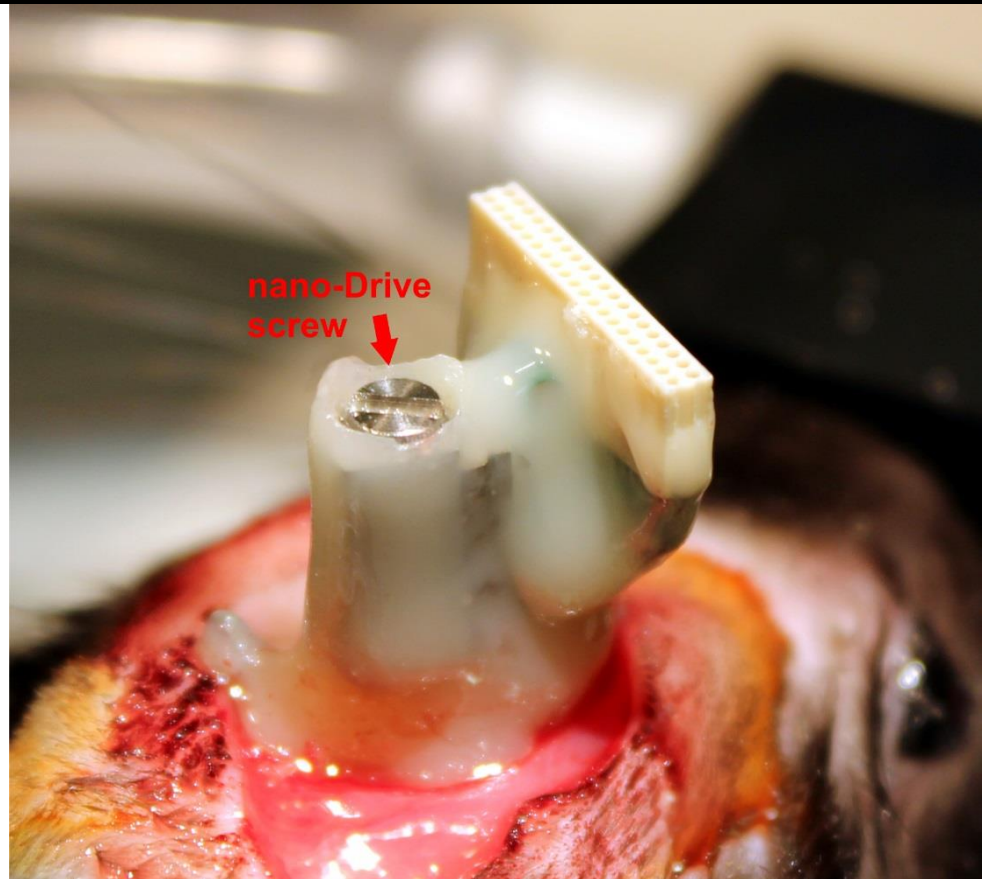
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a) Release the tension on the stereotaxic holder and carefully retract to reveal the nano-Drive screw head (the vaseline you applied to the holder earlier aids in this by preventing cement adhesion)

b) Apply additional cement as required

c) Clean the wound and repair soft-tissue

d) Start gathering data!

