Subclinical motor impairment assessed by an engineered glove correlates with MRI brain damage in radiologically isolated syndrome

Laura Bonzano[1], Marco Bove[1], Maria Pia Sormani[1], Maria Laura Stromillo[2], Antonio Giorgio[2], Andrea Tacchino[1], Giovanni Luigi Mancardi[1], and Nicola De Stefano[2]

[1]University of Genoa, Genoa, Italy

[2]University of Siena, Siena, Italy

BACKGROUND

The increasing use of magnetic resonance imaging (MRI) in the diagnostic work-up of multiple sclerosis (MS) has contributed to identify **asymptomatic subjects with unpredicted brain MRI abnormalities suggestive of MS**, defined as **subjects with radiologically isolated syndrome (RIS)** (Okuda et al., Neurology 2009).

An engineered glove measuring finger motor performance has been demonstrated to provide reproducible parameters able to discriminate healthy controls (HC) and people with MS even at the early disease stage, with high sensitivity in detecting a subclinical impairment not revealed by the commonly adopted clinical scales (Bonzano et al., 2013).

AIM

To **quantitatively assess finger motor performance in a cohort of subjects with RIS** with respect to a group of HC and its **relationship with MRI measures**.

MATERIALS & METHODS

17 subjects with RIS (mean age: 37.3±10.0 years) and 17 sex- and age-matched HC performed a repetitive **finger-to-thumb opposition sequence** (index, medium, ring and little finger) with their dominant hand **at maximal velocity (MV), and bimanually metronome-paced (2Hz)**. A sensor-engineered glove (Fig. 1) was used to calculate: movement ***RATE***, i.e. the number of touches per second, and ***Inter Hand Interval (IHI)*** for the bimanual trial, i.e. the absolute time difference between the touch onset occurring in the left hand and the corresponding one in the right hand (**the larger the IHI value, the more severe the impairment in bimanual coordination**) (Bonzano et al., 2008).

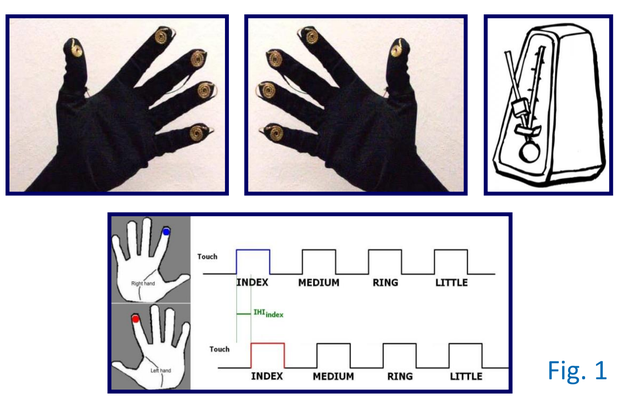


Fig. 1

All subjects underwent conventional MRI and **diffusion tensor imaging** (DTI) to obtain global **T2-lesion volume** (LV), fractional anisotropy (FA), axial diffusivity (AD) and radial diffusivity (RD) of the white matter "skeleton", obtained with tract-based spatial statistics (TBSS).

RIS subjects were **clinically followed up for 6 years.**

RESULTS (I)

Worse finger motor performance was found in subjects with RIS with respect to HC:

- RATE was significantly lower (2.6±0.5 vs. 3.4±0.9 Hz, p=0.005) , indicating movement slowing (Fig. 2);
- IHI was significantly higher (25.6±10.8 vs. 17.5±6.7 ms, p=0.006), indicating bimanual coordination impairment (Fig. 3).

Fig. 2

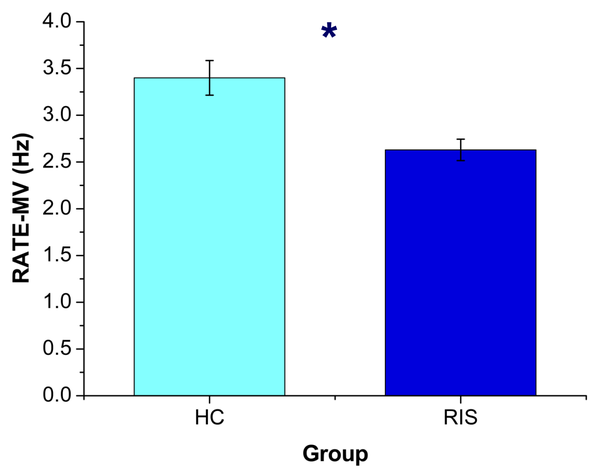
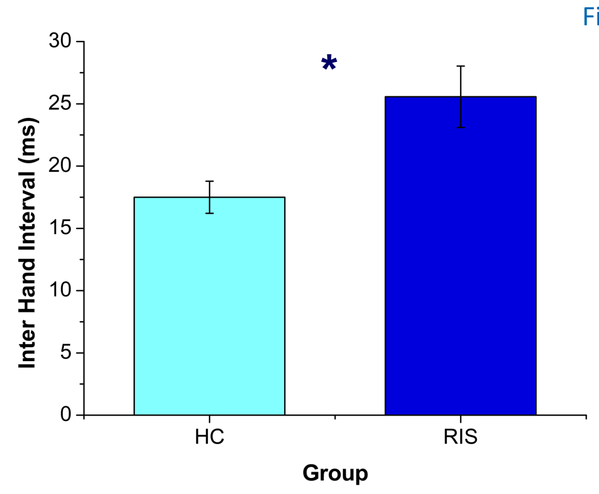


