Methods for Muscle Sampling

Rabi Tawil, MD

Neuromuscular Disease Center

University of Rochester

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Outline:

- Muscle Biopsy procedures
  - Open muscle biopsies
  - Needle muscle biopsies: Bergstrom, UHD, Conchotome
  - Fine needle biopsies
- Safety and tolerability of procedures
- Processing muscle samples
- Advantages and disadvantages of each method
- Improving yield, safety

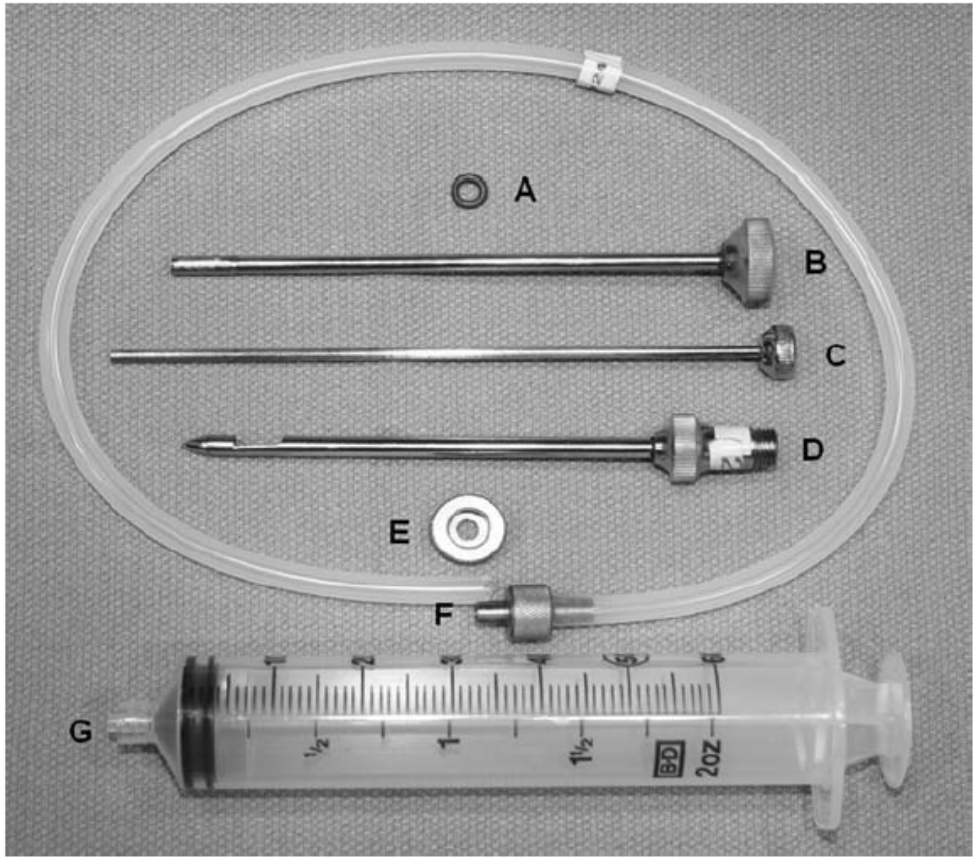
Open Muscle Biopsy:

- Setting: Outpatient surgical suite
- Anesthesia: Local/Conscious sedation for adults, conscious sedation in pediatric patients
- Procedure:
  - Incision: 1-4 inches depending on size of patient
  - Direct visualization after incision of muscle fascia
  - Yield: 100%; sample size: whatever is needed
  - Requires suturing to close fascia and skin
- Safety: well tolerated, direct visualization allows assurance of hemostasis

Needle Muscle Biopsy:

- Setting: Bedside procedure
- Anesthesia: Local for adults, conscious sedation in pediatric patients
- Procedure:
  - Incision: 3-5 mm (0.1-0.2 inches) depending on needle size
  - Success: variable (95%);sample size: variable (30-75mg/pass)
- Safety: well tolerated, low incidence of painful hematomas

