Dynamic ultrasound in hand rehabilitation: from the clinical question to functional benefit

Educational article - English edition

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Dynamic ultrasound shows tissue behaviour during movement. In hand rehabilitation, its value depends on the clinical question it answers: understanding a limitation, identifying a treatment target and checking the functional consequences of treatment.

Information supporting decisions

Medical diagnosis identifies the condition and helps define precautions. Rehabilitation diagnosis seeks to explain impairments limiting activity and identify factors amenable to intervention. The two approaches complement each other.

The same injury may produce different difficulties depending on pain, tissue mobility, joint restrictions and movement strategies. Ultrasound becomes relevant when a specific uncertainty remains. With limited active flexion, the question may concern tendon gliding; with triggering, agreement between the mechanical event and the symptom; with unsatisfactory progress, what requires treatment adjustment or medical reassessment. The hypothesis precedes image acquisition.

Tendon gliding: examine the interfaces

After zone II flexor repair, an important issue is tendon movement relative to its sheath and surrounding tissues. Available passive motion, reduced active flexion and limited tendon excursion must be considered together. Concordance may strengthen a restricted-gliding hypothesis, without dispensing with checking tendon continuity or the complete clinical assessment.

In the case shown two months after repair, dynamic observation supports adapting permitted gliding exercises. The image alone cannot determine a safe load. Healing, the postoperative protocol and the surgeon’s restrictions remain the framework for intervention.

A retrospective study by Budovec and colleagues examined 28 digits in 21 patients after tendon repair. Ultrasound correctly distinguished rupture from adhesions in 27 cases. This performance concerns a diagnostic question in a selected population. It does not, by itself, demonstrate superiority of ultrasound-adapted rehabilitation. [1]

The index proximal phalanx fracture case also illustrates the importance of interfaces. According to the presentation, restricted flexor gliding relative to bone helps explain the active limitation. Treatment reasoning then addresses the potentially modifiable mechanical component while considering bone healing and the full examination.

Follow change without confusing sequence with causation

Follow-up of tenosynovitis illustrates repeated assessment. In the example, an initial fluid collection is no longer visible after three weeks, while tissues appear more fibrous. If consistent with clinical findings, these observations may shift the treatment goal towards tissue mobility and gliding.

Two distinctions remain necessary: changed echogenicity does not establish a definite histological diagnosis, and changes observed during treatment cannot be attributed solely to the techniques applied. This case illustrates reasoned adaptation during follow-up.

Loading, Doppler and protection

In tendinopathy, ultrasound may complement assessment of load tolerance. Doppler signal reflects vascularity detected under the examination conditions. Changes require interpretation with comparable settings and acquisition conditions. Pain, response to effort and function remain necessary to guide progression.

A reduced Doppler signal alone does not prove restored tendon mechanical capacity. The flexor carpi radialis image in the presentation illustrates the signal; it is not a before-and-after treatment comparison. [2]

For volar plate injuries, monitoring combines tissue change, oedema, clinical stability and range of motion. Leclère and colleagues' retrospective series of 78 patients describes dynamic ultrasound use in this management. It documents a follow-up approach without, by itself, establishing the causal superiority of an imaging-guided strategy. [3]

Biofeedback: learn, then transfer

Ultrasound biofeedback gives patients visual information about tissue movement. The proposed sequence is to observe a permitted action, connect the image with intention and sensation, reproduce the action without the screen, then incorporate it into a functional task.

Immediate improvement under guidance is insufficient evidence of lasting learning. Retention and transfer must be assessed. Valera-Calero and colleagues' systematic review reports favourable findings for some exercise-performance parameters, but studies mainly concern muscle regions outside the hand and many healthy populations. Application to finger motor control remains to be validated specifically. [4]

From clinical practice to research: the scapholunate example

Mesplié and colleagues studied a mechanical question involving the scapholunate interval in 24 asymptomatic adults. Six conditions combined maximal pronation or supination at rest or with resisted isometric radial or ulnar deviation. Intrarater measurement reliability was good to excellent, with ICCs of 0.82-0.99.

Under the tested conditions, radial deviation reduced the dorsal interval and ulnar deviation increased it. Maximal supination produced a larger interval than maximal pronation.

These findings demonstrate measurable mechanical modulation and support rehabilitation hypotheses. They do not establish programme effectiveness in patients with scapholunate instability. The dorsal interval alone does not describe three-dimensional kinematics or overall carpal stability. [5]

Function remains the decisive outcome

Showing a phenomenon, measuring it reproducibly and demonstrating treatment benefit are distinct steps. Observation becomes useful when it contributes to an appropriate decision. That decision's effectiveness must then be assessed using outcomes that matter to the patient.

Repeated observations should maintain comparable tasks, positions and acquisition conditions. Differences between examinations must be considered against measurement error and clinical change. The opposite side provides an individual comparison without necessarily being a normal reference for every parameter.

Dynamic ultrasound's contribution can therefore be stated precisely: observe tissues during a task, compare findings with a hypothesis, adapt intervention and seek functional benefit. The next scientific question concerns actual utility: in which situations and for which patients does ultrasound information improve decisions and outcomes in hand rehabilitation?

References

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The conference cases illustrate clinical reasoning; they are not comparative evidence of effectiveness. Editorial visuals were produced using an image-generation tool. The first two use ultrasound images from the presentation as visual references. Clinical analysis requires the original acquisitions. Assessing gliding requires dynamic acquisition.

Illustrations from the original resource

Figure 1



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Figure 2



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