The Jp Sensometer: An Instrument to Train Joint Position Sense for the Wrist

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Introduction

Joint position sense assesses precision or accuracy in repositioning a joint at a predetermined target angle [1]. Joint position sense is a sub modality of proprioception and contributes to the sensorimotor control of the joints [2,3].

Previously published studies have demonstrated significant wrist and hand sensorimotor impairment and functional deficits after distal radius fractures and carpal ligament injuries [4,6].

The importance of measuring and re-training joint position sense after wrist trauma has been drawing attention recently. Therefore, restoring joint position sense should be integrated into a rehabilitation program in patients with wrist trauma to re-establish the sensorimotor control of this joint.

Two methods have been described to measure joint position sense: Ipsilateral matching and contralateral matching [7]. Ipsilateral matching is performed by passively positioning the joint to a specific angle, then asking the patient to replicate the same position actively. Contralateral matching follows the same process, but the participant is asked to replicate the angle with the contralateral limb. (See protocol below). It has been suggested that for re-training purposes, patients should start with ipsilateral matching and progress to contralateral matching, since the last one requires transmission between brain hemispheres in addition to working memory [6].

Measuring joint position sense of the wrist joint has been standardized by Karagiannopoulos et al. [8] using a standard goniometer. This method has demonstrated high intra-tester reliability and responsiveness [9].

Based on the studies mentioned above [8,9], hand therapists should teach patients to practice conscious joint position sense as part of their treatment and home exercise program. This can be accomplished at the clinic but requires the therapist to be present to obtain the measurements with a goniometer. In addition, it is difficult for patients to practice this exercise at home because there is no point of reference to measure with a goniometer. This method has demonstrated high intra-tester reliability and responsiveness [9].

In a clinical setting, a skilled hand therapist can integrate joint position re-training into their treatment session with the use of a goniometer. However, this can be time-consuming for the therapist to track all changes. Additionally, it is extremely challenging for patients to perform this activity at home independently.

To address these challenges, the authors created the JP Sensometer: a tool that provides immediate feedback and tracks progress. The JP Sensometer eliminates the need for a therapist to measure with a goniometer; the patients can perform the exercise independently and monitor progress themselves.

Description of the Jp Sensometer

The template was developed using AutoCAD® computer software utilized for Engineer and Architectural drafting to ensure accuracy in establishing angles within a 180 degree arc. The template was then printed onto a 12” × 9” wooden white board. Figure 1 depicts the JP Sensometer with the landmarks:

- Center point indicated with a cross as "wrist resting point".
- Blue lines indicate 0° as neutral point for the 5th finger when hand is on the ulnar side or the 3rd finger when hand is palm down. There are 10° increments to each side, up to 90 degrees.
- Green lines indicate 5° increments
- Black lines indicate 1° increments

In addition, the authors developed a log-in sheet (Figure 2) with pre-determined target angles and three trials per angle as a means to record progress.

How to Use the Jp Sensometer

The patient's forearm must be supported on a towel roll to minimize cutaneous input. This practice is based on literature that considers that pure joint position sense should come from the stimulus of the muscle spindles and the Golgi organ and not cutaneous input [10].

The patient aligns the wrist onto the center point of the template, marked as "place the wrist here". To perform wrist flexion and/or extension, the forearm is positioned in neutral (Figure 3).

To perform ulnar and radial deviation, the forearm is positioned in pronation, the wrist aligned on the center point and the middle finger aligned at the 0° marker (Figure 4).

Once the patient becomes familiar with the goals of the JP

Figure 1: Depicts the JP Sensometer with the landmarks.
Sensometer, the patient initiates the re-training exercises starting with ipsilateral matching.

**Protocol:**

1. Patient positions hand on the center marker.
2. Patient positions the hand in the target angle and holds the position for 3 seconds [8].
3. Patient returns to starting position.
4. Patient replicates the angle with eyes closed.
5. Patient documents the angles in the log in sheet.

For contralateral matching training, 2 boards are used in the same manner described in the protocol above.

Authors have used the JP Sensometer in the clinic with their patients for 5-10 minutes within a single session. Patients are provided with a template printed on paper as part of their home exercise program with specific instructions, including taping the template to a table top.

**Conclusions**

The JP sensometer is an instrument that allows patients with deficits in joint position sense to re-train independently. The JP Sensometer does not intend to replace goniometry measurements taken by the therapist; however, it offers the patient the possibility to have immediate feedback about his performance when practicing joint position sense and can be incorporated easily into clinical practice.

**References**