Module-Based Analysis of Upper-Limb Movement Post-Stroke

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INTRODUCTION

- Muscle modules are groups of muscles that activate together to generate a specific movement.
- The number of modules and their activation timing can describe the level of independent movement that the muscles are capable of producing.
- The number of modules in the lower limb have been shown in vivo to reduce after stroke [1].

Objective: To examine to what extent the number of muscle modules in the upper limb reduce post-stroke.

METHODS

Computational Analysis: Non-negative matrix factorization (NNMF) was used to break down muscle activity into two matrices:
1. Muscle weighting matrix per module and (ii) a module activation over time matrix.

Data Collection: MoBL-ARMS model in OpenSim was used to simulate post-stroke changes to muscles and estimate muscle activity.

RESULTS & DISCUSSION

- Muscle activation timing overlaps more extensively post-stroke.
  - Module activation is less distinct over the time it takes to complete the reaching task.
  - Overlap indicates that muscles are not firing independently.
- Muscle weightings in modules are altered post-stroke.
  - Prevalent muscle in module 1 of the control and module 3 post-stroke.
  - The simulations indicate a reduction in the number of modules between the control and stroke states. This finding suggests that the structural changes in muscles following stroke impact how individuals generate movement.

CONCLUSIONS

- Modular activation timing overlaps more extensively post stroke:
  1. Module activation is less distinct over the time it takes to complete the reaching task.
  2. Overlap indicates that muscles are not firing independently.

REFERENCES