NEW PARAMETER IN MULTIPLE SCLEROSIS ANALYSIS

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Summary
Changes in motor evoked potentials in patients with multiple sclerosis (MS) during the process of magnetic stimulation were analysed. Several specific muscle responses were studied and a new multiplication factor (MF) was defined as the ratio between average latency times or central motor conduction times (CMCTs) and average times with a reference in healthy group and corresponds to each grade of Kurtzke Disability Status Scale.
This parameter shows a great utility in the assessment of motor dysfunction, correlating with the severity and nature of MS with a special role both in disease diagnosis and tracking of the evolution of pathological processes from the early illness stages until Kurtzke scale value of 6.
The variation of multiplication factor values on each appropriate muscle response is presented, depending on the specific magnetic stimulation and the Kurtzke scale.
Four multiplication factor types were defined by taking into account CMCTs and respective latency times for cortical, cervical and lumbar stimulations.

Key words: multiple sclerosis, magnetic stimulation, motor evoked potential, multiplication factor

CONSIDERED PARAMETERS

Increase in latency of motor evoked potentials (MEP) in multiple sclerosis (MS) is caused by high values of central motor conduction time as an effect of slowing the transmission of nerve impulses through the cortico-spinal tract depending on the degree of axonal degeneration, while the cervical latency shows much lower values. These observations are characteristic for demyelization process in the cerebral nervous system, of which the values are confirmed by this study (9, 10, 11).

While comparing the parameters of motor evoked potentials (MEP), statistically significant changes in cortical latency values were found in patients with Kurtzke scale of five and six, compared with patients in early stages of the disease (1, 2).

The paper analyzes MEP changes concerning the silent periods of cortical and spinal stimulation as well as CMCTs to brachial biceps muscle, tibialis muscle and thenar eminence muscles by using the criteria based on the MF evolution considering the Kurtzke scale from 1 to 6 (1, 7).

The comparative analysis of the statistic data has shown to be extremely useful in order to define a parameter summarizing the evolution of pathological processes from the early stages of the MS disease until the advanced forms (5, 7). The CMCTs which represents the difference between cortical and cervical latencies, was considered as a key factor in calculating the MF values. The cortical, cervical and lumbar latencies were used to determine the characteristic MF for these three parameters respectively.

The proposed four multiplication factors MF types are:

a) **MF-CMCT** – multiplication factor on CMCTs (ratio between MS patient's CMCTs and reference in healthy group CMCTs)

b) **MF-C** – multiplication factor on cortical latency (ratio between MS patients cortical latency and reference for cortical latency in healthy group)

c) **MF-S** – multiplication factor on cervical latency (ratio between MS patients cervical latency and reference for cervical latency in healthy group)

d) **MF-L** – multiplication factor on lumbar latency (ratio between MS patients lumbar latency and reference for lumbar latency in healthy group).

All these multiplication factors have been calculated from 1-6 Kurtzke scale range.

RESULTS

Analysis of the results leads to the following observations:

a) Observed increase in cortical latency for biceps brachii and thenar eminence muscles, directly correlated with increasing disability levels. Values were significantly elevated in patients with severe pyramidal disabilities, characterized by values of 5 and 6 on Kurtzke scale.

b) There was an increase in cortical latency, specific for tibialis anterior muscle, with its values increased also

in patients presenting significant disabilities of the pyramidal system.

c) The evaluation of motor dysfunction was observed for the CMCT parameter; its' change also correlates with increasing severity and nature of the pathology of MS patients.

d) The MF values show a slow impulse transmission at cortical-spinal tract, highlighting the existence of specific neuronal demyelization process and/or neurodegenerative progression in MS lesions in the superior segment of the central nervous system.

Following tables and graphs present concisely the multiplication factor values and variation in each muscle response, considering the appropriate magnetic stimulation method and taking into account the Kurtzke scale from 1 to 6. The MF values are presented and analyzed for MS patients in parallel with the obtained values for healthy volunteers.

