Participation in Recreation and Sports for Persons with Spinal Cord Injury: Review and Recommendations

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Running Head: Recreation and Sports for Persons with SCI

Abstract

Recreation and sports following Spinal Cord Injury (SCI) are beneficial, but under-studied, aspects of community integration. Previous studies have shown that sports and recreation can offer numerous physiological and psychological benefits to those who participate. This manuscript critically reviews available literature focused upon participation in recreation and sports among persons with SCI. Issues of participation, technology and safety are discussed and recommendations are provided.

Key words: Spinal Cord Injury, Recreation, Sports, Community-Integration

1. Introduction

The 2002 Paralympic Winter Games provided the world a glimpse of the potential of athletes with spinal cord injury (SCI) and the advancements made since inception of adaptive sport a half-century ago. Elite athletes from 36 countries participated in the Salt Lake City Games, creating a dramatic display of excellence and mastery of their perspective sports. The success of these games along with the level of competition displayed challenge stereotypes of disability and demonstrated the benefit of recent social and technological efforts to promote accessibility. The games were a tribute to the vision of Sir Ludwig Guttman, a pioneer of adaptive sports and subsequent international competition, who stated, "the noblest aim of sport is to facilitate and accelerate social reintegration [18]."

A small but growing field of research reveals the usefulness of sport and recreation in promoting community reintegration, physiological, and psychological benefits among persons with SCI. A few studies have documented demographics of participants in sports with SCI as well as common injuries and risks in this population. This manuscript critically reviews available literature focused upon participation in recreation and sports among persons with SCI.

2. History

In 1948 Dr. Ludwig Guttman introduced sport as a component of rehabilitation for patients in England who had obtained SCI as a result of the Second World War. His work eventually led to the creation of the International Stoke Mandeville Games, the first international competition held for athletes with SCI. This trend continued and in 1960 the first wheelchair Olympics took place immediately following the regular Olympics in Rome [18]. Not until 1980 were the games inclusive of athletes with amputation, visual impairment, and cerebral palsy [29].

Participation has grown immensely with athletes from 122 countries participating in the 2000 Paralympic Summer Games held in Sydney.

The paralympic competitions are impairment specific with classifications assigned to each athlete by a medical examiner based upon level of injury, strength, deformity, spasticity, and "genuineness of exam as compared to competition [28]." The classification system is somewhat subjective and is continually debated and often modified. Nonetheless, the foremost objective is to promote the fairest level of competition possible.

These international athletic competitions have profound implications for everyday rehabilitative practice. The achievements at these venues warrant examination and remind the practitioner of the danger of assuming future capabilities of patients. Certainly, research of objective functional outcomes after SCI is necessary and valuable. However, these studies are often restricted to finite and specific tasks making it difficult to truly assess what is possible outside of the ADL and mobility realm. Of course, the elite athletes of the Paralympic games are not representative of a typical patient population with SCI. Nevertheless, their continuing improvement in competition reveals the immeasurable potential that is possible when their determination is met with social and technologic efforts to promote access.

3. Benefit of Participation

Recreation has been shown to be an important factor in quality of life. General population studies have shown that recreation is a chief determinant of life satisfaction above job, health and financial resources [30, 35]. Furthermore, physical activity has been found to decrease mortality and reduce risk of cardiovascular disease, hypertension, obesity, and several cancers [44]. Despite these documented benefits, only 22% of Americans participate in

sustained and regular physical activity [55]. People with disability are even more likely to be sedentary as are people in certain ethnic minority groups and those with lower income. People with disabilities who remain active not only enjoy the physical and emotional health benefits but are also found to have improved overall functional status [56].

The benefits of sports and recreation for patients with SCI are poorly studied. However, Krause [33] indicates participation in physical activity likely increases life expectancy. The ongoing prospective study documents several predictors of mortality after injury including: decreased social vocational activities, increased time in bed, lower perceived quality of life, and lack of employment or involvement in education. Furthermore, the study indicates high levels of fitness correlate with decreased time in bed, increased social interaction and overall improved life satisfaction [20].

3.1. Physiological Benefits

Several studies document objective physiologic changes after SCI and among athletes with SCI compared to athletes without injury (For a recent and comprehensive review of this topic, see Bhambhabi [2]). Studies comparing athletes vs. non-athletes with SCI reveal objective gains in aerobic power and other indices resultant from sustained physical activity.

Aerobic power, which generally describes performance in endurance-type activities, is diminished after SCI secondary to physiological factors. However, evidence does demonstrate that improvement in endurance can be achieved through sustained training. Maximum $VO_{2,}$ the standard measure of aerobic power, tends to be higher in individuals with paraplegia versus tetraplegia and those with incomplete versus complete SCI. The decreased active muscle mass available for oxygen extraction as well as the decreased catecholamine response in individuals

with tetraplegia may explain this difference [16]. Paralyzed muscle after SCI also has a higher ratio of fast glycolytic, type IIB, muscle fibers and reduction of slow oxidative fibers that will result in decreased oxygen extraction [17].

