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Projet N° 4.7.360 - Project N° 4.7.360

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Fine adaptive control of precision grip after median nerve mobilization

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Teamwork

Fine adaptive precision grip control without maximum pinch strength changes after upper limb neurodynamic mobilization

Frédéric Dierick[1,2,3]✉, Jean-Michel Brismée[4], Olivier White[5,6], Anne-France Bouché[7], Céline Périchon[3], Nastasia Filoni[3], Vincent Barvaux[3] & Fabien Buisseret[3,8]

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Introduction

- Median nerve: key player in hand function
- Role of median nerve in precision grip control (healthy subjects)
  - Microneurography, anesthetic blocks (wrist, hand)
  - Scaling of grip force (GF), coupling GF-Load force (LF)
- Role of median nerve in precision grip control (carpal tunnel syndrome)
- OMPT: UL neurodynamic mobilizations for median nerve (ULNT1)
- Effects of tension and sliding on median nerve is unclear
- Objective: explore physiological grip (3-jaw chuck pinch) responses, maximum pinch strength and fingertips pressure sensation tresholds (thumb, index, major) before and immediately after ULNT1

Methods: participants

- 49 students recruited, 40 students included
  - 24 males, 16 females
  - Age: 26±2 years
  - 34 right-handed, 6 left-handed
- Inclusion: 18-30 years, no neck and dominant UL symptoms
- Exclusion (n=9): DASH>1

Methods: ULNT1 maneuver

- Randomly received passive ULNT1 maneuver:
  - sliding (n=20), tensioning (n=20)
- Elbow slowly extended to the point of pain tolerance, a position of the elbow located at submaximal pain
  - "the position at which pain or tingling increased and the participant wanted the extension movement to be ceased"
- 20 repetitions

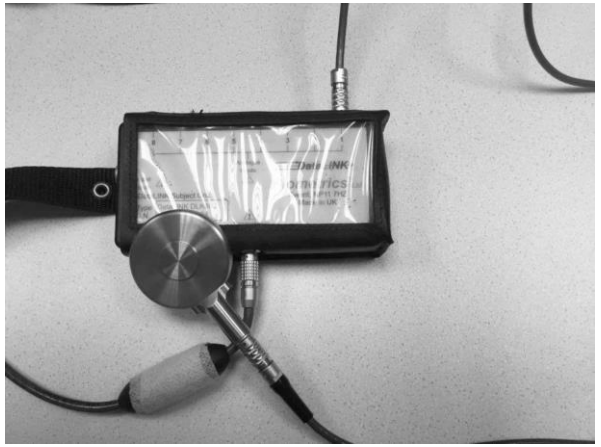
Sliding

ULNT1

Tensioning

Methods: pinch strength & fingertips pressure sensation treshold

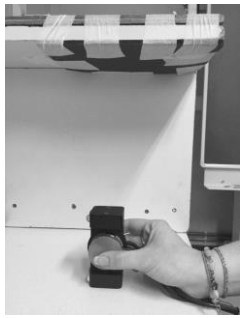
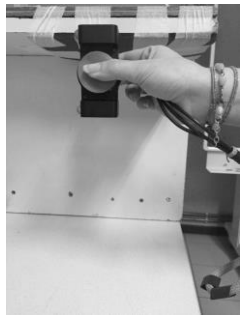
- 3-jaw chuck (palmar) pinch
- Maximum vouluntary pinch strength of dominant hand



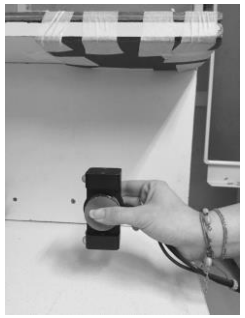
- Semmes-Weinstein monofilament testing
- Fingertips of thumb, index, major fingers
- Smallest monofilament recoded

Methods: 3 precision grip control tasks

Grip-lift-hold-replace (GLHR)