Variation of the multiplication factor corresponds with increasing values for Kurtzke scale (from 1-6) as follows:
MF-CMCT: values between 1.1 and 2.78 (fig. 1)
MF-C: values between 1.033 and 1.95.
MF-S: values corresponding with those of the healthy reference group (tab. 1).

Variation of the multiplication factor corresponds with increasing values for Kurtzke scale (from 1-6) as follows:
MF-CMCT: values between 1.11 and 3.81 (fig. 2).
MF-C values between 1.05 and 2.06.
MF-S values corresponding with those of the healthy reference group (tab. 2).

Variation of the multiplication factor corresponds with increasing values for Kurtzke scale (from 1-6) as follows:
MF-TCMC: values between 1.08 and 4.19 (fig. 3).
MF-C values between 1.087 and 2.83.
MF-L values corresponding with those of the healthy reference group (tab. 3).

CONCLUSIONS

- The analysis presented above show the usefulness of the multiplication factors in evaluating patients with disabilities of the pyramidal system.
- There exists a significant correlation between MF and disease evolution regardless of the CMCTs or latency times.
- It confirms that in the early stages of the disease (Kurtzke scale 1 and 2), the multiplication factor does not show significant differences compared with the reference healthy group.
- The multiplication factors show increased values up to 3-4 times in the advanced disability Kurtzke scale (6).
- The multiplication factor could be considered as a relevant tool in the diagnosis and monitoring of the MS patients. □

Table 1. Magnetic Stimulation Guide – Multiplication Factor – "Biceps brachii".

Multiplication factor for Biceps brachii	Kurtzke Scale 1	Kurtzke Scale 2	Kurtzke Scale 3	Kurtzke Scale 4	Kurtzke Scale 5	Kurtzke Scale 6	Healthy volunteers
MF-CMCT* «Multiplication Factor CMCT»	1.1	1.05	1.14	1.48	1.82	2.78	1
MF-C** «Cortical Multiplication Factor»	1.033	1.043	1.07	1.23	1.43	1.95	1
MF-S*** «Spinal Multiplication Factor»	0.96	1.01	0.98	0.94	0.95	0.94	1

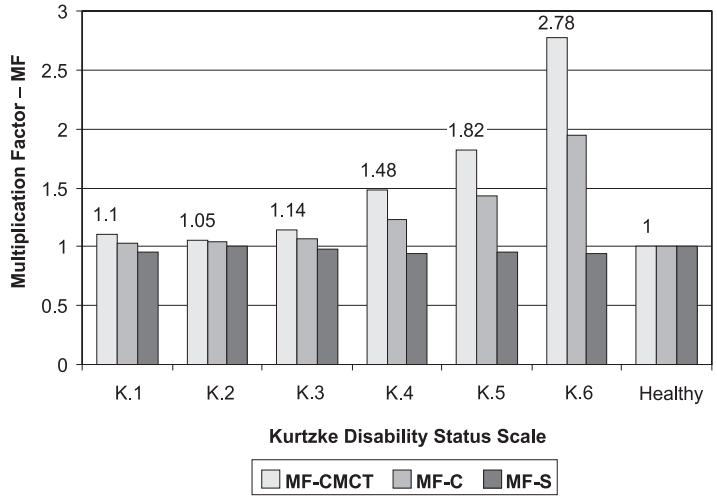

Fig. 1.
* **MF-CMCT** – Multiplication Factor – Central Motor Conduction Time
** **MF-C** – Multiplication Factor – Cortical Latencies
*** **MF-S** – Multiplication Factor – Spinal Latencies

Table 2. Magnetic Stimulation Guide – Multiplication Factor – "Thenar eminence muscles".

