Right-angle Dissector Scissors Hybrid Surgical Instrument

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Background: Client

- Dr. Emily C. Hartmann
  - Plastic & Reconstructive Surgery resident at UW-Madison Hospital
- Surgery: latissimus dorsi flap breast reconstruction
  - Conducted following mastectomy due to breast cancer

Background: Anatomy

- Latissimus dorsi
- Origin
  - Inferior 6 thoracic vertebrae
  - Lumbar vertebrae
  - Iliac crest
- Insertion
  - Bicipital groove

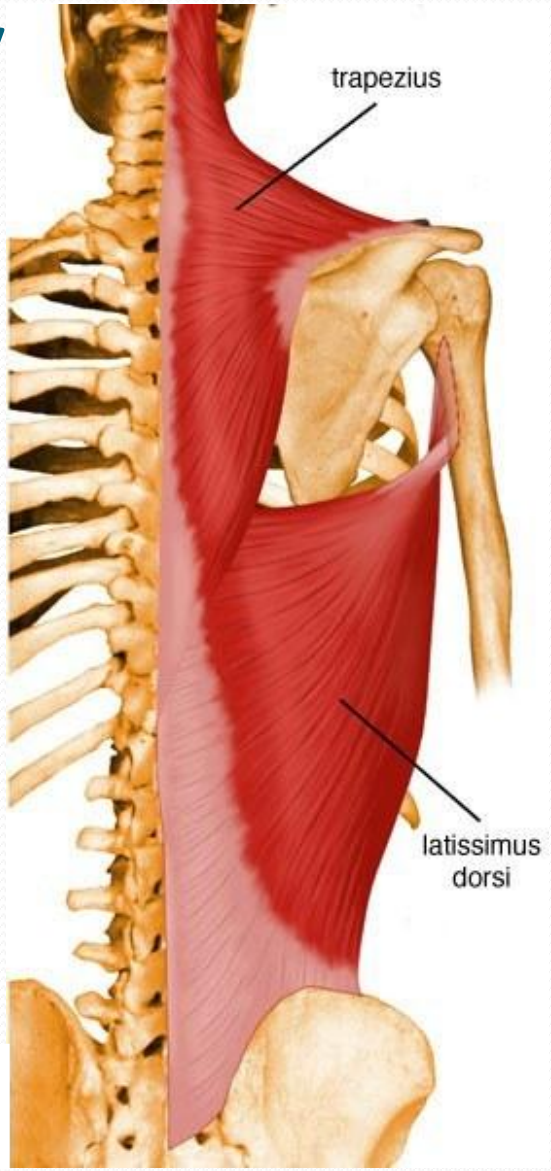

Figure 1: Anatomy of latissimus dorsi muscle[1]