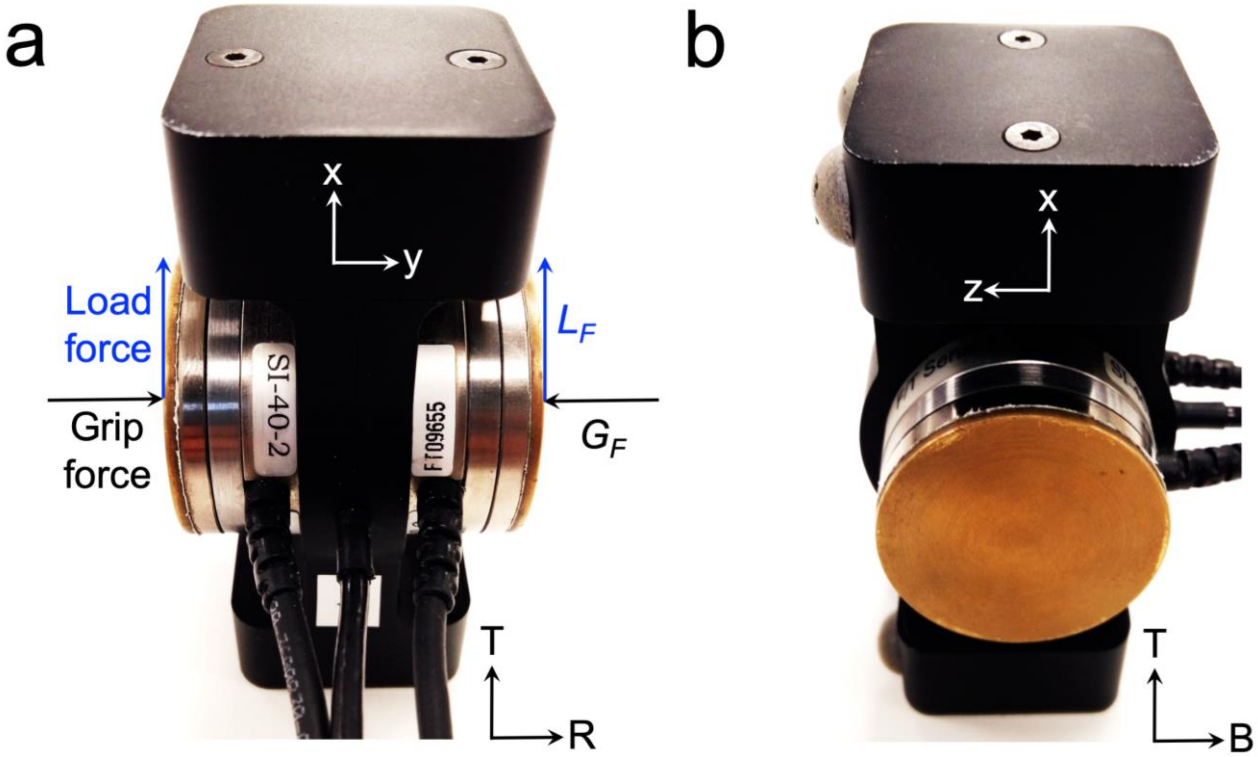




Oscillations (OSC)