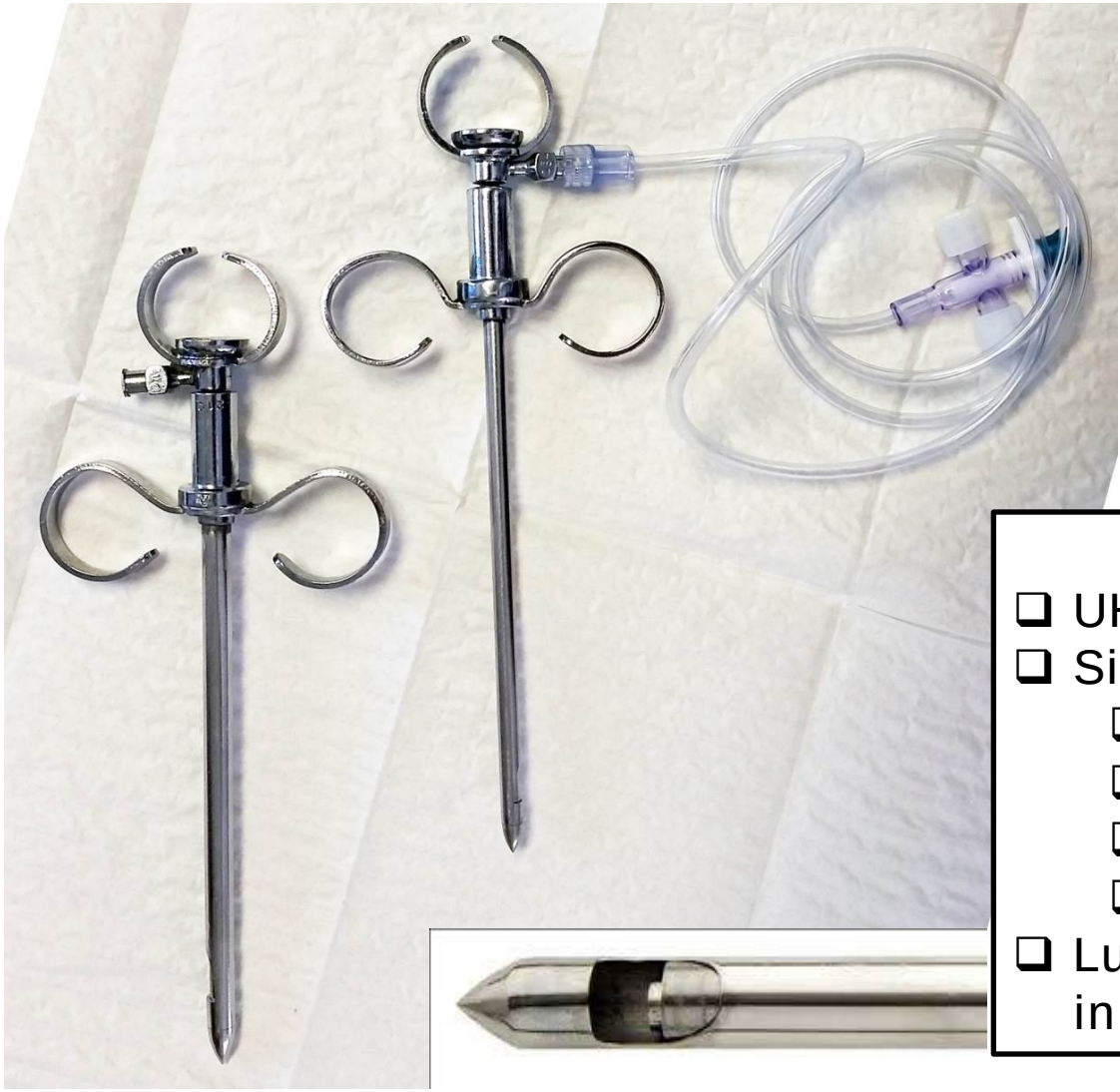
Bergstrom Needle



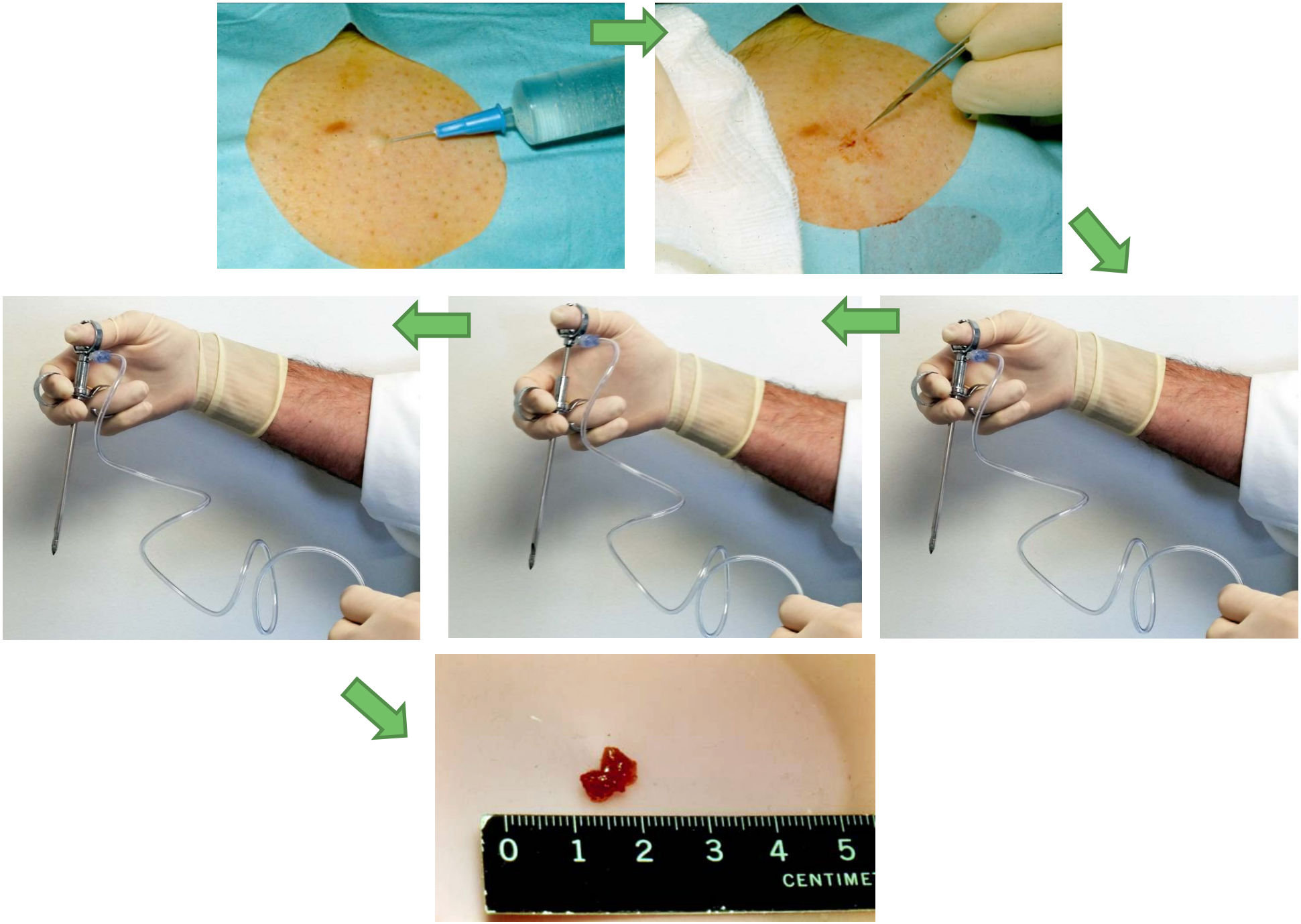
Tarnopolsky et al. Suction modified Bergstrom muscle biopsy technique: experience with 13,500 procedures. M&N 2011. 43:717-725

Melendez et al. Wall suction applied to needle muscle biopsy. J of Surgical Research 2007. 142:301-303.

