Editorial

Physiological costs of reciprocal gait in FES assisted walking

It is now some years since the professions became aware of the possibilities for the restoration of walking for paraplegic patients. Originally, a series of well publicised media articles in the press and on television gave rise to changing expectations. These hopes have not dissipated, but the results demanded by the paraplegic have sadly not yet been fulfilled. It was assumed that either electrical stimulation of the paralysed muscles, or splint (orthotic) walking could achieve the objective. Spinally injured persons, and the scientific fraternity were sceptical because the walking method as demonstrated, did not seem like true walking. Further, the practical problems of doff and don of splint or stimulation electrodes, the appearance of the device, and the walking pattern achieved, plus the high energy cost and, not least, the expense, have all contributed to a natural slowing of enthusiasm.

These difficulties have spurred researchers to look for better solutions. The first, and perhaps most practicable, has been a functional electrical stimulation/'hybrid' orthosis. Several centres have achieved such hybrid walking,^{1,2,3} in which stability for the paralysed musculoskeletal system is orthosis dependent. An additional FES 'assist', to the motion of the body through space by the orthosis, uses artificial neuromuscular stimulation. This muscle contraction improves the theoretical mechanisms of the orthotic function in both the RGO/FES combination³ and the Parawalker.⁴

The second, by pure FES means, is seen in this issue (Winchester Carollo & Habase-

vich). Further elaboration of the FES mechanism has allowed FES signals to be sequenced through a microprocessor control system with electrodes let into a garment to ease doff and don. These workers claim comparable performance to other orthotic options, but their studies are limited in number, as are all the experiments performed on paraplegics able and willing to participate in these studies.

A sense of proportion is required here since their stated average walking velocity ranged up to a maximum of 24.3 m/min, which at this level remains much below the normal speed of up to 88.1 m/min. This low velocity was achieved for an energy cost, found at PCI testing, to be at least ten times greater than normal.

A third solution needs reporting as a glimmer on the horizon. Direct spinal cord repair has been reported successfully in rats and mice. Bjorkland⁵ states firmly that we are a long way from developing a repair for humans, but we are now advancing knowledge about the process of nerve regeneration in small mammals. Whether this technology can be elaborated in higher mammals or applied to humans remains to be seen.

J H Patrick FRCS
Consultant Orthopaedic Surgeon
Director, ORLAU Movement
Analysis Laboratory
Robert Jones and Agnes Hunt
Orthopaedic and District
Hospital NHS Trust Oswestry,
Shropshire, SY10 7AG,
England

References

- 1 Andrews BJ, Baxendale RH, Barnett R *et al* (1988) Hybrid FES orthosis incorporating closed loop control and sensory feedback. *J Biomed Eng* 10: 189-195.
- 2 Nene A, Andrews BJ (1986) An assessment of the Parawalker hybrid orthosis. *Proceedings of the 2nd Vienna International Workshop on FES, 1986*: 79-82.
- 3 Isakov E, Douglas R, Berns P (1992) Ambulation using the reciprocating gait orthosis and functional electrical stimulation. *Paraplegia* 30: 239-245.
- 4 Nene AV, Jennings SJ (1989) Hybrid paraplegic locomotion with the Parawalker using intramuscular stimulation: a single subject study. *Paraplegia* 27: 125-132.
- 5 Bjorkland A (1994) Spinal cord repair: a question of making it work. *Nature* 367: 112-113.