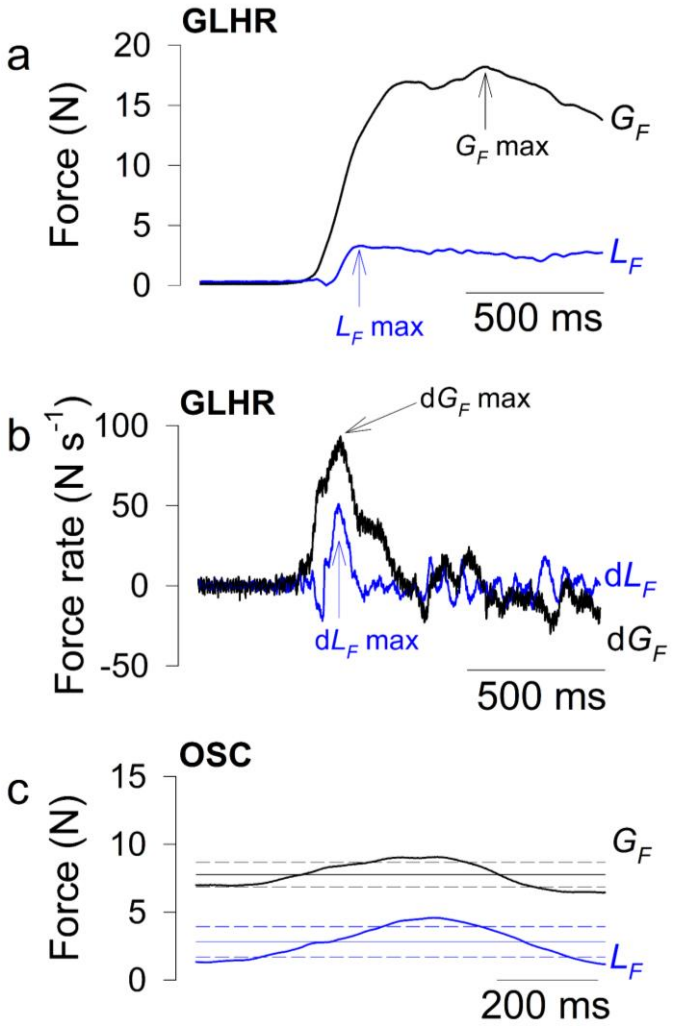


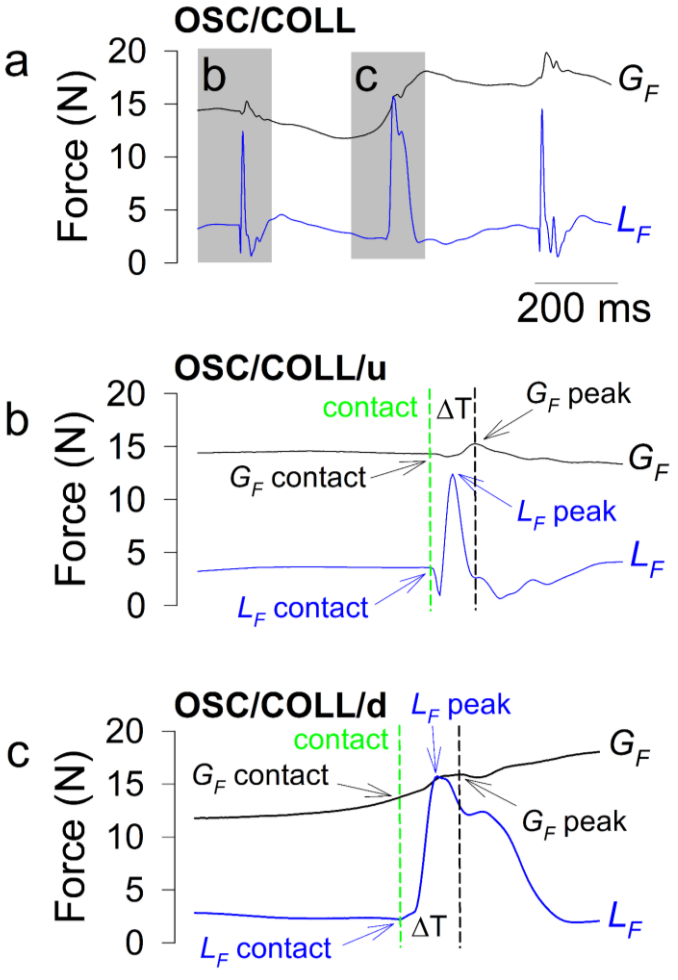

Ocsillations with collisions (OSC/COLL)