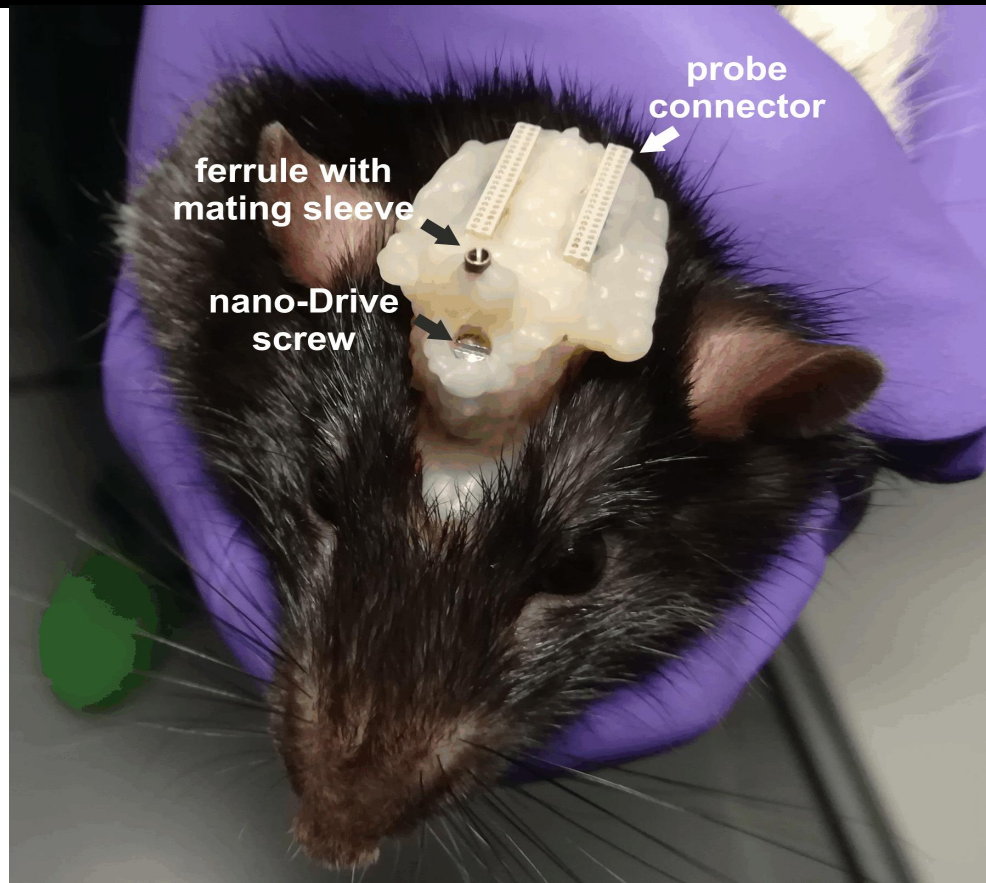


Surgery Protocol – the finished implant

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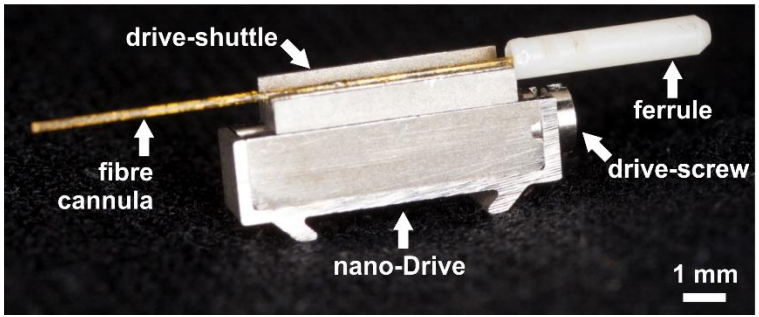


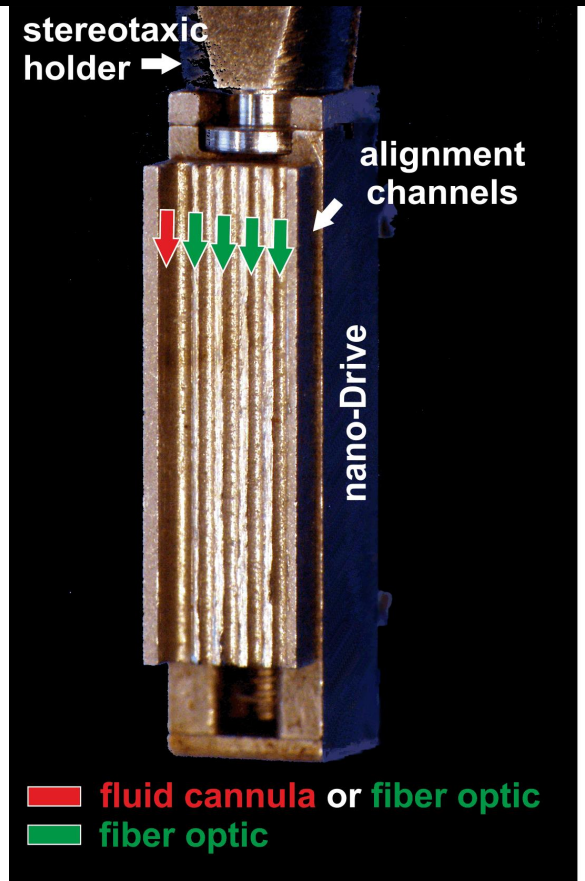
Surgery Protocol – Step 1b [OPTO]