Background: Breast Reconstruction

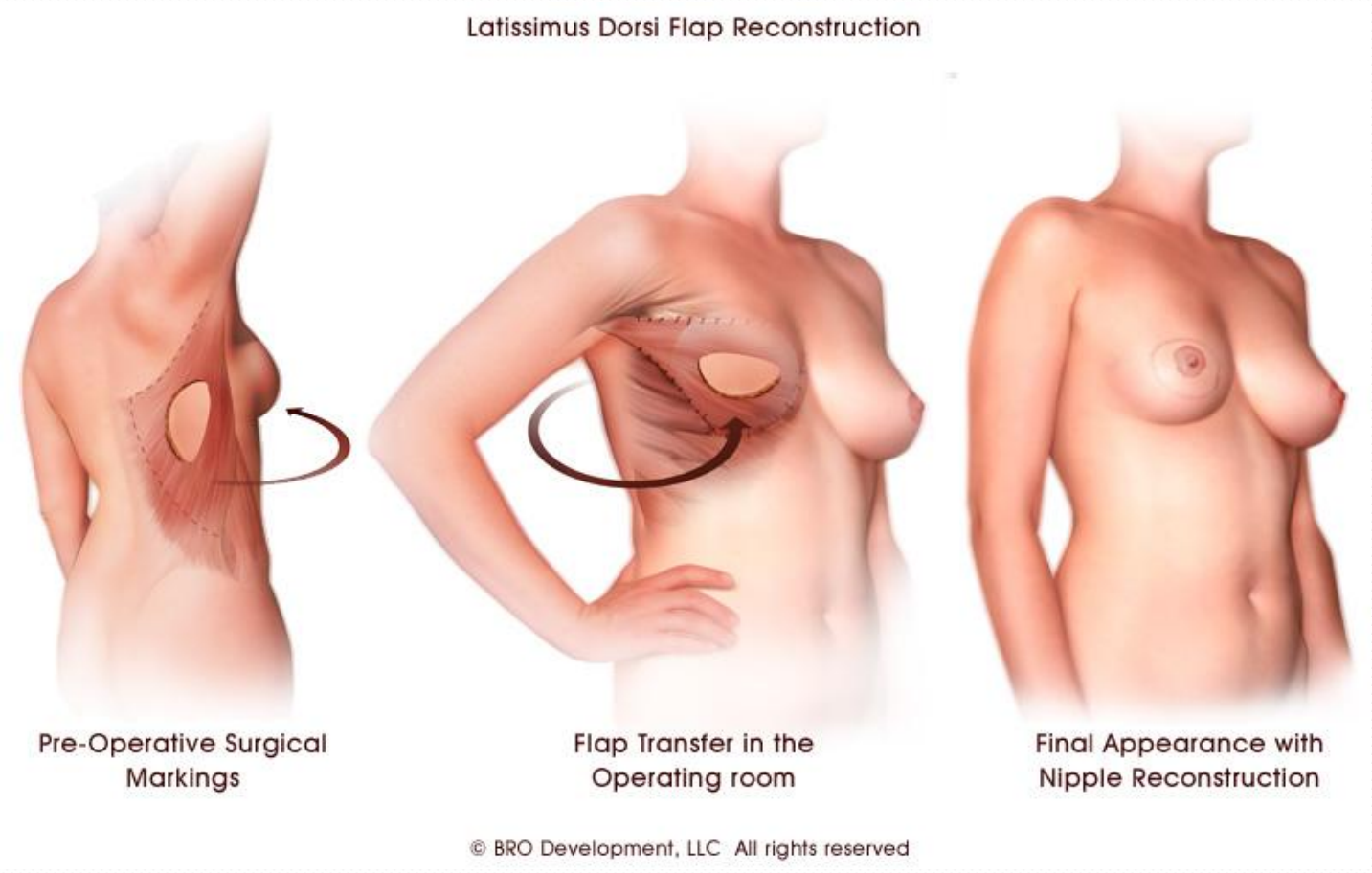

Figure 2: Process of latissimus dorsi flap breast reconstruction[2]

Problem Statement

- Operation in deep hole
  - Assistant cannot reach
  - Surgeon‘s other hand occupied
- Dissect around sensitive vascular structures

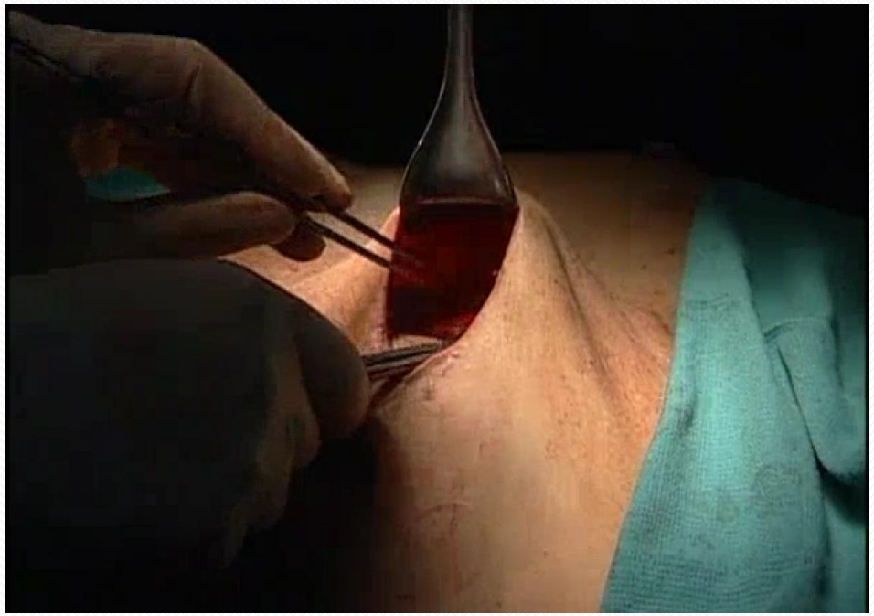

Figure 3: Surgeon using right-angle dissector in deep hole[3]

Right-Angle Forceps

- Kantrowitz 90° forceps
  - Length: 7.5 inches (19.1cm)
- Used with scissors or bovie-tip cautery device
- Multiple functions:
  - Dissector
  - Forceps

Figure 4: Right-angle forceps

Right Angle Harmonic Scalpel

- Combines right-angle forceps and Harmonic Scalpel®
- Ultrasonic vibration cauterizes tissue
- No prototype constructed
- Prohibitively expensive

Client Requirements

- Incorporate dissector and scissors function
  - One-handed
  - Maintain visibility
  - Forceps function optional
- Surgery-compatible
  - Surgical-grade stainless steel
  - Autoclavable
- $200 budget

