Measuring Jitter with Concentric Needle electrodes

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SFEMG Principles
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SFEMG; jitter

Principles of selectivity of SFEMG
• small recording surface
• high pass filter (500 Hz)
• this restricts active uptake radius to 300 µm
• inside this hemisphere, there are 1-2 muscle fibers in the normal muscle from a given MU

New rules
Many countries do not allow re-usable material for invasive procedures, including EMG electrodes.

Today no disposable SFEMG electrodes are available. Alternatives necessary.

Conventional EMG electrodes
Larger uptake area, enclosing 3-10 fibers in a normal MU.

The motor unit potential, MUP is the sum of these muscle fiber action potentials.
Four types of EMG electrodes

<table>
<thead>
<tr>
<th>Recording surface</th>
<th>width (µm)</th>
<th>length (µm)</th>
<th>area (mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>monopolar</td>
<td>680</td>
<td>0.240</td>
<td></td>
</tr>
<tr>
<td>concentric</td>
<td>150</td>
<td>580</td>
<td>0.070</td>
</tr>
<tr>
<td>concentric, facial</td>
<td>80</td>
<td>300</td>
<td>0.019</td>
</tr>
<tr>
<td>SFEMG</td>
<td>25</td>
<td>25</td>
<td>0.0005</td>
</tr>
</tbody>
</table>

Three types of EMG electrodes

Pitfalls in narrow signal filtering

Filter settings for Jitter recordings with CNE

1000Hz-10 KHz

1000Hz gives a balance of:
* reduction of slow wave components
* still allowing visual detection of summation
Although contaminated, is it possible to use these "Apparent SF Action Potentials", ASFAP, for jitter analysis?
Jitter in a compound signal is smaller than its constituents

Examples of super-impositions

Jitter with conc needle electrode acceptable

Jitter with conc needle electrode not acceptable

Large Jitter with conc needle electrode acceptable
Conc jitter at vol contraction
Effect of measuring technique

- Level trigger:
  - separate signals - OK
  - riding signals (<150-300 usec) will increase jitter

- Peak trigger:
  - separate signals - OK
  - riding signals, nearly correct value
  - noise will affect the measurements

MCD with SF and Conc electrodes in the same session
Stålberg-Rehmal, unpublished

High pass filter (500) 1000Hz
Peak analysis
Mixed material; normal
MG, with or w/o treatment
other neuromuscle disorders

Mixed material; normal
MG, with or w/o treatment
other neuromuscle disorders

Jitter SF vs Conc, mixed diagn
>#>10 values, total mtrl; n=92

Stimulation Jitter analysis with CNE
Stimulate with monopolar needle electrode:
- intramuscularly
- extramuscularly

Stimulate with surface electrode
- percutaneously

Jitter in control subjects

Comparison between voluntary and electrical activation
CNE recordings at electrical stimulation from frontalis, orbicularis oculi, EDC

Courtesy Dr J Kooyumjian
Conclusion

**TECHNICAL**
- Measure only from really spiky components (definitions needed)
- Separation from other spikes > 150-300 µs
- Peak algorithm better than level in noise free signals

**METHOD CHARACTERISTICS**
- Conc jitter somewhat lower than SF (3-5 µs for EDC)
- Diagnostic sensitivity about the same for SFEMG and CNE jitter - CAUTION in the interpretation of borderline findings
- Disposable conc electrode better than a bad SF electrode. USE the SMALL CNE electrode
- SF-electrode superior
- Conc cannot be used for FD measurements
- Studies with el.stim have more pitfalls than with vol.act.