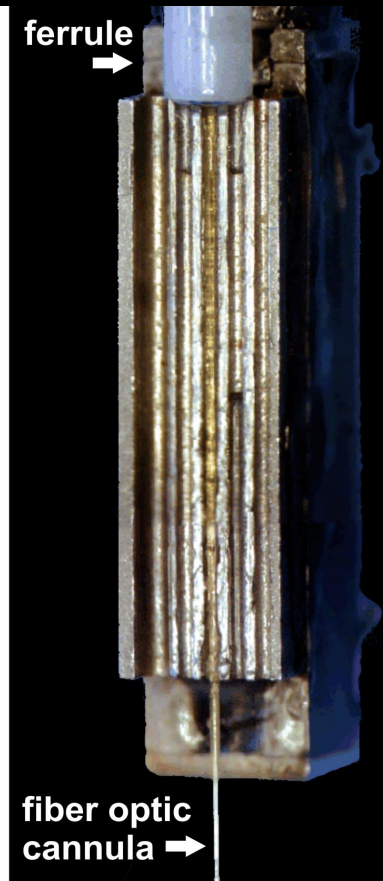
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a) Align your chosen fiber optic cannula to one of the alignment channels in the nano-Drive shuttle

b) Seat the base of the ferrule tight against the top of the nano-Drive shuttle and bond with superglue gel or epoxy, ensuring you evenly coat the length of the fiber and ferrule base







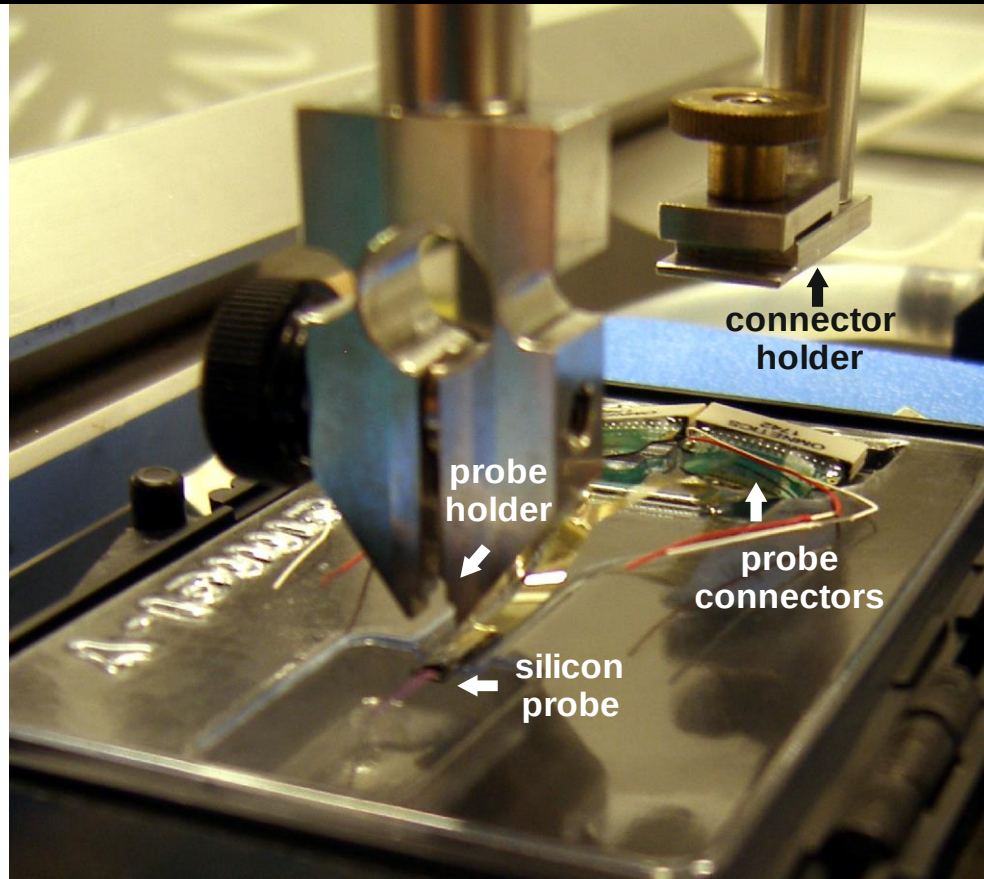
Surgery Protocol – Step 2b [OPTO]

