Multi-unit microneurography and modeling of afferent responses of human muscle mechanoreceptors

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Ethical review	Approved WMO
Status	Recruitment stopped
Health condition type	Other condition
Study type	Observational invasive

Summary

ID

NL-OMON35175

Source
ToetsingOnline

Brief title
Multi-unit microneurography of human muscle afferents

Condition

- Other condition
- Neuromuscular disorders

Synonym
function of mechanoreceptors; function of muscle spindles and Golgi tendon organs

Health condition

fysiologie of diagnostiek van de functie van mechanoreceptoren in spieren

Research involving
Human

Sponsors and support

Primary sponsor: Universitair Medisch Centrum Utrecht
Source(s) of monetary or material Support: Ministerie van OC&W

Intervention

Keyword: humans, mechanoreceptors, microneurography, muscle

Outcome measures

Primary outcome

The primary outcomes of this study are the time required for finding a useful electrode position, the measurement duration until signal loss, a variety of indicators for the (relative) presence of the different fiber types in the signal, the signal-to-noise ratio and the test reproducibility.

Secondary outcome

Secondary output parameters are diverse quantitative (model) descriptions of the mechanoreceptor functions, like the effect of amplitude and frequency of the movements, and the optimized settings of filters and other signal analysis techniques.

Study description

Background summary

Research of human muscle reflexes strives to distinguish the dynamic properties of the different parts of the reflex loop. For this purpose, the research group of Prof. van der Helm is using since a few years mathematical physiological models of the neuromusculoskeletal system of the ankle, wrist, shoulder and other joints. These models are validated by applying mechanical stimuli to subjects, using robotic manipulators and measuring muscle force, position and EMG. Besides for fundamental physiological research, this method has been found useful for the acquisition of patient data. For instance, it has been found that healthy subjects dynamically adapt their reflexes to the task, but that

neurological disorders decrease this capability for reflex modulation. The physiological mechanisms of reflex modulations are not well understood. Reflex strength could be modified via the pyramidal tract, by pre-synaptic inhibition, but also by the fusimotor system, which regulates the sensitivity of muscle spindles via the efferent gamma fibers. The current method can not discriminate between the effects of muscle mechanoreceptors (as non-linear sensors) and the central nervous system. This requires direct measurement of the mechanoreceptors signals, which can only be done using microneurography, inserting a micro-electrode into a nerve fascicle.
The common 'single-unit' microneurographic technique records the signal from a single axon. This method has major practical drawbacks. It is hard to find the appropriate axon type; and even the smallest movements of the needle can cause signal loss, such that one often has to be content with 5 minute recordings. Furthermore, a single-unit recording gives only a very limited subset of all afferent information that reaches the central nervous system. These practical aspects seriously limit the applicability of single-unit microneurography.
We hypothesize that multi-unit microneurography, using a bigger electrode pick-up area, will reduce these problems. This technique measures the activity of multiple nerve fibers simultaneously. It is to be expected that this will relax the requirements on electrode position, requiring less time to find an electrode position and giving the opportunity of lengthier registrations. Increased stability would be a great benefit, especially when studying subjects during natural tasks. In the long term, we hope to use this method also for investigations in subjects with neurological disorders.
Simultaneous contributions from various afferent (muscle spindle, Golgi tendon organ, cutaneous) and efferent (alpha motor neuron, autonomic) nerves are to be expected in the recordings. It is new and innovative in the proposed research project to separate these signals using advanced system identification techniques, taking advantage of the robot manipulator to accurately generate and measure a variety of carefully designed movement and force patterns.

Study objective

In this research project, we will investigate the feasibility of multi-unit microneurography for the research of human muscle mechanoreceptors. We will therefore answer the following questions:
1) How hard is it to find and maintain an effective electrode site? In terms of success rate, search and measurement times; these are aspects where single unit microneurography is notorious?
2) Which types of nerve fibers contribute to a multi-unit recording, and can we discriminate between the various afferent and efferent signal sources?
3) What is the quality of the obtained signals, expressed as signal-to-noise ratio and reproducibility?

We will use successfully obtained recordings for modeling of multi-fiber (muscle spindle) responses and to optimize the applied technique.

Study design

In an observational study setup, we will make multi-unit microneurograms during a variety of active and passive
movements of the wrist joint.

Study burden and risks

The subjects are asked for a measurement sessions in a seating posture, with a maximum duration of 3 hours, with
passive and active movements of the wrist joint, with limited amplitude and force. For the microneurography, a 0.2mm
needle electrode will be inserted in the radial nerve. This is known as a safe technique. There is a chance (< 10%) of mild
aftereffects. Such effects normally dissolve spontaneously within two weeks. Searching an electrode position can be uncomfortable for the subject. Searching time is limited to 45 minutes. Decreased
searching times (as compared to single-unit microneurography) is one of the expected advantages of multi-unit
microneurography that we want to research.

Contacts

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Trial sites

Listed location countries

Netherlands

Eligibility criteria

Age
Adults (18-64 years)
Elderly (65 years and older)

Inclusion criteria

healthy volunteers
using no medication
age at least 18 years

Exclusion criteria

microneurographic examination of nervus radialis of same arm in previous month
history of movement disorders in the arms

Study design

Design

Study type: Observational invasive

Masking:	Open (masking not used)
Control:	Uncontrolled
Primary purpose:	Diagnostic

Recruitment

NL

Recruitment status:	Recruitment stopped
Start date (anticipated):	07-04-2008
Enrollment:	14
Type:	Actual

Ethics review

Approved WMO Date:	12-02-2008
Application type:	First submission
Review commission:	METC Universitair Medisch Centrum Utrecht (Utrecht)
Approved WMO Date:	05-07-2010
Application type:	Amendment
Review commission:	METC Universitair Medisch Centrum Utrecht (Utrecht)

Study registrations

Followed up by the following (possibly more current) registration

No registrations found.

Other (possibly less up-to-date) registrations in this register

No registrations found.

In other registers

Register	ID
CCMO	NL21168.041.07