

Brain Biopsy

Last updated: December 20, 2020

RESOURCES 1

INDICATIONS 1

YIELD & ACCURACY 1

BIOPSY NEEDLES 1

 Nashold Biopsy Needle (Integra) 1

PROCEDURE 2

 STEREOTACTIC 2

 Navigation scans 2

 Registration 2

 Vertek® Passive Biopsy Kit with Vertek Probe 2

 Trajectory Guide Kit with Navigus Probe 3

 Biopsy 3

 Tissue amount necessary 3

 Sampling area 3

 Postoperatively 3

 FORAMEN OVALE APPROACH 3

 Cannulation 3

 Gasserian ganglion procedures 4

 Biopsy 4

 Depth electrode 7

 Postop 7

 PINEAL REGION TUMORS – ENDOSCOPIC APPROACH 8

 PINEAL REGION TUMORS – STEREOTACTIC NEEDLE 8

COMPLICATIONS 8

TISSUE PROCESSING TECHNIQUES, HISTOLOGICAL FINDINGS – see p. D34 >>

RESOURCES

See >>
 Karl Storz NeuroEndoscopes and Instruments >>

INDICATIONS

1. **Brain tumors** - definitive tissue diagnosis necessary for treatment planning. see p. Onc1 >>
2. Differentiating **residual tumor** from **radiation necrosis** (coagulative necrosis and vasculopathic changes).
3. Mass forms of **infection** (abscess, cerebritis, tuberculoma), incl. differentiation from CNS lymphoma in AIDS patients.
4. Rare **viral encephalitides** (esp. **rabies**, **Creutzfeldt-Jakob disease**). see p. Inf9 >>
5. **Vasculopathies** (e.g. **granulomatous angiitis**).

N.B. do not biopsy **vascular lesions!**

Indications for **open biopsies**:

- 1) *prominent blood vessels*
- 2) *hemorrhage within lesion*
- 3) contemplated resection (during same procedure)

YIELD & ACCURACY

Diagnostic yield - percent of biopsies that obtain a histopathologic diagnosis (i.e. ability to obtain diagnostic tissue).

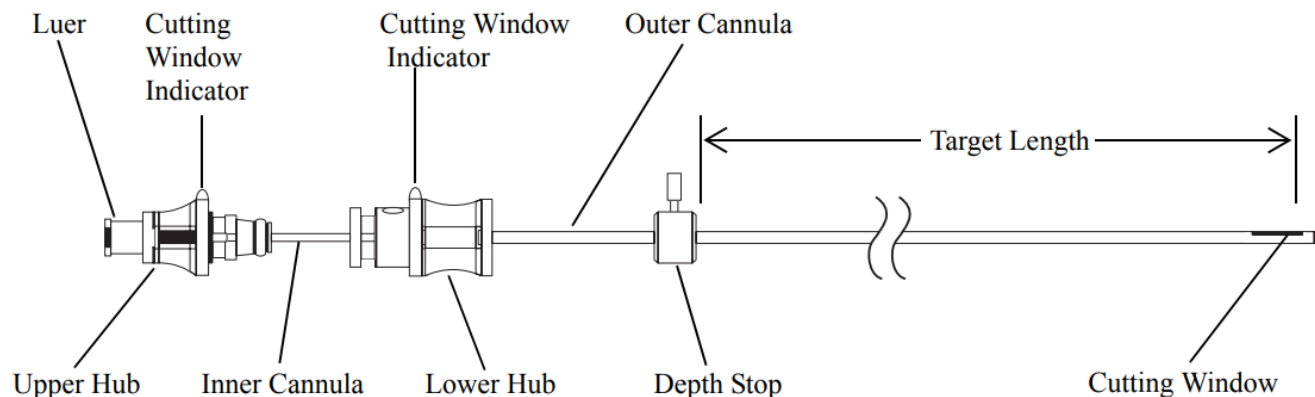
- 82-99% in **nonimmunocompromised** (NIC) patients vs. 56-96%. in AIDS patients.
- yield rate is higher for **lesions that enhance** with contrast on CT or MRI (in NIC patients - 99% vs. 74%).

Diagnostic accuracy - proportion of biopsies that agree with the “gold standard” of surgical resection or autopsy.

