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Comparing clinical ratings and 3D kinematic measurements for tremor assessment. A pilot study

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Background: Clinical rating is the current gold standard for the evaluation of tremor. In neurologic examination, tremor of a body segment is expressed as displacement in centimeters in an ordinal scale [1]. Objective tremor quantification is often performed with inertial sensors, which indirectly estimate tremor in the frequency domain of either linear acceleration or angular velocity signals [2]. However, objective displacement in position units is rarely measured in both clinical and research practice.

Objectives: The aim of this study was to assess arms tremor as measure in position units and to compare it with clinical rating scales.

Methods: A kinematic analysis of movement was performed in patients with action tremor affecting upper limbs using six infrared HD digital cameras (BTS SMART-DX, Milan, Italy) and a refractive marker positioned in the third phalanx of each II finger. Tremor was recorded in forward outstretched position and measured as the 95° percentile of the linear displacement in the three axes (x, y and z). A linear regression analysis was run to understand the relationship between measured hand displacements and the score of TETRAS rating scale item for outstretched limb position (FO-TETRAS).

Results: N = 15 patients were enrolled (N = 6 ET; N = 6 ET-plus; N = 3 dystonic tremor) and N = 90 observations were obtained (left and right for each movement axis). Measured displacements were significantly associated with clinical estimations, accounting for 22.7 % of the variation in FO-TETRAS score ($F = 25.79$, $p < 0.001$; $R2 = 0.227$). One mm increment in tremor displacement leads to an increase of 0.4 point (95% CI: 0.23 to 0.54) in FO-TETRAS score. Overall, lower displacement values (max measured displacement = 6 mm) were found as compared to clinical ratings (max FO-TETRAS score = 2.5, corresponding by definition to a tremor amplitude between 3 and 5 cm).

Conclusion: Estimated point-to-point displacement significantly correlated with clinical ratings. However, kinematic tremor measurement showed smaller displacement values than clinical ratings. This should be considered when comparing wearable devices measurements of tremor.

References:

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