

WHY THE WIJIT HELPS USERS ACHIEVE GREATER COORDINATION

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Smart Shifting

There are a number of neuro-anatomical factors that distinguish the control of the upper limb flexors from those of the extensors. **The flexor muscles are stronger than the extensor muscles** (Vallbo & Wessberg, 1993) and require a smaller proportion of motor units to be activated in order to produce a given level of force. The Wijit engages the flexor muscles when the user flexes the wrists inward to shift into forward drive.

SuperQuad designed the Wijit to take advantage of the body's natural phylogenetic make-up. The Wijit's biomechanically intuitive design enables individuals to achieve greater efficiency in their forward movements because less force is required to flex the wrists contrast to extending them. The flexion and extension exercises also strengthen the extension activities inherent in neutral and reverse shifting due to correct positioning of, posture of, and training of the wrists.

Healthy Resistance Training

Resistance training is one key aspect of the Wijit. The capacity of a muscle to generate force is dependent upon its length (Gordon, Huxley, & Julian, 1966). Strengthening muscles, brought about by resistance training, minimizes joint torque and the degree of muscle activation required to perform movement (Carroll, Riek, & Carson, 2002).

In standard manual wheelchair propulsion, where individuals by contrast propel by gripping and releasing a hand rim, acute fatigue induced in the upper arm muscles (triceps brachii), by virtue of eccentric contractions, reduces the force generating capacity of the muscle by approximately one third. There are further indications that when the level of descending neural drive to a muscle is increased (e.g., when propelling on a hand rim) to overcome the damage induced by prior eccentric contractions, there is substantial spread of excitability to other motor centers, thus reducing the efficiency in the overall coordination of the standard manual wheelchair propulsion stroke.

Result: Increased Coordination

The manner in which movements are generated by the neuromuscular-skeletal system has a profound influence on the stability of coordination. Particular combinations of muscle actions are likely to be more stable than others. For example, the greater efficiency with which movement is generated by flexors of the upper limb (as described above) indicates that the most stable patterns of bimanual coordination will be those in which flexors are active simultaneously.

When shifting the Wijit into forward drive, both shifters are flexed inward with the wrists, which are positioned in a horizontal posture that alters the operating lengths of muscles that flex and extend the index fingers. When homologous muscles are active simultaneously, the required pattern of bimanual coordination is maintained throughout.

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Simultaneous shifting into forward, reverse, or neutral, results in increased coordination. Parallel muscle activation patterns do not impose strong constraints on the stability of bimanual coordination - this is why it is relatively easy to perform the 'elevator spin' where one shifter is shifted into reverse at the same time the other is shifted into forward drive, and then pushed and pulled respectively.

Individuals are drawn to patterns of coordination, regardless of whether flexion or extension movements are accentuated, which makes the coordination achieved by virtue of using a Wijit on a manual wheelchair an easier, more effective form of manual wheelchair propulsion.