

Optically pumped magnetometers reveal fasciculations non-invasively

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This proof-of-principle-study evaluated the extent to which spontaneous activity (SA) of the muscle can be detected via non-invasive magnetomyography (MMG) with optically pumped magnetometers (OPM). Five patients, who together exhibited all forms of SA (fibrillations, positive sharp waves, fasciculations, myotonic discharges, complex-repetitive discharges) with conventional needle electromyography (EMG), were studied by OPM-MMG and simultaneous surface EMG (sEMG) while at rest, during light muscle activation, and when a muscle stretch reflex was elicited. Three healthy subjects were measured as controls. SA was considered apparent in the OPM-MMG if a signal could be visually detected that corresponded in shape and frequency to the SA in the respective needle EMG. SA in the context of fasciculations could be detected in 2 of 5 patients by simultaneous OPM-MMG/sEMG (Figure 1). Other forms of SA could not be detected at rest, during light muscle activation, or after provocation of a muscle stretch reflex. We show that other forms of SA are not detectable with current OPM and propose necessary technical solutions to overcome this circumstance. Our results motivate to pursue OPM-MMG as a new clinical neurophysiological diagnostic.

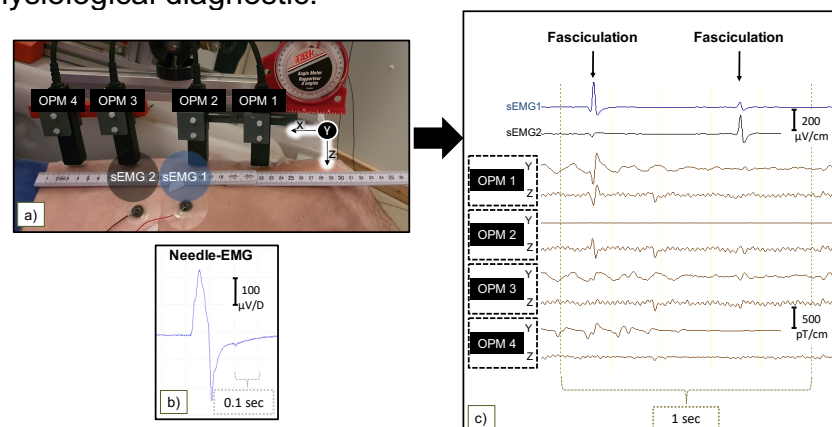


Figure 1: Simultaneous optically pumped magnetometer – electromyography (OPM-EMG)-Setup with recording of fasciculations. **a)** Picture of a patient with fasciculations. Optically pumped magnetometer (OPM) 1-4 were placed from distal (OPM 1) to proximal (OPM 4). Medial to OPM 1 and 2, two surface EMG-electrodes were also placed. An additional reference electrode was attached to the ipsilateral lateral knee. **b)** Fasciculation recorded in the needle EMG of patient #5, who also showed fasciculation in a simultaneous OPM-EMG (right). **c)** Representative example two fasciculations with simultaneous OPM-EMG. Note that the measurement of the Y-component of the flux density of OPM 2 was not acquired due to technical issues (saturation of the analog-to-digital converter of the OPM); therefore, only a flat line is shown.