Several factors can decrease cardiac output after SCI. Injury at or above the T1 level disrupts sympathetic feedback to the heart and lowers maximum attainable heart rate and cardiac output. The mechanism of "boosting" in athletes with tetraplegia may be explained by a temporary surge and restoration of this sympathetic input and catecholamine deficit [16]. Venous pooling of blood in paralyzed limbs likely contributes to decreased stroke volume found in individual with SCI during exercise [2]. Furthermore, in individuals with tetraplegia, the respiratory "muscle pump" which aids in venous return to the heart is compromised leading to decreased pre-load and stroke volume. Left ventricular volume is decreased in individuals with SCI [22]. The combined effect of decreased heart rate, stroke volume, oxygen extraction in paralyzed muscle, and ventricular dimension all contribute to decreased VO_{2peak} seen after SCI.

A comparison of endurance trained able-bodied canoeists and those with paraplegia showed the able-bodied group to have a 41% higher VO_{2peak} [23]. Athletes with paraplegia and tetraplegia who took part in endurance training showed significantly greater aerobic power as measured byVO_{2peak} relative to their more sedentary counterparts [3, 43]. One study found individuals with paraplegia who were sedentary have a 32% lower VO_{2peak} than untrained, able-bodied individuals. However, endurance trained individuals with paraplegia actually had 10% higher aerobic power [1]. Confounding evidence exists as to whether ventricular volumes are significantly higher in athletes with paraplegia compared to their sedentary counterparts [23]. If present, this would also likely influence cardiac output.

Anaerobic power is a measure of performance during short-term, 30-60 second, exertion tasks. Peak anaerobic power appears to be inversely related to vertebral level of SCI and completeness of cord lesion [10, 57]. One study, using the Wingate 30-second wheelchair propulsion test, demonstrated no significant difference in anaerobic power in able-bodied individuals versus those with SCI lesion below T8 [26]. Furthermore, specific measurements of torque were actually higher in the cohort with SCI, showing benefit of specific training with a wheelchair. Similar to able-bodied athletes, participants with SCI who partake in sports that demand anaerobic energy have subsequent increased anaerobic power when compared to those that participate in more aerobic activities. Specifically, players of wheelchair basketball, a sport with higher anaerobic demand, had greater power output than track athletes. Both groups had higher power output than athletes who participated in less active activities such as shooting or archery [59].

These studies demonstrate sport specific physiological changes that occur with sustained training with or without SCI. Male wheelchair racers have higher peak power and mean power as well as decreased fatigability compared to their female counterparts [27]. This is likely due to increased lean muscle mass among males.

With regard to health status, participation in physical activity appears to decrease morbidity in several areas including incidence of urinary tract and respiratory infections, severe spasticity and decubitus ulcers [13, 23, 34, 38]. Hospitalizations in athletes with paraplegia were three-fold less frequent and significantly less expensive in one study [54]. Although not specifically studied in patients with SCI, the same benefits of exercise in disease prevention likely exist as in the general population. In fact, with a higher rate of hypertension among

patients with SCI [64], sustained physical activity may be an even higher priority due to its efficacy in blood pressure reduction in able-bodied individuals [13, 56].

3.2. Psychological benefits

While the psychological benefits of recreation and physical activity for persons with SCI have been documented, the majority of these studies have been conducted using qualitative methodology and small samples. Datillo and colleagues' interviews with 14 individuals with recent SCI highlight the importance of leisure activities for connecting with friends and family members and community integration [9]. Taylor and colleagues interviewed three individuals with SCI who participated in sea kayaking expeditions through a disability organization about the meaning of the activity to them [53]. Response themes include the role of sea kayaking in providing a sense of fun, its importance as a method of social interaction and adjusting to disability, and how it provides a sense of accomplishment and a way of engaging in healthy activities. Finally, Hutchinson and colleagues used semi-structured interviews to explore how individuals with SCI used leisure to cope with traumatic injury [25]. Their finding suggest that engaging in "enjoyable and personally meaningful activities (p. 158)" serve both as an immediate coping mechanism as well as a stress-management activity [25].

A few studies using qualitative methodology also appear to support the psychological benefits of recreation. Muraki and colleagues compared a group of wheelchair basketball players with a group of varsity college players and a control group of college men [37]. The participants in wheelchairs were found to have "significantly better mental health profiles than the two comparison groups [37]." This retrospective study may indicate the mental health of those who choose to participate in sport rather than the benefit of the sport itself. Adaptive

sports teams may "select" a certain type of participant who is willing to sign-up despite perceived or real risk of failure and re-injury. Level of injury was not found to be related to either depression or anxiety levels [29].