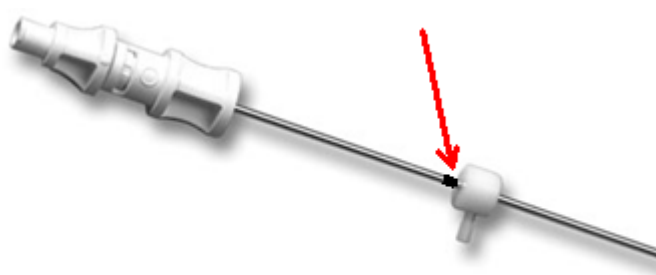
BIOPSY NEEDLES

NASHOLD BIOPSY NEEDLE (INTEGRA)

- has a side window-type cutter at its tip - window is opened and closed by rotating the inner cannula within the outer cannula, using the upper and lower hubs.
- needle length – 249 mm
- outer diameter – 2.0 mm (works well through ROSA 1.8 mm adaptor).
- side cutting window – 10 mm



1. Set the depth stop on the outer cannula to the target length.
 N.B. mark with permanent marker the position of stopper – sometimes you feel pops and clicks and may not be sure if stopper did not slip!



2. With the cutting window closed (see “Cutting Window Use”), insert the NBND.
3. At the target, open the cutting window.
4. Apply a slight vacuum with a syringe attached to the Luer connector – to draw a tissue sample into the open window.
5. Close the cutting window quickly to shear off a tissue sample inside the inner cannula.
6. Withdraw the inner cannula (or entire assembly, if procedure is complete) containing the tissue sample and flush tissue sample onto wet Telfa (may use the tip of 25G needle to dislodge tissue from the cannula)
7. If desired, reposition the needle and repeat the procedure from step 1 (when putting inner cannula back in place, keep it in closed rotation position and gently aspirate in syringe – the air is not getting pushed into the brain).

PROCEDURE

- avoid MANNITOL if lesion is small – may shift target!!!
- head secured in a 3-point Mayfield headholder (if using O-arm - radiolucent frame, including pins, is ideal but not necessary)
- carried out under *general anesthesia* (in adults, *local anesthesia* is possible).

STEREOTACTIC

NAVIGATION SCANS

Use CTA / MRA whenever available to plan trajectories away from vessels.

- to improve tumor biopsy results:
 1. **MRS with maps** (choline/creatine ratio) superimposed on MRI - where is necrosis, where is tumor
 2. **pMRI (PWI)** - will see if it is enhancing piece of necrosis (no perfusion) or real tumor (perfusion↑)

REGISTRATION

Medtronic Stealth frameless navigation: registration → set target (definite) and skull entry (preliminary) points.

May use alternative high accuracy registration – **registration with O-arm** (optional - may place one bone fiducial to verify navigation accuracy after registration):

- need to use Stealth “dogbone” to attach radiolucent Mayfield (with radiolucent pins) to table; “dogbone” has two starbursts for attachment of two Vertek arms; “dogbone” uses different separate screw to attach to table frame!!!
N.B. attach “dogbone” from outside (not from Mayfield inside) – easier to reach for Vertek arm during the case.
- O-arm is needed for registration only: attach passive cranial frame, spin O-arm and may remove O-arm; remove passive cranial frame and use sterile one during surgery (leaving nonsterile one on and covering with sterile camera drape also works but is tricky – need to deflect OR lights to avoid reflections of light).

Entry points and trajectories:

- thalamus – slightly lateral to Kocher’s point.

Target

Note: probe tip on Stealth corresponds to needle tip; actual biopsy window is marked by lines on probe on Stealth screen (when on trajectory views only)

VERTEK® PASSIVE BIOPSY KIT WITH VERTEK PROBE

Vertek® Probe (9733158) - has 70 mm shaft (vs. 50 mm in Navigus probe); may need to add to instrument list on Cranial software module (as likely only Navigus Probe is there).