UHC Needle



- UHC Needles:
- Sizes:
  - Infant 11 G (3 mm)
  - Small 8 G (4mm)
  - Medium 7 G (4.5 mm)
  - Large 6 G (5 mm)
- Luer lock attachment to inner cannula for suction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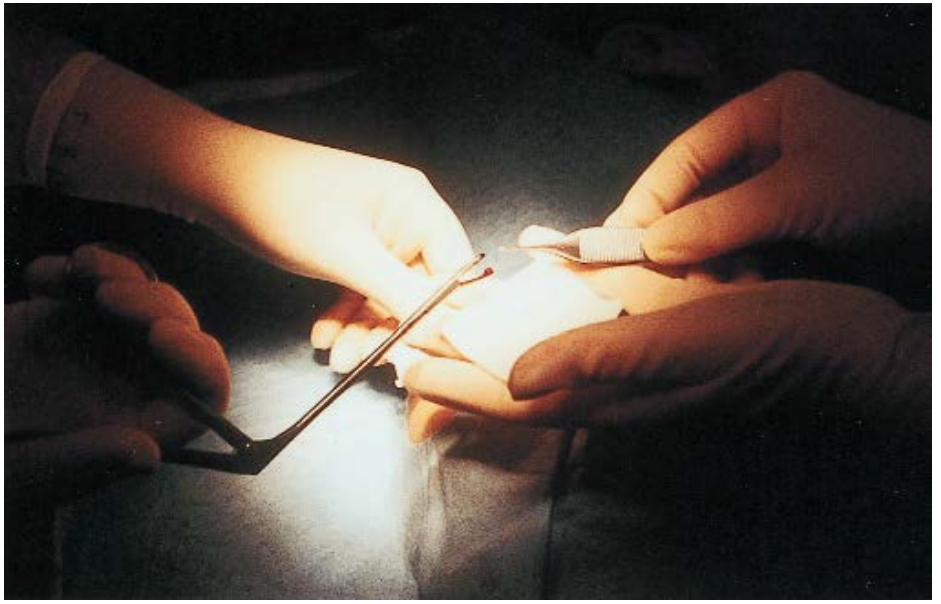
Conchotome



