MuscleViz: free open-source software for weakness visualization

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Abstract

Muscle strength testing is routine in clinical practice. Here we provide an aid to the interpretation and communication of those results – MuscleViz: a free, open-source application for visualizing the results of muscle strength testing. Its use in clinical settings streamlines the communication of findings. The tool is also useful for presenting patient data in case reports or case series. A push towards free, open-source software has benefitted other areas of science; we believe a similar effort for clinical tools is worth pursuing.

Main Text

Muscle strength testing is central to the neuromuscular examination. Recording the results of the examination, however, is not standardized. Common practice involves using the Medical Research Council (MRC) strength scale and recording the results in a table [1, 2]. While useful for analysis and archiving, this tabular format is not as ideal for presenting an intuitive picture of the pattern muscle strength/weakness. This can be better achieved with a "muscle strength plot" – a stylized depiction of the human form and muscles, with each muscle colored in correspondence with the measured strength. In a clinical setting, communicating results in such an intuitive and visual format could decrease confusion during patient presentations. In a research setting, multiple weakness plots can highlight patterns of weakness across groups of patients or within a single patient over time. Here we present a free, open-source software application – MuscleViz – for generating such muscle strength plots. These plots provide an alternative or supplement to written tables of weakness.

MuscleViz provides a simple and intuitive interface for recording muscle strengths as measured on the MRC scale (Figure 1). For each muscle, results are entered by tapping a button corresponding to the measured strength (0 - 5), as well as an optional modifier (plus or minus). As results are entered, a muscle strength plot is updated in real time. A separate "annotation" interface

allows one to enter metadata, such as patient name, diagnosis, notes, etc. The muscle strength plot can be saved in a publication-ready vector graphics format (SVG). All of the data (MRC scores as well as metadata) can also be saved to and loaded from a JSON file. JSON is a text-based format that benefits from being human readable as well as parsable by many popular programming languages and database programs. The tool is available as a web application (https://jwittenbach.github.io/muscle-viz) or as a mobile app for phones and tablets (downloadable online at https://github.com/jwittenbach/muscle-viz and in major app stores).

The introduction of technology to patient care is not novel; indeed, clinic visits have become increasingly dependent on technology. We do not intend to add more clutter. Effective communication requires a patient and physician connection which can be negatively impacted by technological distraction. Our decision to include less detail was purposeful. The tool should provide enough information to make weakness distribution obvious, but it should not include any distractions. By introducing software that is simple to use, freely available, and modifiable, we hope to improve clinical diagnosis and communication.

Previous groups have addressed visualizing muscle strength using software, however the lack of availability of the tool and the underlying source code limited its usefulness for the field [3]. There has been a recent push in neuroscience for free, open-source tools [4]. We believe that an increase in open-source technology would also benefit the medical community, in particular when it comes to research. The MuscleViz tool and its source code are freely available. The source code can be found on GitHub (https://github.com/jwittenbach/muscle-viz), a web-based code repository where users can discuss issues about the tool and even contribute to its development. We hope the framework will be adapted for similar uses by the community to develop additional useful clinical tools.

The regular use of the tool should be beneficial for communication between caretakers and for patient education. We anticipate this tool will be useful in the clinic and in case reports. Ideally, the use of this tool by medical students and residents will allow for more clear patient presentations. The onus will no longer be on the receiver to generate a mental image of weakness. The image can be generated by the presenter and shown to the receiver; this should decrease confusion and aid in diagnosis. This tool also provides a useful platform for figure generation for publications. By displaying weakness in a uniform structure, the range of weaknesses among cases and progression over time can be easily appreciated. Furthermore, we hope the release of source code will inspire others to join us in open source medical tool development.

