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

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Ethical review	Not approved
Status	Will not start
Health condition type	Other condition
Study type	Observational invasive

Summary

ID

NL-OMON31125

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 time until signal loss and a variety of indicators for the (relative) presence of the different fiber types in the signal.

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 and evaluation of treatment methods and neuromuscular disorders. However, it can not discriminate between the

effects of muscle mechanoreceptors (muscle spindles and Golgi Tendon organs) and the central nervous system. Notably the role of non-linear mechanoreceptor behavior and of fusimotor activity (efferents dynamically change muscle spindle sensitivity) in the muscle reflexes is not yet well understood.
To investigate these effects, the mechanoreceptors signals must be measured directly. This can only be done using microneurography, inserting a micro-electrode into a nerve fascicle and carefully positioning it to find the signal of a single mechanoreceptor. This 'single-unit' technique can give very detailed information, but 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. 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.
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

Our goal is to acquire a practical, maybe even clinically useful microneurographic technique. In this research project, we will investigate the usefulness of multi-unit microneurography for the research of human muscle mechanoreceptors, by answering two questions:
1) Practical feasibility, especially regarding aspects for which single-unit microneurography is notorious. How hard is it to find and keep an effective electrode position?
2) Contributing nerve fibers. Can we discriminate between the various afferent and efferent signal sources? What fibers contribute to a multi-unit recording?
Secondary goals are the comparison of multi-fiber microneurograms with published single-unit results for various movements, velocities and forces, and the optimization of the microneurographic technique and signal processing.

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 18 - 40 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:	Will not start
Enrollment:	14
Type:	Anticipated

Ethics review

Not approved

Date:	26-06-2007
Application type:	First submission
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	NL17090.041.07