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a) Mount the probe holder tool on a stereotaxic manipulator for controlled movement

b) Align the probe holder to pick up the probe by the “interface chip” and gently tighten the thumb-wheel to initiate a grip

c) Carefully secure the connector(s) in the connector holder and gently tighten the thumb-wheel to initiate a grip



Surgery Protocol – Step 4b [OPTO]

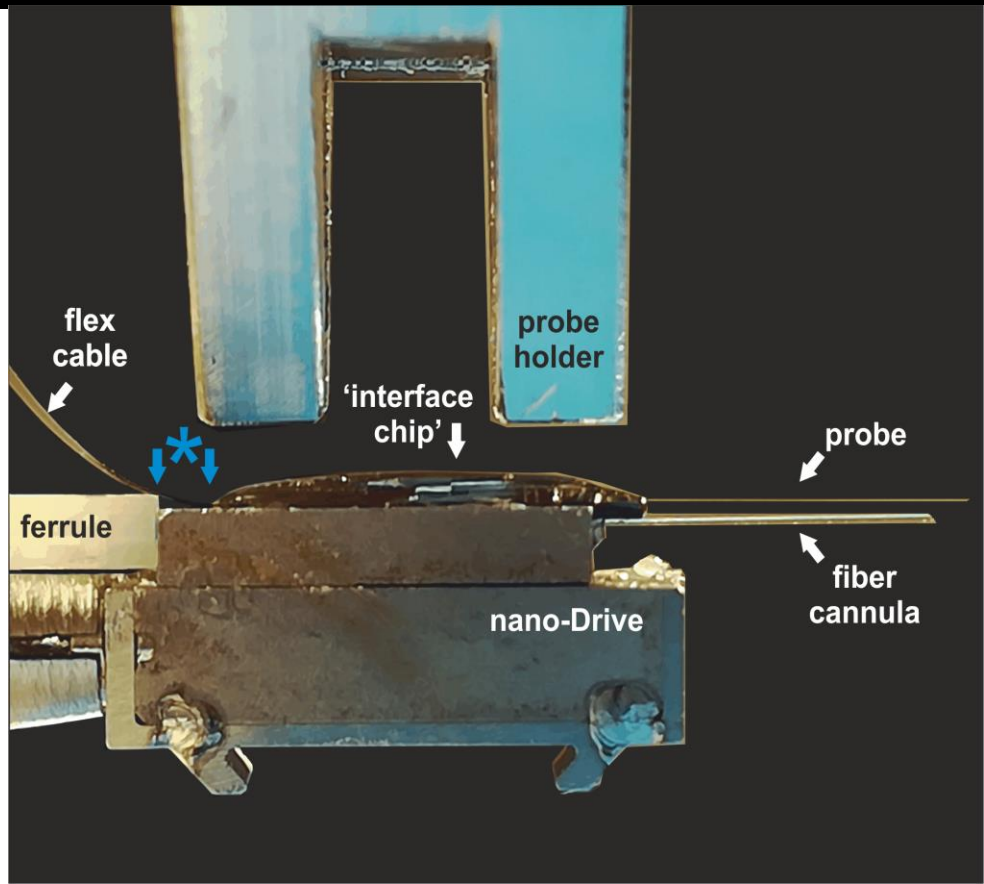
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a) Apply a small amount of superglue gel to the nano-Drive shuttle surface

b) Align your mounted probe with the nano-Drive shuttle and lower in to position

c) Ensure a small gap between top of the probe ‘interface chip’ and the bottom of the ferrule, to allow the probe flex cable avoid being obstructed by the ferrule (see *)

d) To bond the probe to the nano-Drive shuttle, apply gentle downward pressure to the ‘interface chip’