- attach Mayfield leg to inside (facing patient feet) of Mayfield frame.
- use “dogbone” attachment to Mayfield (has two starbursts for two Vertek arms – one nonsterile for holding passive cranial frame, one sterile for instrument guide)
- prep scalp, drape, place sterile passive cranial frame
- attach sterile Vertek instrument holding arm to Mayfield (cut hole in drapes and assistant reaches under drapes).
- using Vertek Probe establish trajectory, then make incision:
 - a) use 15 blade on long handle to make stab through Vertek port
 - b) disassemble Vertek port and make 0.5 cm skin incision with Colorado Bovie tip (more cosmetic than Navigus probe approach!!!)
- twist hole is made with matchstick drill bit through Vertek arm port (don’t press on Vertek arm as it will bend!); usually it opens dura as well (if not – use long spinal needle).
- trajectory is verified using Vertek Probe and entry point is reset on Stealth.
- press Stealth foot pedal – this locks trajectory (locking trajectory gives depth to target needed to set depth gage on biopsy needle).
- insert needle adapter to Vertek arm port and tighten.
- perform biopsy >>
- remove entire biopsy assembly.
- optional (incision is 5 mm – unable to reach galea this way) - galea is approximated with one inverted 2-0 Vicryl in interrupted fashion.
- skin – Monocryl 3-0 / staples and Bacitracin ointment.

TRAJECTORY GUIDE KIT WITH NAVIGUS PROBE

Navigus® Probe (9733157)



- 14 mm bur hole with perforator; \pm remove (Kerrison or matchstick drill) bony shelf (esp. at direction of biopsy)
- biopsy assembly base with 3 cortical screws:
 - angled (freedom 5° and 25°)
 - straight (freedom 10° in all directions)
- mount entire assembly: transparent holder (pops into socket), white cap
- insert Navigus Probe: set new entry \rightarrow align to trajectory \rightarrow lock trajectory on Stealth (by pressing Stealth pedal) – note distance to target on screen.
- insert grey needle holder
- open dura using monopolar cautery touching biopsy needle (becomes dirty – maybe to avoid this?) and then spinal 14 G needle.
- perform biopsy >>
- remove biopsy needle (with closed window) and entire biopsy assembly.
- place Gelfoam in bur hole, followed by cranial plate.
- closure with bur hole cover

BIOPSY

- set biopsy needle stopper (on special measurement board) to distance to target on screen.
 - N.B. maximum needle length is 180 mm (even if distance from skull entry point to target is < 180 mm, remember that Vertek Probe and needle adapter add 70 mm!)
- insert both needles with closed biopsy window.
- take core biopsy in four quadrants – rotating biopsy needle each time 90°; insert needle with closed window \rightarrow open window \rightarrow apply suction (syringe half with saline is directly attached to needle hub) \rightarrow quickly close window \rightarrow pull out needle \rightarrow flush saline so tissue core moves on Telfa \rightarrow reinsert needle.
 - N.B. always flush needle on Telfa as sometimes there is more tissue
- when reinserting inner needle, gently aspirate air (otherwise, air gets plunged into brain).
- may repeat biopsy again (rotate 45°), thus, obtaining total of 8 tissue cores – send for frozen pathology.

TISSUE AMOUNT NECESSARY

- **few cells** may be sufficient in diagnosis of metastatic carcinoma or lymphoma, whereas even postmortem examination of **entire brain** may be inadequate to establish precise diagnosis in some degenerative or metabolic diseases.

SAMPLING AREA

- mass lesion / defined area** on imaging studies
 - possibility of tissue heterogeneity! - multiple biopsies along needle trajectory through entire tumor thickness (to the farthest tumor edge) may provide more complete picture of pathological process.
 - N.B. sampling of only central area (e.g. complete tissue necrosis in tumors or abscesses) may not yield diagnostic tissue!
- diffuse pathology** (no lesion on imaging) - **NONELOQUENT AREAS** of cerebrum.
 - N.B. random biopsies may be nondiagnostic
 - type of tissue sampled (gray or white brain matter, leptomeninges) is guided by suspected diagnosis (tissue wedge consisting of cortex, overlying leptomeninges, and underlying white matter provides most useful tissue sample).
 - tissue should be considered potentially infectious (precautions for Creutzfeldt-Jakob disease should be taken).

POSTOPERATIVELY

- immediate postoperative head CT – if normal, may go to the floor / gateway.

