"The Mechanics of Applied Biological Engineering"
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INTRODUCTION

Experience demonstrates that control and manipulation skills for orthotics/prosthetics and robotics devices are vastly enhanced when sensory input and feedback from the O&P device are associated with mental imagery. As much as 80% of all energy used by the brain is dedicated to prediction and anticipation of paltry sensory input reaching it from the outside world to include information coming from the O&P device (Raichle 2010). Explicit, accurate and otherwise fully developed kinaesthetic interpre-tation of sensory input is not possible unless it is correlated with a corporeal image of wholeness and normality (Thomas 2010). Sensations correlated with a corresponding or coinciding imagery experience are not an isolated, singular or individual neural event, but rather a well defined and predictable pattern (O'Regan 1999). It is postulated by this author that the primary biological purpose of a biomechanical device is to "enactively" facilitate such imagery, anticipatory and neural correlating skills.

METHOD

An experimental "neurocorrelagraphic" device was developed in 2006 to physically measure the subject's capacity and ability to predict specific kinetic, kinematic and kinaesthetic events when connected to and operating an O&P or robotics device. Low profile energy storing ADL feet are attached to post acute fracture braces which in turn are connected to the operator. Information from sensors in the prosthetic feet is fed into a PC for display and analysis. (First illustration shows application in a unilateral TT). A graphic readout indicated kinetic and kinematic activity on the vertical axes and timing on the horizontal axes. Hand activated timing markers appear on the graph relative to both vertical and horizontal axes. Both axes can be compressed or stretched to record greater magnitudes and multiple cycles or accuracy to within 5 ms (Illustration 2).

RESULTS

Among other things, the neurocorrelagraphic device accurately measures the elapsed time between what the operator thinks he or she is going to feel and do and what actually happens in terms of kinetic and kinematic activity. This cause and effect cycle is referred to as a "contingent" or "closed" sensorimotor loop (Gailey, 2013). If the elapsed time can be reduced to 30 ms. the sensations attributable to this mechanical activity can be correlated with mental imagery and if mental imagery includes an egocentric frontal view of one's whole and entire body, these sensations can be interpreted as coming from the sensory modality being supported or substituted rather than from the orthotic/prosthetic or robotics device itself.

DISCUSSION

It is apparent successful physical restoration and rehabilitation of individuals with desensitized or missing limbs require illusion of wholeness and normality at the conceptual rather than at the perceptual level. This is

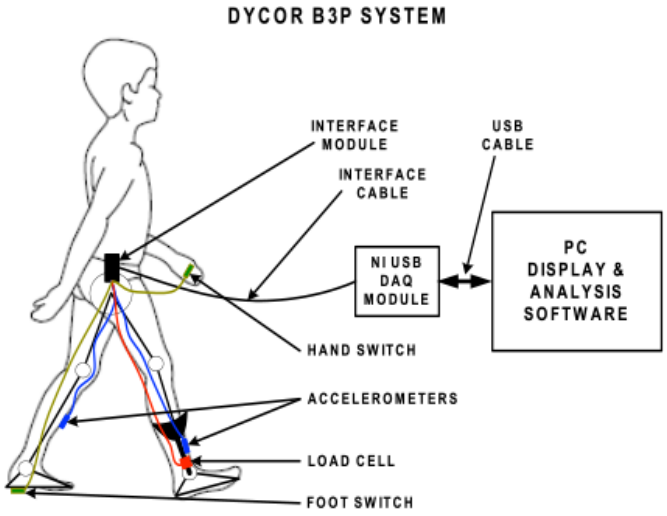

Fig. 1 Schematic of experimental neurocorrelagraphic device

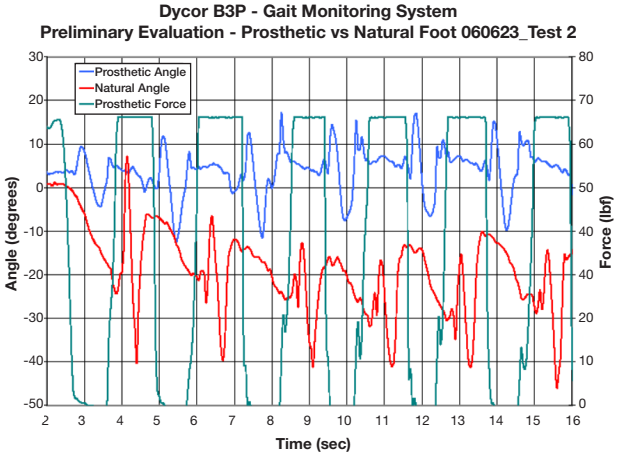

Fig. 2 Neurocorrelagram or printout of neurocorrelagraphic measurements

a scientifically valid approach because "hard science" does not allow alteration of data characterized by perceptual illusion but does allow considerable latitude in how such unaltered and objective data may be subjectively interpreted and conceptualized.

CONCLUSION

Neurocorrelagraphy can be used to profoundly characterize the biological compatibility of a mechanical O&P or robotics device with the operator's unique capability to acquired contingent sensorimotor skills when connected to and operating the device and this quantifiable encapsulation and characterization of biomechanical compatibility and suitability should be included in treatment outcome assessments.

REFERENCES

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