Design 1: Built-In Blade

- Inner edges sharpened
- Maintains dissector function
  - Blunt outer edges
- Incorporates scissors function
  - Sharp inner edges

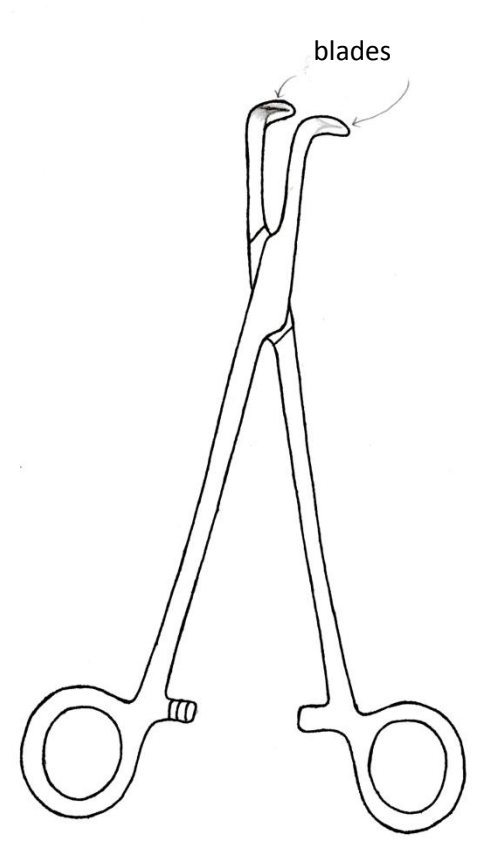

Figure 5: Built-in blade design

Design 2: Guarded Scissors

- Scissors blades on inner edges
- Shell attached to outer edges
- Shells can be extruded and locked