Surgery Protocol – Step 5b [OPTO]

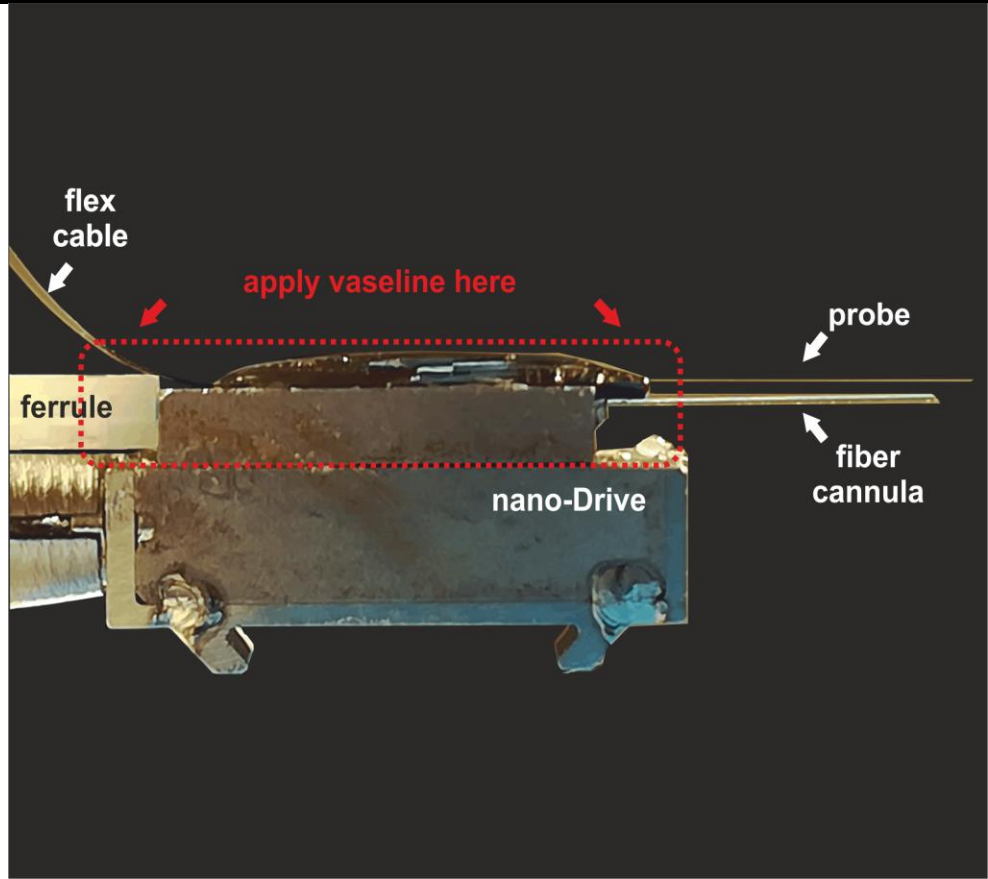
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a) Secure the probe connector to the stereotaxic holder by means of tape or adhesive putty

b) Apply a **thin** film of Vaseline to any surface of the assembly that is required to be moveable – include the bottom half of the ferrule

c) Apply a thin-film of vaseline to the to the stereotaxic holder tool (this will prevent cement sticking to it – see later)

d) Use a low-temperature cautery to apply and gently melt the Vaseline in to place



Surgery Protocol – Step 10b [OPTO]