Methods: precision grip control assessment

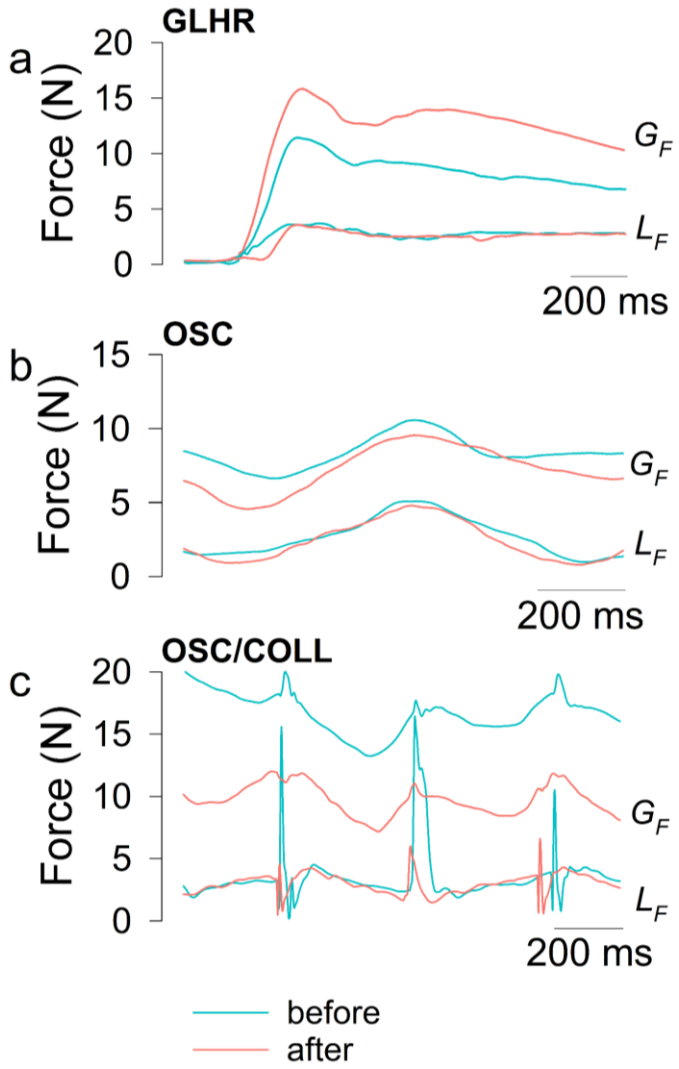


Methods: precision grip control metrics



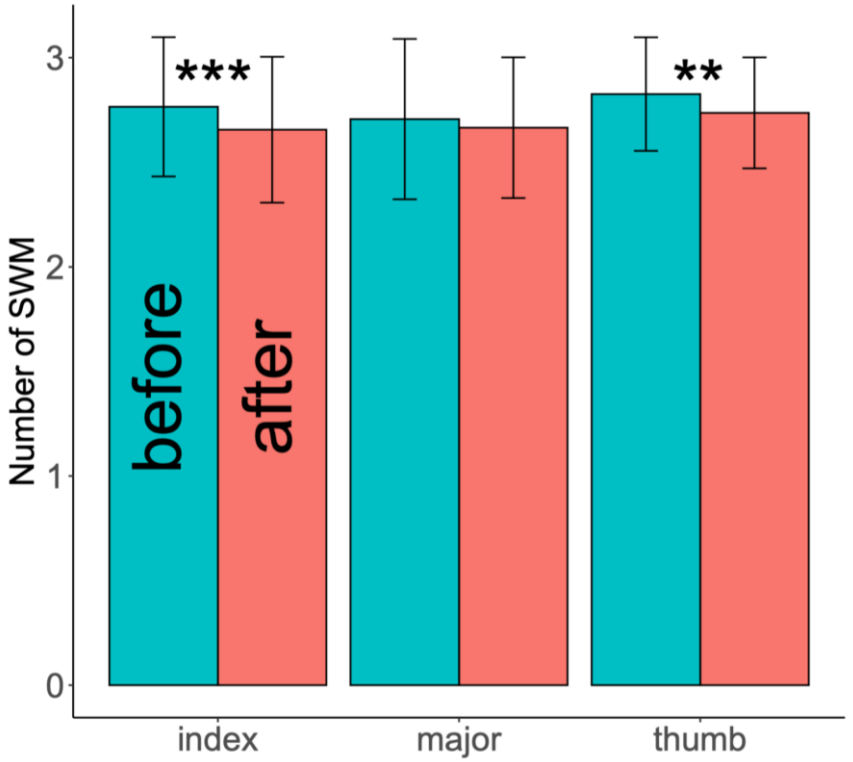


Results



Variable	Before (Mean ± SD)	After (mean ± SD)	F value	*p* value
Pinch strength				
Maximum force (*kg*)	8.1 ± 2.0	8.4 ± 2.2	2.12	0.153
Grip-lift-hold-replace (GLHR)				
G_F max (*N*)	15.2 ± 13.4	15.0 ± 11.1	0.03	0.86
L_F max (*N*)	3.2 ± 0.4	3.4 ± 0.4	6.66	**0.014**
dG_F max ($N\ s^{-1}$)	89.0 ± 66.6	106.2 ± 59.6	7.54	**0.009**
dL_F max ($N\ s^{-1}$)	43.6 ± 17.0	56.0 ± 17.9	19.56	**<0.001**
Oscillations (OSC)				
G_F mean (*N*)	8.1 ± 4.0	8.1 ± 4.7	0.001	0.974
L_F mean (*N*)	2.3 ± 0.2	2.4 ± 0.3	2.59	0.116
G_F SD (*N*)	1.8 ± 1.5	1.8 ± 1.6	0.004	0.951
L_F SD (*N*)	0.9 ± 0.3	1.0 ± 0.2	9.34	**0.004**
Oscillations with up collisions (OSC/COLL/u)				
G_F peak (*N*)	13.3 ± 7.1	12.5 ± 7.3	1.39	0.245
L_F peak (*N*)	17.4 ± 8.3	15.1 ± 7.5	15.35	**<0.001**
G_F contact (*N*)	12.4 ± 6.7	11.3 ± 6.8	4.88	**0.033**
L_F contact (*N*)	2.9 ± 0.4	3.0 ± 0.4	6.14	**0.018**