FORAMEN OVALE APPROACH**CANNULATION**

- patient supine under general anesthesia, tube facing down and taped well, under gel donut (**Dr. Holloway**) or horseshoe headholder (**Dr. Broaddus**).
- if doing glycerol injection, patient is on the stretcher – can be sit up during procedure.
- guidance:
 - frameless navigation**, e.g. Stryker mask; assemble 18 G 3.5 inch foramen ovale (vs. spinal) needle with its plastic hub secured in Stryker tracking device; register-calibrate needle; for details - see p. Op30 >>
 - fluoroscopy (C-arm)** – regular OR table or stretcher are enough radiolucent for this purpose; work under **AP** with beam aligned along trajectory (mouth corner to zygoma; see below) but head rotated away from operated side – should clearly see foramen ovale (intersection of top of petrous bone with clivus; confirmation – when moving patient's head or AP fluoroscopy up or down, foramen disappears as beam is no longer along foramen canal).
- prep cheek with chlorhexidine or Betadine.
- **Härtel's landmarks**:
 - needle entry point – 2-3 cm lateral to mouth corner (maybe also a little bit inferior – to avoid lateral pterygoid plate in trajectory).
 - surgeon inserts index finger in patient's mouth (to palpate and guide needle tip through mucosa as it is advanced, making certain it does not breach mucosa); opposite hand is used to advance needle; keep needle **medial to coronoid process of mandible** and outside oral cavity i.e. deep to oral mucosa – needle slides on medial surface of mandibular ramus (here needle trajectory becomes rather fixed, so if need to change needle trajectory, withdraw needle back to this point).
 - needle is aimed at inner aspect of ipsilateral pupil + at point 3.5 cm anterior to external ear canal at level of zygoma (practically, it is inverse EVD target).
- when patient shows evidence of pain, anesthetists gives brief general anesthesia.

- needle is advanced through *foramen ovale*; slowly advanced until slight release is felt (penetration through Gasserian ganglion into trigeminal cistern – remove stylet and check for CSF flow for reassurance).
 - may feel **mandible jerk** when needle irritates CNV₃
 - may cause **bradycardia** – wait before advancing needle until heart rate recovers (have atropine ready).
 - change **fluoroscopy** to **lateral** to verify – needle tip has to be just posterior to clivus
- verify good position (esp. if unable to get CSF):
 - a) inject 0.5 cm³ of saline – should go easily without resistance (but may mean that needle is too far and already in the middle fossa).
 - b) insert foramen ovale electrode through needle – see if it slides along petrous surface (means needle is in Meckel's cave)
 - c) injecting Omnipaque – should fill Meckel's cave under live fluoroscopy (notice volume of Omnipaque needed – gives idea of cave volume).