References

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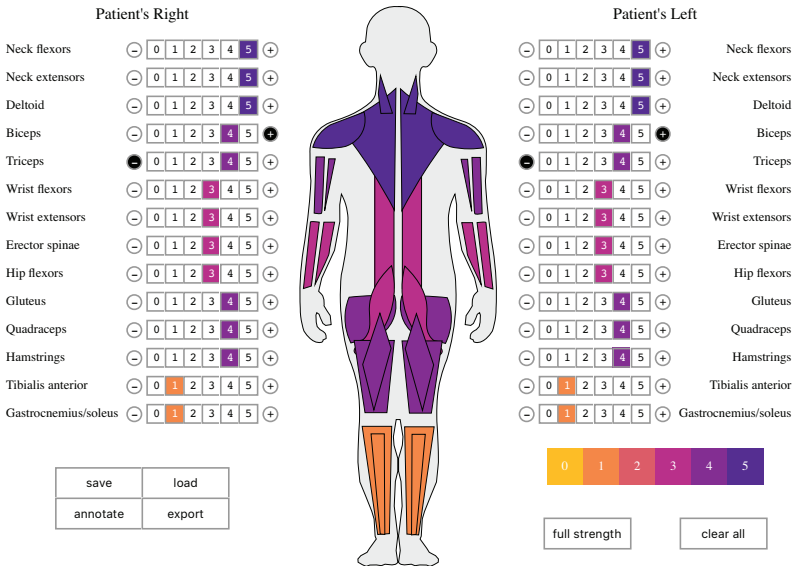

Figure 1: MuscleViz screenshot. Full strength is dark indigo while complete paralysis is gold. The distribution of weakness is along the superior/inferior axis. In the context of full clinical history, a diagnosis of Guillan Barre can be made in this fictious patient.

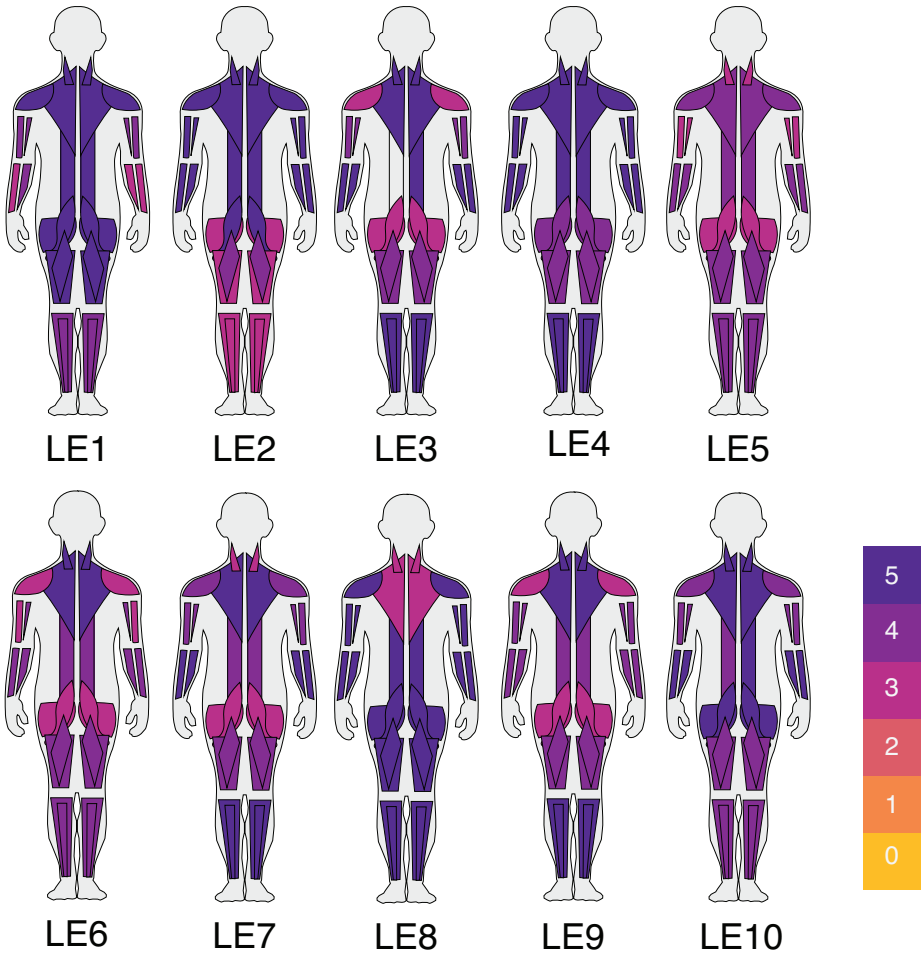

Figure 2: Sample figure created from exported images. Muscle strength examination results from cases given in the appendix of a Lambert-Eaton myasthenic syndrome case series are visualized [5]. The weakness throughout the cohort is generalized, with the most severe symptoms in proximal upper and lower limbs. By showing each patient individually, the range of heterogeneity can be more fully appreciated.