

## VOLITIONAL MODULATION OF PELVIC FLOOR MUSCLES AND REFLEXES IN SPINAL CORD INJURY

### Hypothesis / aims of study

Voluntary control of the pelvic floor muscles, including the sphincters, is part of an important set of continence mechanisms usually weak or absent in people with a spinal cord injury. Ordinarily, as the bladder fills, a so called 'guarding reflex'<sup>1</sup> involving the striated urethral sphincter, gradually but automatically increases in tone to maintain continence. At the point of a strong desire to void voluntary control of the sphincter takes over until a place to empty the bladder is found. The guarding reflex in spinal cord injury is usually aberrant depending on the completeness of injury<sup>2</sup>. However, little is known about residual voluntary control of the sphincters and pelvic floor in spinal cord injury. The aim of this study was to compare residual volitional control over the sphincters and the sacral reflexes between non-SCI subjects and those with complete or different grades of incomplete spinal cord injury.

### Study design, materials and methods

With local ethics committee approval and informed consent, three groups of volunteer male subjects, non-SCI (ASIA (American Spinal Injuries Association) grade A), incomplete SCI (ASIA grades B-D) and complete SCI (ASIA grade A) were recruited. These groups were compared using two measures of volitional effort, the pudendo-anal reflex (PAR) and the integrated electromyogram (iEMG) of the sphincter. Each subject was prompted to make or attempt a voluntary contraction which they could monitor as the iEMG on a screen showing recordings from an anal probe. During this contraction paired-pulse stimulation of the dorsal penile nerves was used to elicit the PAR<sub>vc</sub>. Paired pulses were also delivered during the intervals between the contractions and these served as control resting signals both for the PAR<sub>rest</sub> and the iEMG<sub>rest</sub>.

The percentage change in each of the signals (R) for the PAR and the iEMG with and without voluntary contraction was calculated: %Change in R =  $[(R_{VC} - R_{rest}) / R_{rest}] \times 100$ .

Comparisons of the PAR responses and iEMG signals with and without volitional effort were determined using a two-tailed paired t test and statistical significances determined at the 95% confidence level ( $p \leq 0.05$ ).

### Results

Figure 1 shows the results for both the PAR and iEMG changes with volitional effort in the three categories of subject. Whilst the changes in PAR responses in the spinal injured subjects were found to be significantly different from the non-spinal injured subjects ( $p < 0.001^{**}$ ) interestingly there was no significant difference ( $p > 0.05$ ) in the iEMG response to volitional effort across the spinal lesion groups. Both these groups were just significantly different from the non-SCI group in this respect ( $p < 0.05$ ). Most interesting of all was the observation that the ASIA A subjects (complete spinal lesions) were not statistically different from the ASIA B-D group (incomplete spinal lesions) in their volitional ability to contract their sphincters and pelvic floor muscles.

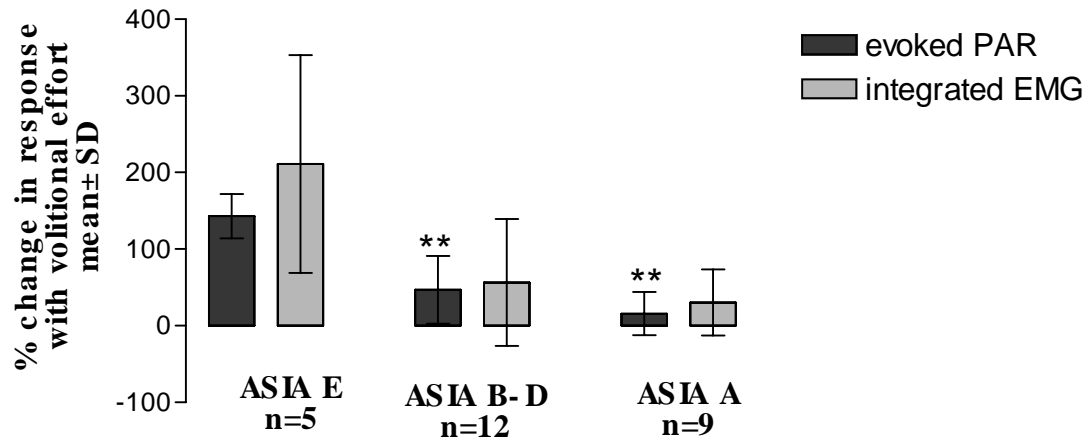
### Interpretation of results

It appears that modulation of the PAR sacral reflex by pelvic floor and sphincter contraction is more discriminating statistically than the integrated EMG in separating volitional effort in these groups, particularly between non-SCI and SCI subjects. However, the numbers in the study were rather small and so some caution on interpretation must be exercised. There is a clear trend towards a worsening ability to voluntarily contract pelvic floor and sphincter muscles in the complete SCI injured subjects, but that some can do it at all contradicts the classification of ASIA A based on neurological assessment of impairment. Any residual function identified by this type of assessment may offer some hope to some patients and may ultimately prove to be useful in future strategies for rehabilitation.

Concluding message

Assessing volitional modulation of sacral reflexes may provide a more sensitive method for determining the existence of residual spinal pathways in chronic spinal cord injury. Such knowledge will add to that demonstrating the preservation of other continence mechanisms, for example the urinary guarding reflex, in some patients with spinal lesions.

Figure 1



1. The guarding reflex revisited. Brit J Urol 1997; 80: 940-945
2. Urinary guarding reflex: aberrant in spinal cord injury. Brit J Urol Int 2004; 93(S4):4

**FUNDING: International Spinal Research Trust/ European Commission**