GASSERIAN GANGLION PROCEDURES

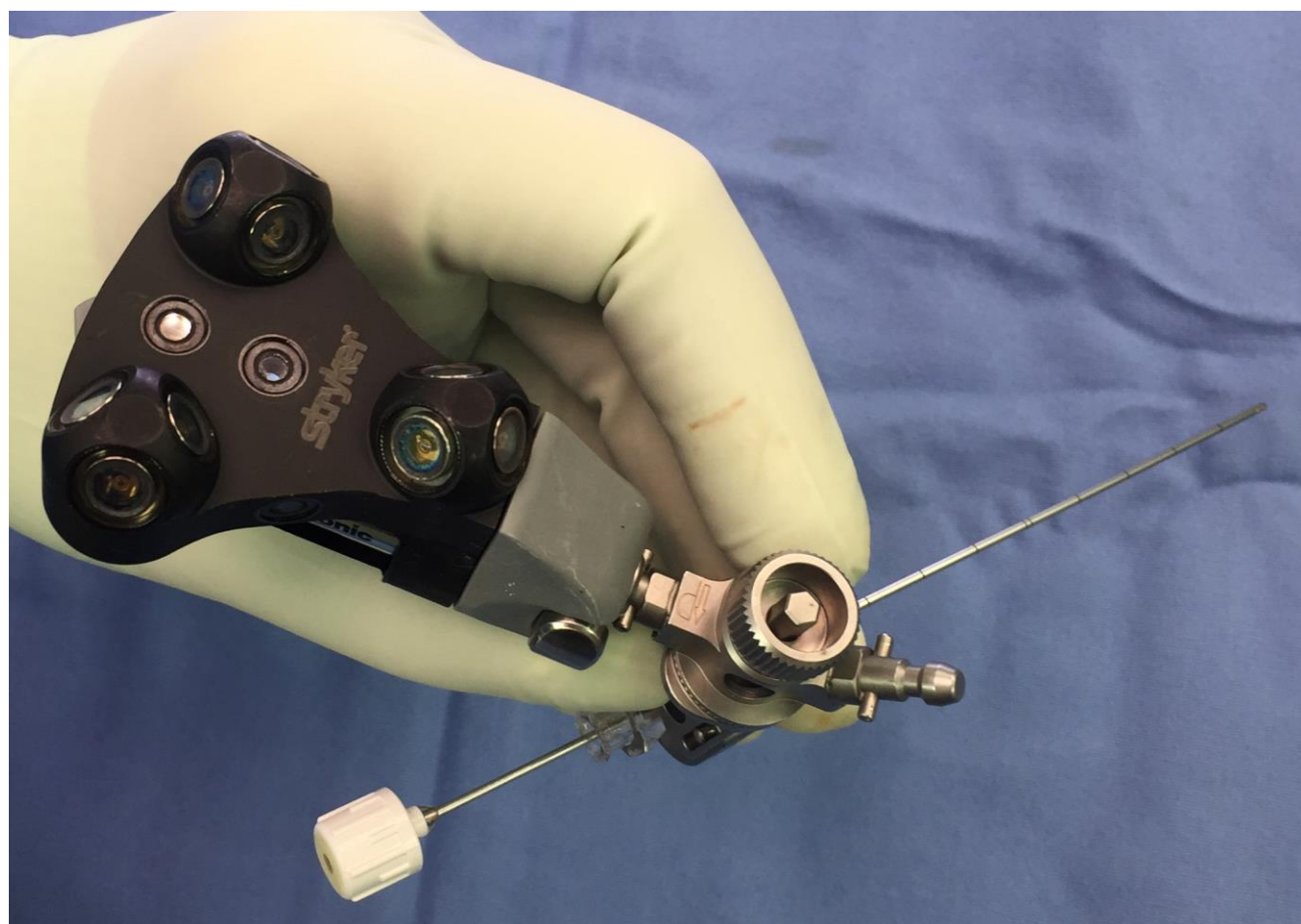
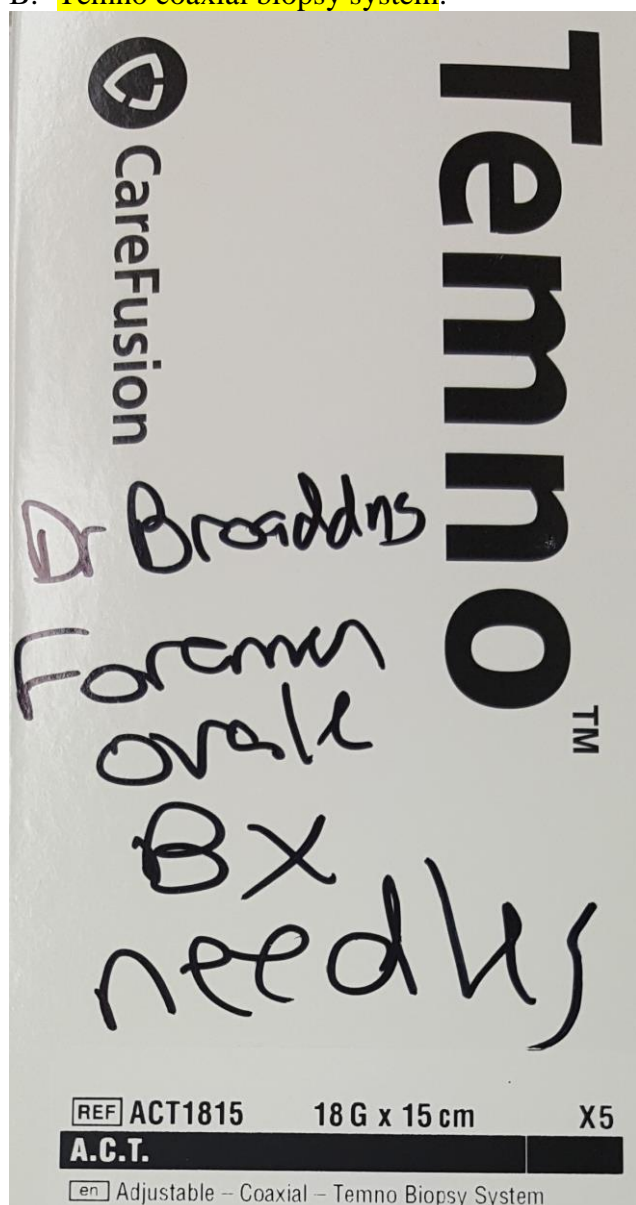
- see p. CN5 >>