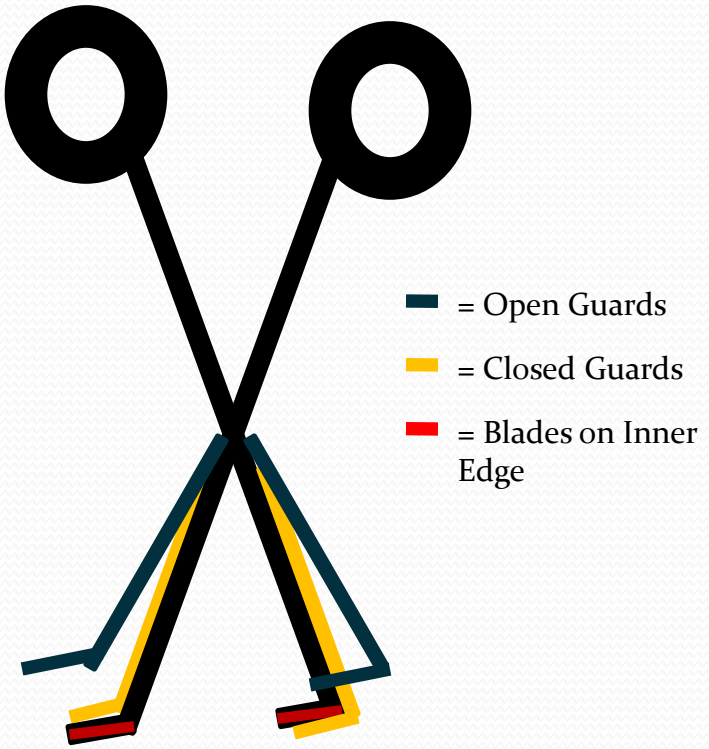

Figure 6: Guarded scissors design

Design 3: Trigger Scissors

- 1- Trigger
- 2- Spring
- 3- Cable
- 4- Pivot
- 5- Blades

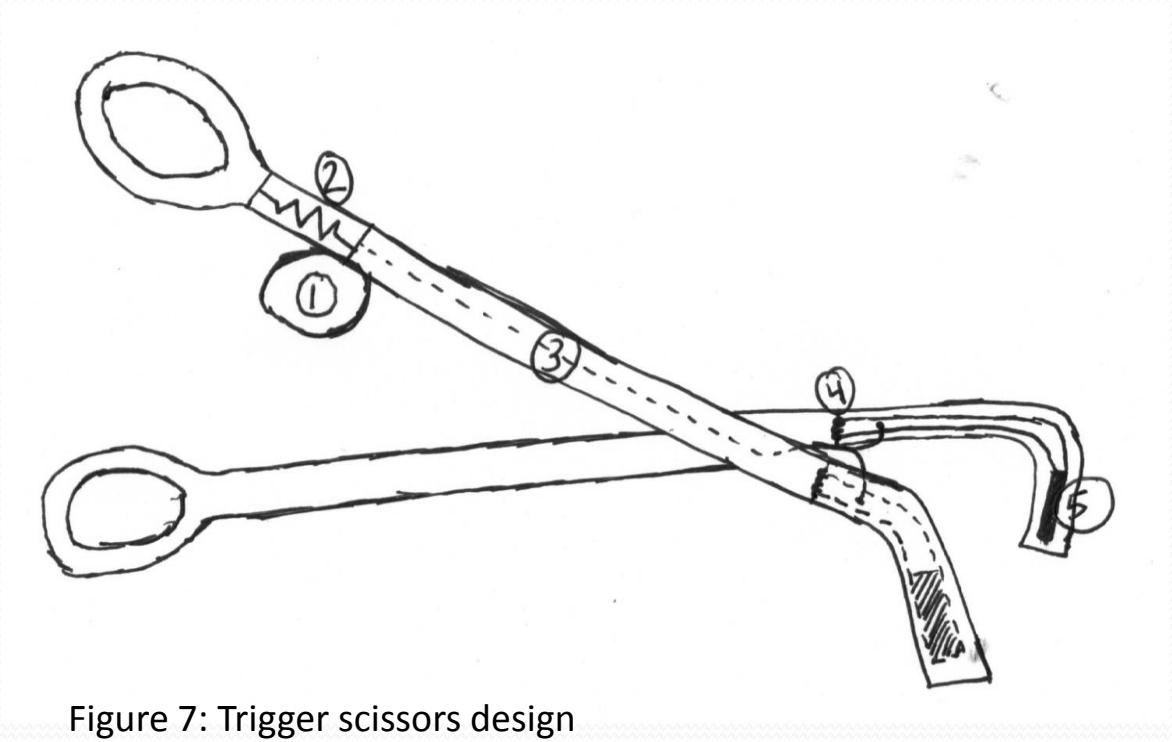

Figure 7: Trigger scissors design

Design Selection Matrix

Design	Patient Safety (30)	Functionality (20)	Client Preference (20)	Sterilizability (15)	Feasibility (15)	Total
Built-in Scissors	10	15	10	15	15	65
Guarded Scissors	20	20	18	10	13	81
Trigger Scissors	30	20	20	5	10	**85**

Table 1: Design selection matrix

Final Design: Trigger Scissors

- Maintains dissector function
- Incorporates scissors
- Ergonomically comfortable

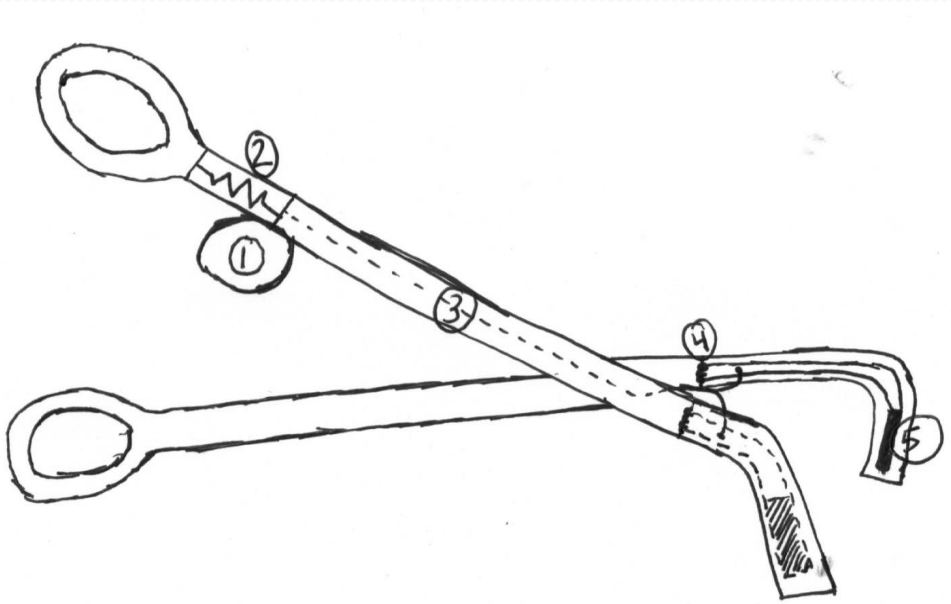

Figure 7: Trigger scissors design

Materials Selection

- Requirements:
  - Surgical-grade stainless steel
  - Autoclavable
- Three grades of surgical steel
  - 316,420,440
- Autoclavable polymers possible
  - Different weight

Future Work

- Refine trigger mechanism
- Build prototype
- Testing
- Refine design

Figure 8: Example of rapid prototyping printers[5]

References

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Q&A

- Questions?