

Proposal: DupuyFix™ – Precision Injection System for Dupuytren's Contracture

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Introduction: Addressing the Limitations of Current Practice

The current standard for collagenase injection in Dupuytren's contracture treatment is a manual procedure that depends heavily on physician experience, tactile feedback, and anatomical guesswork. As a result, patients face a high variability in outcomes, including common and sometimes severe side effects such as:

- Skin tears due to enzyme spread to the dermis
- Bruising and hematomas from vascular wall degradation
- Pain and inflammation from enzyme exposure to non-target tissues
- Rare but serious complications such as tendon rupture

These complications are frequently caused by imprecise needle placement, uncontrolled enzyme leakage, or over-injection into non-cord tissues. Despite the potential of enzymatic injection therapy, its underutilization reflects a widespread hesitation rooted in these risks. DupuyFix™ offers a transformative solution by introducing a standardized, image-guided, and feedback-controlled platform. By automating critical elements of the injection process, the device minimizes operator error, protects surrounding structures, and ensures accurate enzyme delivery, thereby increasing both efficacy and safety.

Device Components and Functions

1. Hand Stabilization and Positioning Frame

- Ergonomically designed hand rest that molds to the patient's palm and fingers.
- Adjustable finger straps or molded pads ensure a relaxed yet immobilized position.
- Transparent working area around the injection zone provides unobstructed access.

Purpose: Prevents unintended movement and optimizes positioning for cord identification and injection.

2. Cord Localization Module

- High-frequency ultrasound probe integrated into the frame.
- Real-time imaging identifies the Dupuytren's cord, its depth, diameter, and relationship to surrounding structures.
- AI-assisted interpretation provides a 3D overlay of safe injection zones.

Optional Upgrade: Optical coherence tomography (OCT) for finer resolution in challenging cases.

3. Smart Injection Arm

- Computer-guided injector mounted on a flexible rail.
- Receives input from the imaging module to calculate optimal needle path, depth, and angle.
- Automated alignment ensures injection into the geometric center of the cord while avoiding adjacent tendons and vessels.
- Includes manual override for physician control when needed.

4. Enzyme Delivery and Control System

- Syringe is mounted in a digitally controlled plunger system.
- Injection rate and pressure are dynamically adjusted in real-time based on tissue resistance using integrated force sensors.
- Adaptive feedback ensures optimal delivery into the fibrotic tissue while minimizing overflow and needle track leakage.
- Post-injection, the system executes a micro-valve seal and withdrawal protocol to reduce enzymatic diffusion into non-target tissues.

Clinical Advantages

- Standardized, reproducible treatment independent of physician experience.
- Reduced complication rates: minimized skin tears, hematomas, and tendon damage.
- Shortened learning curve for new providers.
- Enhanced patient trust with real-time imaging feedback.
- Digital record of injection location, volume, and pressure profile stored per patient.

Future Capabilities and Expansion

- Integration with electronic health records (EHR) for automated documentation.
- Training simulator mode for residents and hand surgeons.
- Expandable for use with other soft tissue contractures or guided corticosteroid delivery.

Conclusion

DupuyFix™ presents a transformative opportunity in hand surgery by automating and optimizing the collagenase injection process for Dupuytren's contracture. By combining imaging, stabilization, smart targeting, and adaptive injection control, it sets a new gold standard for safe, effective, and scalable care.

Opportunity

The idea behind DupuyFix™ is novel, timely, and fills a real gap:

- Brings predictability to a procedure still performed like it's 1985
- Has potential for IP (intellectual property) protection
- May be of interest to companies in medtech (e.g., Zimmer Biomet, Medtronic, Stryker, or smaller surgical startups)

DupuyFix System

PRECISION INJECTION SYSTEM FOR DUPUYTREN'S