Fig. 3



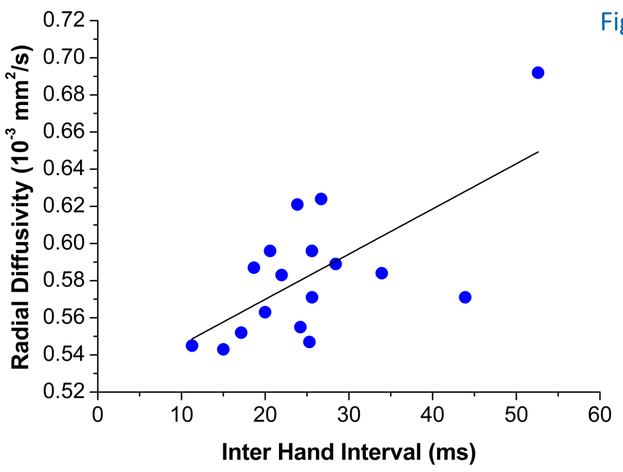
HC = healthy controls; RIS = subjects with radiologically isolated syndrome; * = statistical significance.

DTI was also significantly **altered** (FA: 0.42±0.02 vs. 0.44±0.01, p=0.02; AD: 1.13±0.02 vs. 1.11±0.02 x 10^{-3} mm^2/s, p=0.04; RD: 0.58±0.04 vs. 0.55±0.02 x 10^{-3} mm^2/s, p=0.005).

At multivariate analysis **RD** (OR=1.1, p=0.01) **and RATE** (OR=0.7, p=0.02) were independently retained in the model **providing the greatest discrimination between groups** (C=92%).

IHI of RIS subjects correlated with LV (r=0.42), **RD** (r=0.55) (Fig. 4) **and FA** (r=-0.43).

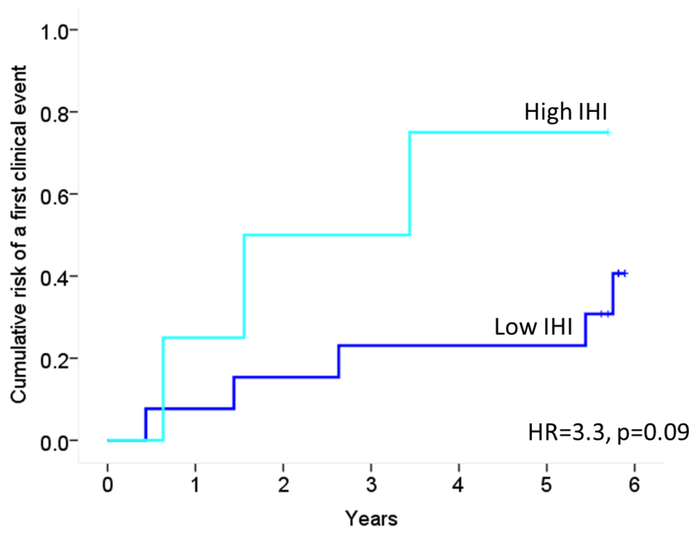
Fig. 4



In the follow-up, 8 out of 17 RIS subjects had a clinical event; **the time to the first event was shorter for those in the highest IHI quartile** (HR=3.3, p=0.09) (Fig. 5).

RESULTS (II)

Fig. 5



DISCUSSION

The results show **subtle impairment of motor performance in our group of asymptomatic subjects**, as revealed by the finger motor parameters indicating **movement slowing and bimanual coordination deficit**; this was **related to diffuse microstructural white matter damage**, as detected by DTI. In particular, **greater bimanual coordination impairment led to shorter time to the first clinical symptom**, suggesting the importance of quantitative evaluation of fine motor performance.

CONCLUSIONS

These findings point out to the importance of including **quantitative evaluation of fine motor performance** to provide a better characterization of these subjects.

This methodology could be **potentially useful for diagnostic and therapeutic decisions**.

Conflicts of interest

Maria Pia Sormani received consulting fees from Biogen Idec, Merck Serono, Synthon, Actelion, Allozyne, Teva. Giovanni Luigi Mancardi received honoraria for lecturing, travel expenses for attending meetings and financial support for research from Bayer Schering, Biogen Idec, Sanofi-Aventis, Novartis and Merck Serono. N. De Stefano has received honoraria from Schering, Biogen-Dompè, Teva and Merck-Serono for consulting services, speaking and travel support. The other authors have no conflicts of interest.

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CONTACT: laura.bonzano@unige.it