BIOPSY

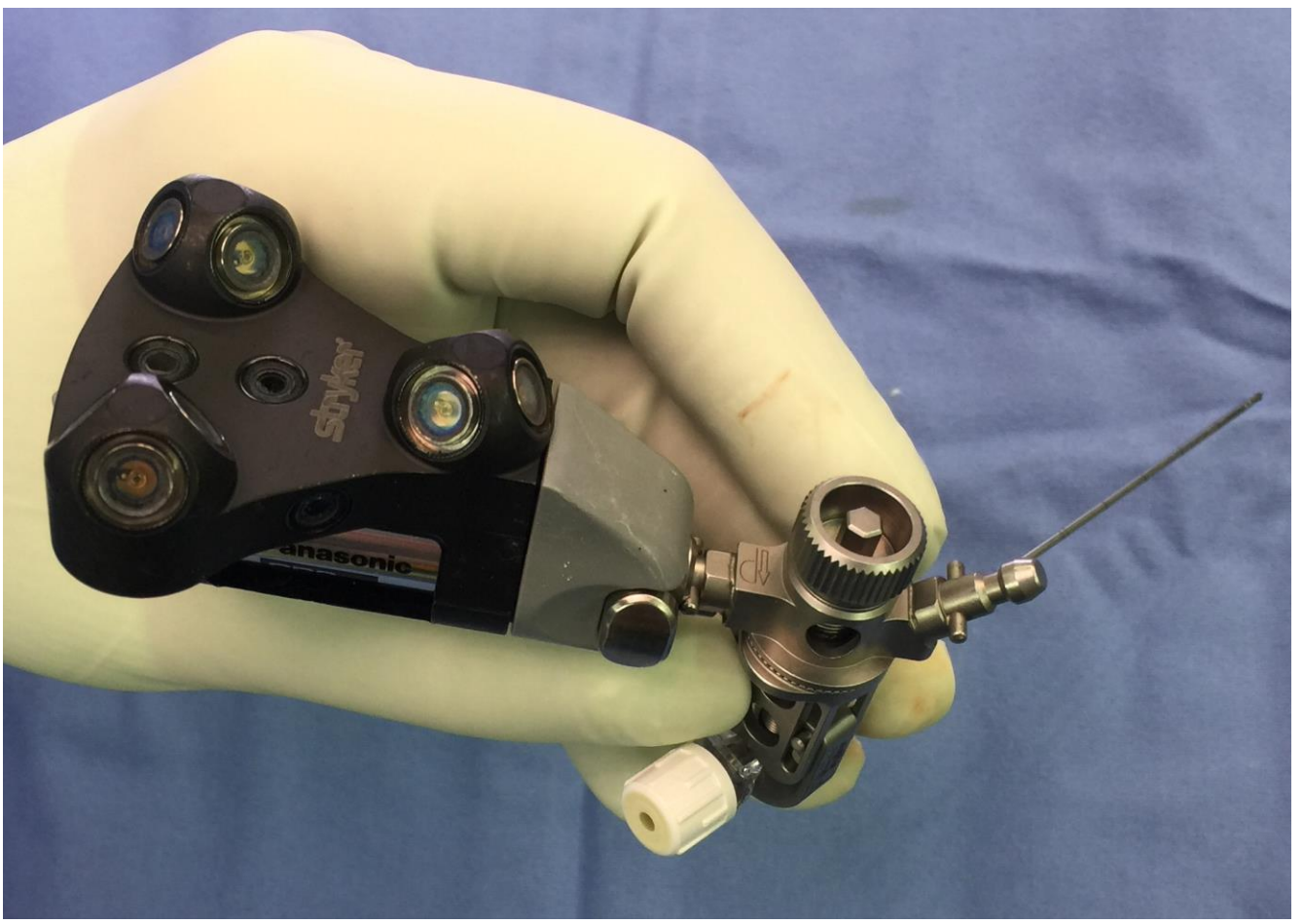
A. **2 spinal needles:**

1. One 18G size 3.5 in spinal needle (attach tracking device to track the tip if using navigation) – cannulate just foramen
 2. Second needle is 22G 5 inch spinal needle – wrap SteriStrip on shaft so tip protrudes 1.5* cm from first needle tip (*or whatever distance to tumor)
- insert second needle back and forth several times (to get tissue cores in) then gently aspirate and pass to cytologist for microscopy.

