CordAlign™ Precision Wand

Integrating Imaging, Alignment, and Automated Delivery for Safer Dupuytren Treatment

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Background

Dupuytren cord injection requires precise, centered delivery of an enzyme into a narrow, variable subcutaneous structure. Traditional methods rely on freehand needle placement guided by separate ultrasound equipment. While handheld ultrasound devices can visualize the anatomy, they do not stabilize needle alignment, measure cord geometry, or ensure that the injection occurs in the cord's center. This creates a risk of off-target delivery, enzyme leakage, tendon injury, and inconsistent clinical results.

These challenges highlight the need for a unified system that not only visualizes the cord but guides needle orientation and controls the injection process itself. The **CordAlign™ Precision Wand (CPW)** addresses this need by integrating imaging, alignment, and micro-dose delivery in a single handheld device, enabling a safer and more reliable approach to Dupuytren cord injections.

AI-Guided Delivery and Multi-Injection Optimization

A complete Dupuytren injection procedure often requires **multiple sequential injections** spaced approximately **5–10 mm apart** along the length of the cord to achieve sufficient enzymatic weakening prior to manipulation. Performing this pattern manually, even with conventional ultrasound, is challenging because each site must be aligned precisely with the cord's centerline, which lies only a few millimeters deep. Small deviations can reduce weakening effectiveness, increase enzyme leakage, or heighten the risk of skin and tendon injury.

The CordAlign™ Precision Wand (CPW) addresses this by combining **UHF imaging**, **real-time geometric mapping**, and **AI-driven spatial analysis**. As the clinician progresses along the cord, CPW continuously identifies:

- the cord's local diameter and depth
- tension-bearing segments requiring enzymatic weakening
- recommended injection spacing (5–10 mm)
- avoidance zones (e.g., displaced neurovascular bundles)
- completion of each validated injection site

The wand then verifies alignment, depth, and tissue classification at each proposed site before enabling controlled micro-dose delivery. This transforms multi-injection delivery from a manual, skill-dependent task into a **structured, reproducible workflow**, enabling uniform cord weakening across its length and improving outcomes of the subsequent manipulation phase.

Concept Overview and Functional Description

The objective is to design a miniature device — the **CordAlign™ Precision Wand (CPW)** — that integrates an ultrasound cord-position (UCP) detector with a syringe mechanism capable of delivering a measured dose of enzyme directly into a Dupuytren cord. The signal from the UCP detector guides the syringe system through an AI-powered control application.

Conceptually, this system is very similar to a stud-finder used in the construction industry. In that tool, a nail hidden behind sheetrock triggers the movement of an internal magnet when the device is positioned exactly over it. The UCP detector functions in essentially the same way: it identifies and visualizes the Dupuytren cord beneath the skin and prompts the clinician to align the wand so that the needle is positioned precisely over the cord's centerline.

By integrating geometric mapping with multi-injection strategy logic, CPW ensures that the enzyme is delivered **not just accurately at one point**, but **reliably across multiple sites** that collectively prepare the cord for controlled manipulation. This transforms the traditional "single-injection plus trial-and-error" approach into a **precisely orchestrated sequence** guided by AI.

Beyond simple localization, the UCP module will also measure the diameter of the cord. This allows CPW to guide the clinician toward delivering the enzyme exactly into the cord's central axis, thereby minimizing off-target placement, leakage, and collateral tissue damage — the key clinical objective of the CordAlign™ Precision Wand. Importantly, the injection itself will be performed automatically by the wand's syringe mechanism after explicit approval from the clinician, ensuring that a precise dose is delivered to a precise location.

Because the wand is extremely light, portable, and easy to handle, it enables the clinician to move effortlessly along the cord and perform a series of accurate injections, significantly increasing treatment efficiency and improving the likelihood of a successful outcome.

Future Applications

After development, the CPW Wand could also be adapted for intravenous injections, making medication delivery quick, precise, and reliable — even into very small veins and arteries, including those located in areas that are difficult to access when necessary.

Summary of Key Innovations

The **CordAlign™ Precision Wand (CPW)** introduces a fundamentally new approach to ultrasound-guided injections by integrating imaging, geometric alignment, and controlled-dose delivery into a single handheld device. Unlike conventional ultrasound systems, which require clinicians to manually coordinate a probe, a needle, and a syringe, CPW stabilizes all components within one miniaturized wand. Its built-in Ultrasound Cord-Position (UCP) detector identifies the Dupuytren cord, measures its diameter, locates its centerline, and guides the clinician into perfect alignment—ensuring that each injection is delivered exactly where intended.

By automating both alignment and micro-dose delivery, CPW minimizes the risk of off-target enzyme leakage, reduces adjacent tissue injury, and enables rapid sequential injections along the cord with unprecedented precision. This capability is not available in any existing ultrasound or injection-guidance technology. CPW's platform design also positions it for future applications, including precise intravenous

access into very small or hard-to-reach veins and arteries, expanding its clinical value far beyond Dupuytren treatment. Additionally, CPW incorporates AI-guided multi-injection planning, determining ideal 5–10 mm spacing between sequential injection points, verifying centerline alignment at each site, and coordinating automated micro-dose delivery for consistent, continuous weakening along the treated cord segment.

Conclusions

The CordAlign™ Precision Wand represents a new category of integrated guidance technology for subcutaneous and vascular injections. By unifying real-time ultrasound visualization with automated geometric alignment and controlled-dose delivery, CPW aims to greatly improve the accuracy, consistency, and safety of Dupuytren enzyme treatment. Its ability to support rapid sequential injections along the cord not only streamlines the procedure but may also enhance therapeutic outcomes.

Looking ahead, CPW's modular platform enables expansion into other precision-guided applications, including access to small or difficult-to-reach veins and arteries. This positions CPW as both a clinically valuable tool and an innovative foundation for a broader generation of miniaturized, image-guided injection systems.