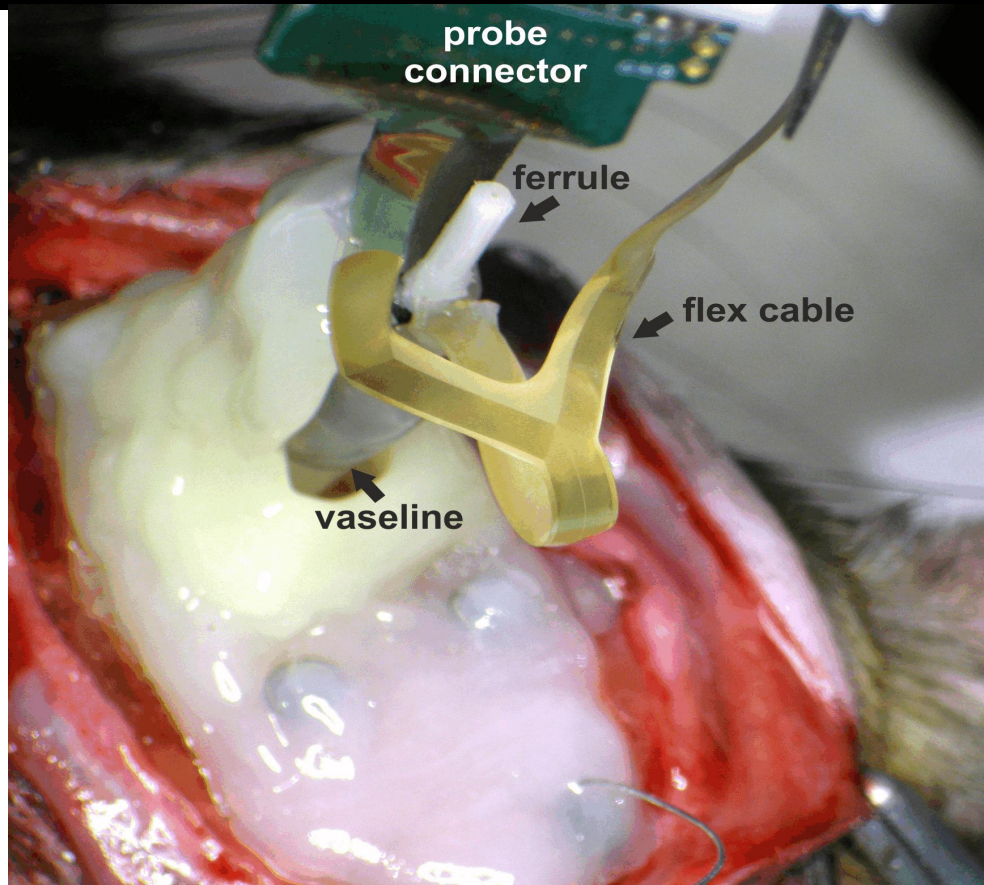
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a) Follow the steps outlined in Step 10a

b) Ensure the lower half of the ferrule has a thin coating of vaseline

c) Fold the flex cable away from the ferrule to form a loop and protect with Vaseline