Multiplication Factor «Thenar eminence»	Kurtzke Scale 1	Kurtzke Scale 2	Kurtzke Scale 3	Kurtzke Scale 4	Kurtzke Scale 5	Kurtzke Scale 6	Healthy volunteers
MF-CMCT* «Multiplication Factor – CMCT»	1.11	1.07	1.16	1.59	2.24	3.81	1
MF-C** «Cortical Multiplication Factor»	1.05	1.044	1.06	1.2	1.46	2.06	1
MF-S*** «Spinal Multiplication Factor»	1.01	1.03	1.012	0.95	0.97	1.01	1

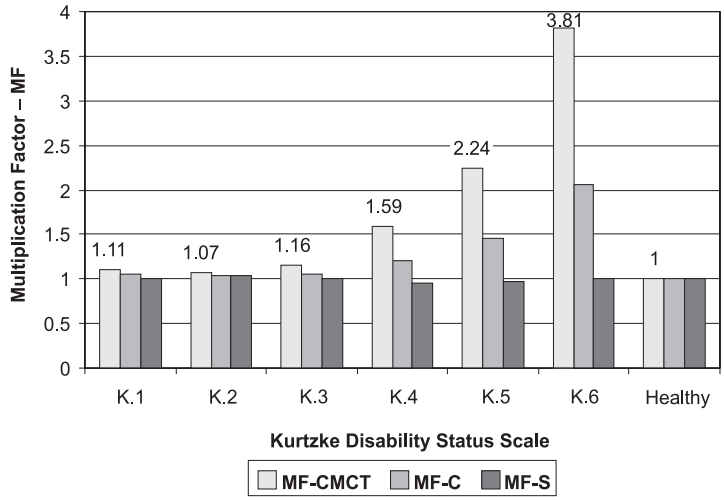

Fig. 2.
* **MF-CMCT** – Multiplication Factor – Central Motor Conduction Time
** **MF-C** – Multiplication Factor – Cortical Latencies
*** **MF-S** – Multiplication Factor- Spinal Latencies

Table 3. Magnetic Stimulation Guide – Multiplication Factor – «Tibialis anterior».

Multiplication Factor «Tibialis anterior»	Kurtzke Scale 1	Kurtzke Scale 2	Kurtzke Scale 3	Kurtzke Scale 4	Kurtzke Scale 5	Kurtzke Scale 6	Healthy volunteers
MF-CMCT* «Multiplication Factor-CMCT»	1.08	1.11	1.26	2.10	1.95	4.19	1
MF-C* «Cortical Multiplication factor»	1.087	1.13	1.16	1.6	1.55	2.83	1
MF-L* «Lumbar Multiplication Factor»	0.9	1.15	1.03	0.996	1.06	1.14	1

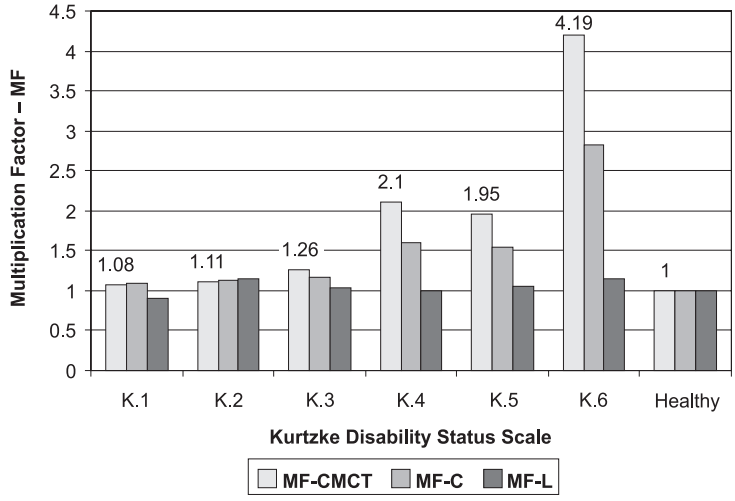

Fig. 3.
* **MF-TCMC** – Multiplication Factor – Central Motor Conduction Time
** **MF-C** – Multiplication Factor – Cortical Latencies
*** **MF-L** – Multiplication Factor – Lumbar Latencies

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