B. **Temno coaxial biopsy system:**



Ready to cannulate foramen ovale:



Temporary attach Temno syringe for biopsy window calibration prior to cannulation:

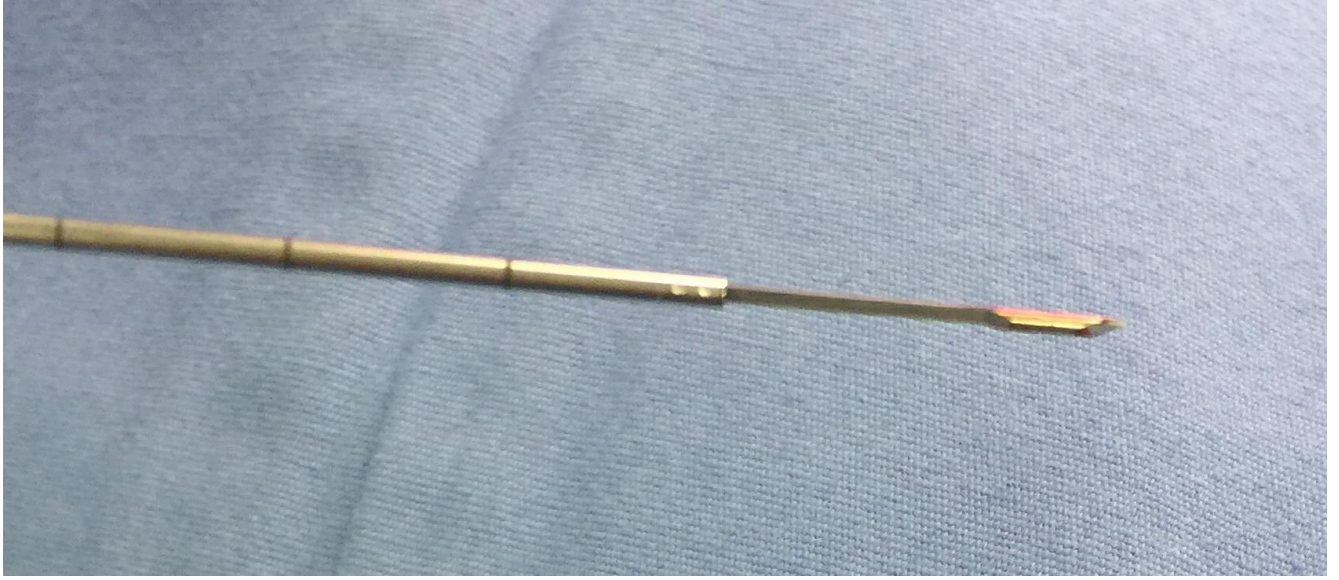




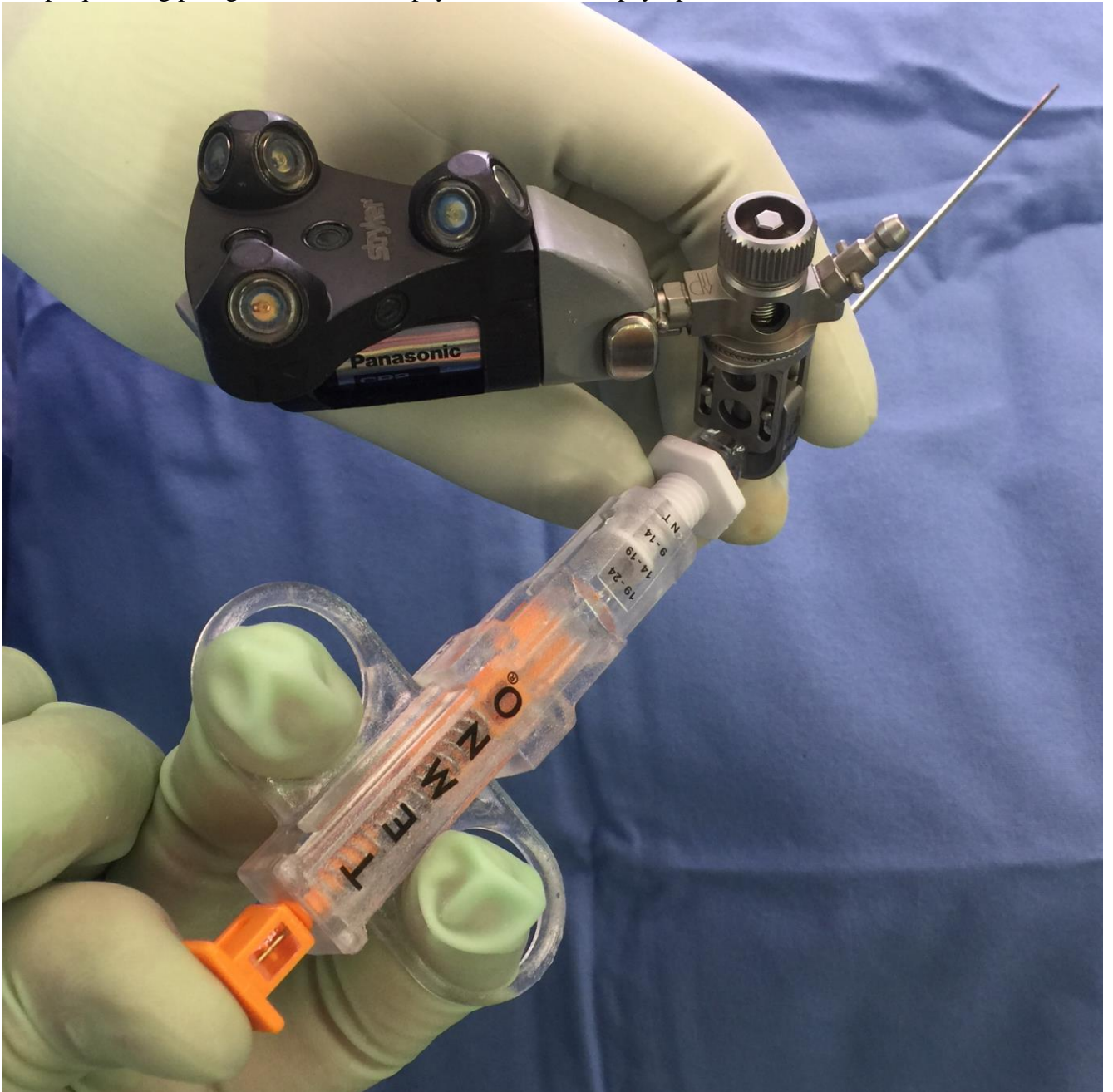
Once cannulated, attach Temno syringe with plunger back:



Push on plunger – biopsy tip exposure:



Keep squeezing plunger – will fire biopsy sheath over biopsy tip:



DEPTH ELECTRODE

- see p. E13 >>

POSTOP

- may skip postoperative head CT.

PINEAL REGION TUMORS – ENDOSCOPIC APPROACH

Do ETV first!

- A. Use ETV bur hole and flexible endoscope to go through foramen of Monroe posteriorly
- B. Use separate more frontal bur hole and rigid endoscope

PINEAL REGION TUMORS – STEREOTACTIC NEEDLE

- through parenchyma, avoiding ventricles:
 - a) frontal approach (but trajectory through thalamus)
 - b) parietal approach (but trajectory may go through sensory cortex)

COMPLICATIONS

Removal of nonregenerating brain tissue is accompanied by risk of *permanent neurological deficit!*

- mortality < 0.2-1%.
- major **hemorrhage** - risk 0-3% (0-12% in AIDS - reduced platelet count or function, vessel fragility in primary CNS lymphoma).
 - *small hematoma at biopsy site is not unusual and is rarely clinically significant
- edema exacerbation, infection, development of seizure focus, increased neurologic deficit.