d) Attach your Gnd / Ref wires to a nearby skull screw

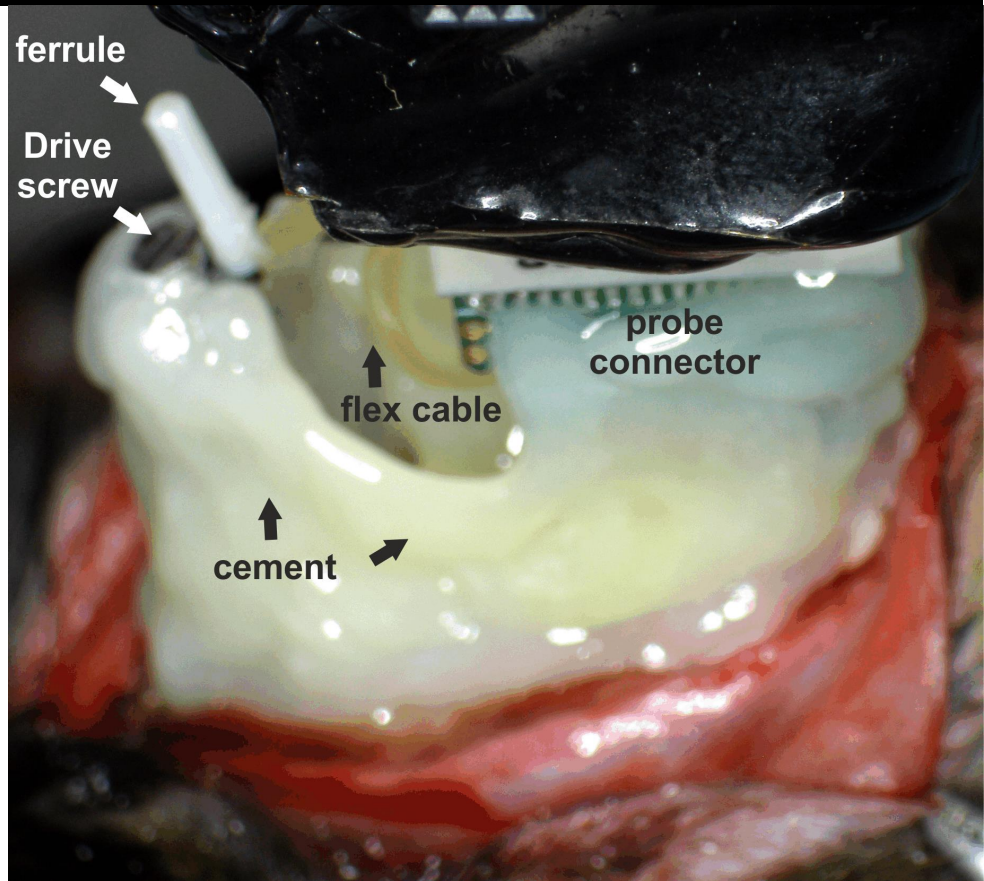


Surgery Protocol – Step 13 [OPTO]

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a) Position the probe connector accordingly and apply cement to cover the flex cable and secure the connector; fully surround the nano-Drive and connector printed circuit board

b) Release the tension on the stereotaxic holder and carefully retract to reveal the nano-Drive screw head and exposed ferrule



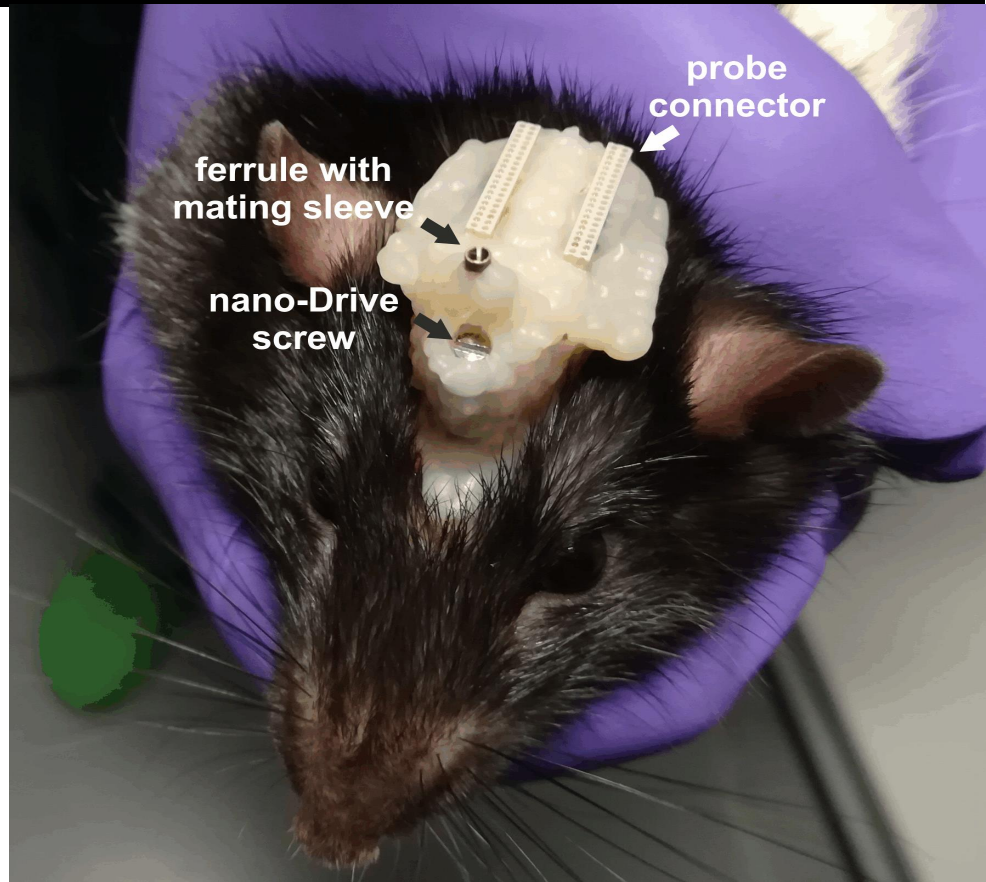
Surgery Protocol – Step 14 [OPTO]