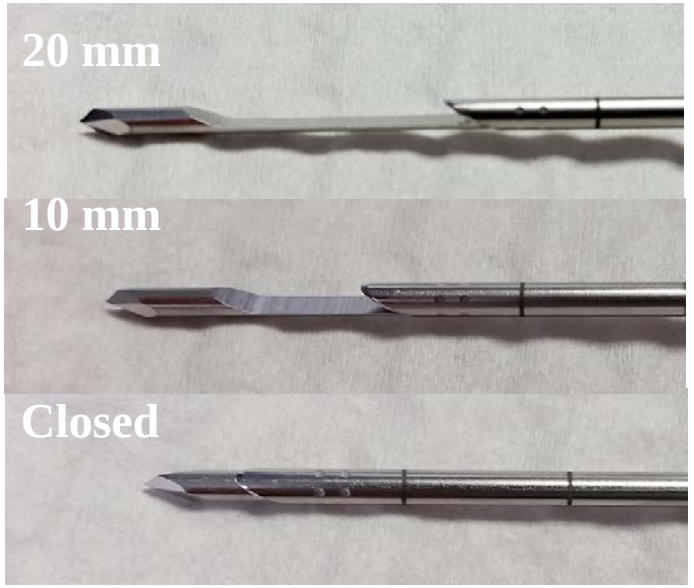
Dorph C, Nennesmo I, Lundberg IE. Percutaneous Conchotome Muscle Biopsy. A Useful Diagnostic and Assessment Tool. The Journal of Rheumatology 2001; 28:7

Needle Biopsies: Success Rates and Complications

- Potential complications: allergic reaction of local anesthesia, infection, hematomas, localized numbness
- Restrospective of >13,500 needle biopsies (Tarnopolsky et al.):
  - 99.9% success rate*
  - Complications:
    - Arterial bleed: 1, Ecchymosis/hematoma: 2, Local skin infections: 8, Localized numbness: 5, Pain lasting more than 3 days: 5
- University of Rochester Experience, about 4000 biopsies:
  - Success rate about 95% (90% by adequacy of sample)
  - Complications:
    - Painful hematomas: 5 patients (none since more stringent procedures were put in place)

Spring-Loaded Fine needles

- Setting: Bedside
- Anesthesia: local
- Procedure:
  - May need a nick in the skin for larger gauge needle
  - Success rate: 95% (Cote et al. 1992) using 14 gauge needles; other references yield 4-10mg of tissue



Processing of Muscle Sample

- For muscle enzyme histochemistry and immunohistochemistry:
  (**requires experienced and skilled lab tech**)
  - Sample to remain fresh wrapped in moist gauze and cooled
  - Should be mounted and frozen within an hour
  - Sample oriented and mounted on chuck under a dissecting scope to insure orientation of fibers and frozen in isopentane cooled in liquid nitrogen
- For protein, RNA, enzyme assays:
  - Sample immediately wrapped in foil and flash frozen in liquid nitrogen
- Myoblast culture
  - Fresh sample place in culture media

Advantages and Disadvantages of Various Approaches: Open Muscle Biopsy

- Advantages:
  - Success rate close to 100%
  - Yield: adequate sample for any analysis
  - Many muscle accessible for sampling
- Disadvantages
  - Most invasive
  - Scarring
  - Additional risk of conscious sedation

Advantages and Disadvantages of Various Approaches: Needle Muscle Biopsy

- Advantages:
  - Less invasive, no scarring
  - Bedside procedure
  - More amenable to repeated sampling
- Disadvantages
  - Success rate 90-95%
  - Fewer accessible muscles
  - Smaller samples**
  - Not optimal for quantitative IHC

Advantages and Disadvantages of Various Approaches: Fine Needle Biopsy

- Advantages:
  - Least invasive
  - Bedside procedure
  - More amenable to repeated sampling
- Disadvantages
  - Success rate ?
  - Smallest samples
  - Cannot be used for histochemistry/IHC

Improving Yield and Safety of Needle Biopsies

- Imaging-guided muscle biopsies:
  - CT and MRI:
    - Useful for targeting deeper muscles or parts of muscles with specific imaging changes (eg: MRI STIR positive muscle).
    - Ultrasound guided:
      - With the advent of portable ultrasound units, ultrasound guidance should help improve the yield of needle muscle biopsy.
- Improving safety:
  - Ultrasound guidance can potentially help access more muscles with a needle more safely
  - Hematomas are a risk. A more conservative approach to establishment of hemostatis helps reduce the risk: 1. insure absence of bleeding before closing incision, 2. Wrap biopsied limb in ace bandage, 3. keep patient supine with limb elevated for 20 minutes at end of procedure.

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