ICS Terms in PFM Assessment - EMG - pre publication

Table 12. Parameters and findings evaluated with sEMG

Parameters, specifications (units of measure) and measurement processes	**Outputs and interpretation of findings**
a). Parameters assessed at rest	
3.4.2.1 Baseline muscle activity: the amount of microvolts generated by activation of motor units in the target muscle during rest[27,75]. FN3.10, FN3.11	**3.4.2.1.1 Inconsistent resting baseline**: the variation of baseline between contractions, between sets, or between days[27,75]. **3.4.2.1.2 Elevated resting activity:** an increase in the active component of muscle tone; (the passive/viscoelastic component is not captured by sEMG). (**NEW**.
b). Parameters evaluating contractile properties	
3.4.2.2 Signal amplitude: microvolts (μV) a muscle generates[27]. Specify: - MVC contraction duration (s) - how the signal was processed. Signals are usually rectified and filtered to measure amplitude[112] i.e. average rectified value or root-mean-square[112].	sEMG amplitude reflects muscle activation[115]. Increase in sEMG amplitude is related to the recruitment of motor units and increased firing rate[116]. The amplitude of the signal should not be interpreted as a direct force measurement because the relationship between force and EMG is generally not linear and is affected by type of contraction (concentric/isometric/eccentric), speed of contraction.). During strength training, early gains in force output are mainly related to an increase in motor unit recruitment and discharge frequency which will result in a higher signal amplitude. Later gains explained by hypertrophy[27] are not reflected in increased sEMG amplitude
3.4.2.3 Peak amplitude: the highest sEMG amplitude achieved measured in microvolts[27,75]. Specify the duration (s). Measured during an MVC or functional activities such as postural tasks or incontinence provocative activities[123,124]. FN3.12	
3.4.2.4 Normalization of the amplitude: the value obtained during a specific task as a percent relative to the electrical activity detected during a MVC[111,115]. (**NEW)**	
3.4.2.5 Time to peak muscle activation: time in ms or s from onset of muscle activity to peak activity. (**NEW)** **Rate of change:** the mean slope of the ascending curve in μVs during a fast MVC**.** (**NEW)**	**3.4.2.5.1 Slow recruitment:** a longer time to peak muscle activation in s or a slower rate of change[125] **(CHANGED)**[27]. FN3.13, FN3.14
3.4.2.6 Reaction time: the latency (time in ms) between a stimulus (or the command) and the onset of muscle activation[126]. (**NEW)** FN3.15 **3.4.2.7 Time from command to peak:** time in ms from stimulus to peak activity. (**NEW)** This term encompasses both the reaction time and the time to peak muscle activation.	**3.4.2.6.1 Slow reaction time:** a longer time to initiate muscle activation. (**NEW)**

3.4.2.8 Time to return to baseline muscle activity: time in s from peak activity to resting activity. (**NEW)** **Rate of change:** the mean slope of the descending curve in uV/s during a fast MVC**.**	**3.4.2.8.1 Slow de-recruitment**: slow relaxation of the muscle contraction[27].
3.4.2.9 Rate of change of amplitude during sustained contraction: the change in sEMG amplitude divided by the duration of the contraction: $EMG_{final} - EMG_{initial}$/time(s)[127]. (**NEW).** The contraction could be sustained or intermittent at different % of MVC[127].	A higher rate of change will be indicative of lower endurance.
3.4.2.10 Timing of muscle activity: onset of the activation in milliseconds can be assessed in relation to onset of activation in other muscles, provocative activities or other aspects of a task. **(NEW)**	• normal • delayed: delayed activation of the PFM relative to the onset of a cough or a postural perturbation has been found in women with stress urinary incontinence[124]
3.4.2.11 Duration of a sustained contraction: the duration in seconds that a contraction could be sustained at a specific % of MVC[127]. (**NEW)**	A shorter duration suggests lower endurance.
3.4.2.12 Power spectrum: the distribution of frequency components of the sEMG signals, measured in Hz[112]. (**NEW)**	The median frequency of the sEMG power spectrum shifts to lower frequencies as a muscle fatigues due to altered muscle fiber recruitment and other changes in the contractile properties[128,129].

Abbreviations: sEMG, surface electromyography; MVC, maximum voluntary contraction; PFM, pelvic floor muscles; uV microvolts.

FN3.10 The recording of resting activity is highly susceptible to contamination by ambient noise. A low proportion of noise in the signal (or higher signal-to-noise ratio) is necessary for accurate assessment.

FN3.11 Unlike many other skeletal muscles[121,122], the PFMs are thought to have a level of constant EMG activity in order to maintain continence and support of pelvic/abdominal contents.

FN3.12 Advanced EMG techniques are needed to prevent inaccurate interpretation from artefacts and muscle crosstalk.

FN3.13 Slow recruitment could be a sign of PFM dysfunction if it leads to leakage during coughing and sneezing when a quick muscle contraction is needed to counteract increased intra-abdominal pressure[27,75].

FN3.14 The definition for this term used in Bo et al[27] is the definition this document calls ‘slow reaction time’.

FN3.15 This may also be considered in the motor control domain.