ΔT (*ms*)	74.9 ± 39.8	74.6 ± 32.9	0.003	0.956
Oscillations with down collisions (OSC/COLL/d)				
G_F peak (*N*)	13.5 ± 7.4	12.3 ± 7.7	5.05	**0.030**
L_F peak (*N*)	14.5 ± 6.0	13.6 ± 5.5	6.11	**0.018**
G_F contact (*N*)	11.7 ± 6.7	10.5 ± 6.8	3.02	0.090
L_F contact (*N*)	2.3 ± 0.8	2.4 ± 0.9	0.128	0.722
ΔT (*ms*)	45.4 ± 30.4	46.8 ± 30.3	0.212	0.648

Results



Discussion

- Intended to capture immediate effects of ULNT1
- 3 motor tasks: dynamics of object (GLHR), UL (OSC), both (OSC/COLL)
- Feedforward and feedback mechanisms used by CNS
  - Internal models to anticipate LF and adjusting GF
  - Sensory input (mechanoreceptors in fingertips)
- Decrease of pressure sensation treshold and fine modifications of precision grip control (mainly LF and dLF): predictive feedforward mechanism modified after ULNT1
- Since elder people favor feedforward mechanisms: future studies exploring effects of ULNT1 in patients with CTS must focus on active and reactive collision paradigms

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