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a) Protect the nano-Drive screw head with Vaseline and surround the lower half of the ferrule with cement (the vaseline you applied to the ferrule earlier will allow the ferrule to slide up and down within the cement 'tunnel' you are now building)

b) When complete, remove the Vaseline protecting the nano-Drive screw head

OPTIONAL – you may choose to add a mating sleeve to the ferrule and cement this in place – this will add extra height to the head-piece, this will fully protect the ferrule from the animal's environment

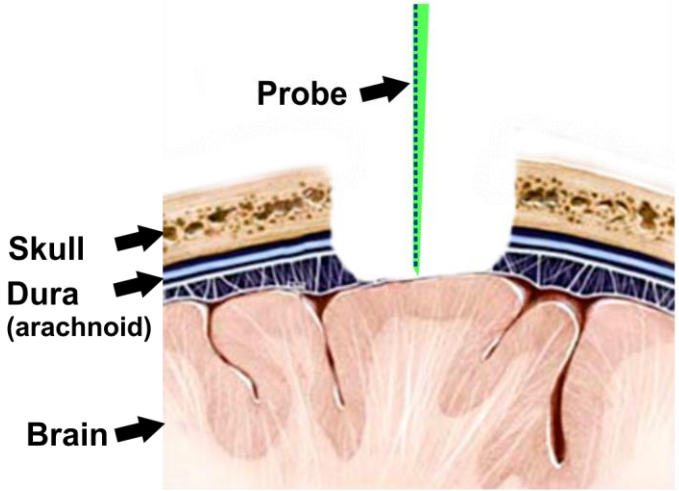


Dural repair – large animal and head-fixed acute

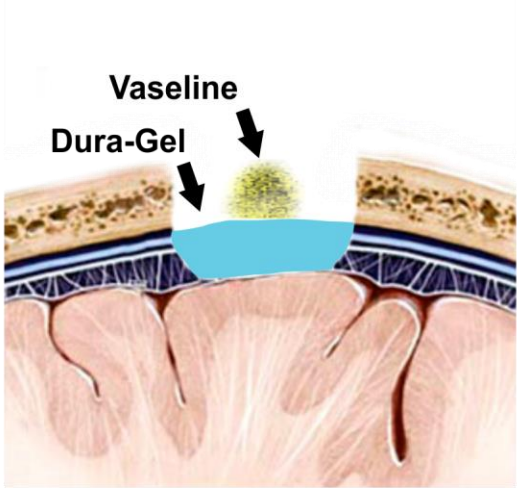
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Cambridge NeuroTech "Dura-Gel" – artificial Dura compound for acute and chronic animals:

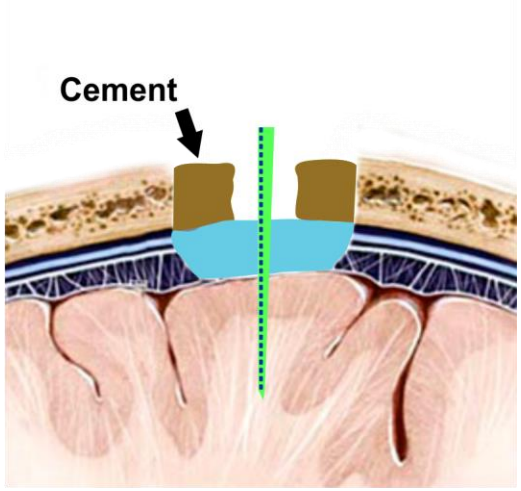
- Restore blood-brain-barrier / reduce connective tissue scar
- Probes can pass-through the gel



- Craniotomy
- Durotomy
- Measure entry point with probe



- Repair durotomy with Dura-Gel
- Protect entry trajectory with Vaseline



- Repair skull with cement
- Melt and wick-out Vaseline
- Insert probe through Dura-Gel