Exercise Prescription for Patients with Spinal Cord Injury

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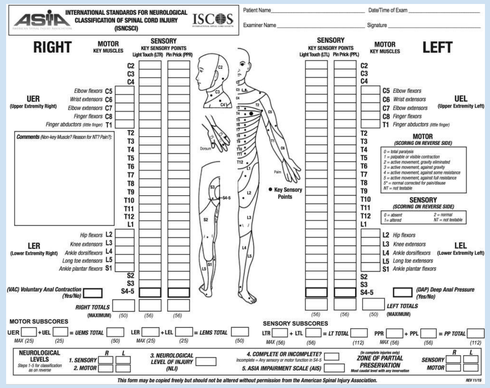
Introduction

The spinal cord serves as the primary neural communication pathway between the brain and most of the rest of the body. Injury to this region of the spinal column can elicit severe, debilitating conditions. According to the National Strength and Conditioning Association (2018), a spinal cord injury (SCI) is characterized by an injury or disease process of the spinal cord that results in altered motor, sensory, or autonomic functioning (or some combination of these). According to Anjum and colleagues (2020), approximately 250,000 to 500,000 individuals in the world suffer from SCI. SCI pathophysiology consists of acute and chronic phases that incorporate a cascade of destructive events such as ischemia, oxidative stress, inflammatory events, apoptotic pathways and locomotor dysfunctions (Anjum et al., 2020). Gender, age, and ethnicity are not limiting or enhancing factors when it comes to spinal cord injuries. Treatment strategies for spinal cord injury are primarily short-term and fail to completely overcome the detrimental effects of spinal cord injury. These strategies, including pharmaceutical, focus on the improvement of decreased neuro-inflammation, promotion of axonal growth, enhanced myelination, and reduced cavity size (Anjum et al., 2020).

Exercise Testing

According to Roberts and colleagues (2017) the American Spinal Injury Association Impairment Scale (AIS) has become the gold standard for evaluation of spinal cord injuries since it replaced the modified Frankel scale in 1982. This assessment is used to standardize careful, detailed documentation of SCIs, guide further radiographic assessment and treatment, and determine whether injuries are complete or incomplete; relative in distinction for prognostic implications (Roberts et al., 2017). The AIS is a standardized examination consisting of a myotomal-based motor examination, dermatomal based sensory examination, and an anorectal examination. Injury severity or grade and level are assigned based on findings from this scale.



01 Sensory Evaluation

- Evaluates 28 specific dermatomes bilaterally for light touch (using a piece of cotton) and pinprick (using a clean safety pin) sensation.
- A grade of 0 denotes absent sensation, 1 denotes impaired or altered sensation, and 2 denotes normal sensation.

02 Motor Examination

- Consists of grading 5 specific muscle groups in the upper region and 5 specific muscle groups in the lower region.
  - Represents major cervical and lumbar myotomes
- Maximal bilateral score in a healthy individual is 100, 50 for scoring 5/5 in all right upper and lower extremity myotomes and another 50 for the left.

03 Anorectal Examination

- Essential for determining completeness of injury and evaluating the presence of spinal shock.
- The external anal sphincter is examined digitally for voluntary motor contraction and the ability to sense deep anal pressure; a.k.a the bulbocavernous reflex.
- Both are graded in a binary fashion: 0 for absent, 1 for present

04 Complete or Incomplete Classification

- Complete SCI is the absence of all motor and sensory function (Grade A); incomplete SCI is the presence of fractionally retained motor and sensory function (Grade B).
- Grade C injuries have preserved motor function below the neurological level, and more than half of key muscles below the neurological level have a muscle grade less than 3
- Grade D injuries have preserved motor function below the neurological level, and at least half of key muscles below the neurological level have a muscle grade of 3 or more.
- Grade E is normal; motor and sensory function are normal .

Exercise Prescription

According to the NSCA the exercise prescription for individuals with a spinal cord injury (SCI) does not change as drastically as one would expect. Exercise programing should be in accordance with the U.S. Department of Health and Human Services, suggesting at least 150 minutes a week of aerobic training at a moderate intensity or 75 minutes of a combination of vigorous and moderate intensity. According to Frasuńska et al. (2021), there was a positive correlation shown between the ability to perform activities of daily life and physiotherapy. In addition to Fransuńka et al. (2021) and Myslinski (2005), paraplegic individuals need to increase their upper body strength for their own safety and well-being.

Type of Exercise	Frequency	Intensity	Volume
Resistance Training			
Mode of Training: - Free weight and weight training machines - Bodyweight resistance	Begin with 1-2 sessions per week Progress to 4 days a week	Start 8-10 exercises with resistance at 40-60% 1RM. Can be increased to 60-85% of 1RM if possible.	Begin with one set per exercise of 10-12 reps. Increase to 2-3 sets if possible If multiple sets have a 1–2-minute rest in between.
Aerobic Training			
Modes of training: - Arm crank exercise - Reciprocal press-pull exercise	Begin with 1 session a week progress to 2-3 days a week	Begin with light to moderate intensity (30%-60% of heart rate reserve) Increase the intensity gradually	Begin with 15-20-minute sessions Gradually increase to 30-minute sessions if possible

Increased strength and upper body endurance + Cardiorespiratory improvement → Gained strength and improvement of life

Special Considerations

Individuals with SCI are unique to others because the level of their lesion is unique to the individual. This means that each exercise program created will depend on the individual's level of mobility. According to the NSCA (2018), conditioning of persons with SCI requires revision in the training environment in order to provide a safe and efficacious training setting. Lack of volitional control of muscles below the point of injury (i.e. muscular paralysis) is the major characteristic of a motor-complete SCI. Muscle groups innervated by nerve roots arising above the injury point is the primary limitation in exercise conditioning of SCI patients (NSCA, 2018). Those patients with paraplegia are able to exercise with upper extremities and much of their torso while those with tetraplegia are limited to muscular actions within the upper extremities (NSCA, 2018). Modifications depending on the level of injury of the individual, for a paraplegic they can perform many upper body exercises and use the arm crank to increase their VO_2.

Conclusion

In conclusion, SCI is one of the most devastating conditions with no permanent cure available to these patients. Accommodated exercise prescription for those with SCI is imperative in patients gaining independence. Those with complete SCI are characterized with total loss of sensory and motor function paraplegically (loss of muscular function in the lower extremities) or tetraplegially (loss of muscular function is upper and lower extremities). Exercise programming geared towards increasing VO2 and improving strength in the un-injured or partially affected muscle groups.

References

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