Level of community integration appears to influence life satisfaction and mortality after SCI [39, 44]. The Craig Handicap Assessment and Reporting Technique (CHART) is an objective measure of a person's level of community integration [60]. Hanson and colleagues found that athletes (n=48), selected from a camp for participants with SCI, scored significantly higher on four of five CHART subsections compared to their non-athletic counterparts attending the same camp [19]. The sections included physical independence, mobility, occupation, and social integration. The power of this study may exist in that both the athletic and non-athletic groups overcame economic and social barriers to attend and engage in camp activities. The results may indicate benefits of participation in sport versus passive recreation. These findings serve as a contrast to those of Foreman and colleagues [15], who found that participation in sports activities was not associated with indicators of psychological adjustment

Interventions that use recreation and sports to facilitate adaptation and improve psychological status for persons with SCI have received even less attention from researchers. While the field of therapeutic recreation is based on the importance in the facilitating participation and activities, the interventions that were found while reviewing the literature were limited to case studies and descriptions of programs without supporting data [46, 47, 61]. Of these, sports and recreation appeared beneficial in increasing self-efficacy in performing sport-specific and general activities of daily living [61], promoting fitness and social integration, and reducing secondary conditions [46, 47].

4. Participation

The creativity evident in adaptive sports reaches far beyond international-level competition, allowing the opportunity for diverse participants with disability to fully participate in sport and recreation. These opportunities afford participants profound and numerous benefits. However, personal anecdotal experience in promoting adaptive sports to rehabilitation professionals reveals a stereotype exists as to the "ideal" participant. The possibility for an older participant with a complete, high-level cervical SCI to engage in and enjoy an activity such as snow skiing is often not known to participants or their treatment team. The elite athletes viewed on national television during the Paralympics as well as the content of adaptive sports magazines that seem to highlight young, male participants may further promote this selection bias [24].

Only a very small minority of individuals with SCI will reach the elite level of athleticism displayed in international competition. Therefore, a notable danger exists when the recovering patient with SCI hinges their perception of recovery upon reaching such mastery. Stories often portray adaptive sport as a "battle" to overcome disability [62]. This is in marked contrast to the perceptions of recreational therapists and psychologists who argue that self-growth and emotional recovery after injury stem from an increased emphasis on non-physical values [6, 7]. "The portrayals of heroic recovery from SCI leads us to wonder if healthy adjustment following SCI becomes more difficult when activity engagement (particularly sports) is enjoined with a narrow masculinity emphasizing physical aggressiveness, competitiveness, and conquest [24]." Certainly, sport can be seen and approached as a way of enhancing the values of cooperation, enjoyment and participation rather than conquest and victory. This may pose special challenges to the recreation therapist in structuring activity but one that warrants the efforts required.

Given the numerous benefits of participation in sports and recreation to participants with SCI, it is important to understand factors that may influence initiation and continuation of such activity. Not surprisingly, there is a noted a decline in participation in both sporting and recreational activities from pre-injury levels following SCI [31, 54]. Participation levels appear related to age and income, with individuals who are younger and having more income more likely to participate [15, 63]. Perhaps surprising, level of injury has not consistently been shown to relate to intensity participation [15, 36, 51, 63]. Mixed evidence also exists as to whether marital status impacts participation. Intuitively, it would seem support provided by a spouse could alleviate social and logistical barriers to preparing for and attending sporting activities. However, depending on the study, either there has been found to be not relationship between marriage and participation in sport [63], or single people with SCI have been found to spend more hours in recreational pursuits then married individuals with SCI [51]. Perhaps related, independent driving ability has been found to be to be related to participation in sports-related activities for individuals with tetraplegia [32].

Pre-morbid sports participation is likely the most important predictor of participation after injury and continuation of such activity [63]. Several reasons have been postulated to account for this difference. Pre-morbidly active participants may be more comfortable in the team and social setting of a sporting activity and also may have intact support systems to ease reintroduction of sport. Furthermore, dropout due to injury from overexertion is likely less among those familiar with training regimens prior to SCI.

A paucity of research exists as to who influences participants with SCI to enroll in sport. A survey of 143 athletes with SCI found that “sport peers” with similar injury are most

influential in initiation of participation [63]. Less important were coaches or disability sport newsletters. Therapists were actually considered an unimportant influence.

More evidence is available regarding barriers that limit participation in recreation and sports activities for persons with SCI. Pentland and colleagues conducted interviews with women living with SCI [41]. Participants in their study noted problems identifying and accessing recreation and fitness opportunities as creating barriers to health and fitness. Interviews conducted by Datillo and colleagues [9] contain similar reports of barriers to participation consisting of problems with physical accessibility as well as lack of support and companionship, and problems with transportation.

5. Assistive Technology, Recreation & SCI

The number of sporting opportunities as well as the level of performance that can be achieved by athletes with SCI continues to progress. It is probably that a participant with a spinal cord injury and pioneering spirit has adapted almost any recreational outlet or sport you could imagine. From worldwide travel to art, music and extreme sport, former spectators with SCI are now becoming participants. Peter Reiki, who suffered a thoracic SCI while rock-climbing with resultant complete paraplegia, vowed he would climb again [11]. He created the "snowpod" an arm powered, 49-gear contraption using his mechanical engineering background. After several failures on multi-day expeditions in the snowy climate, he successfully reached the summit of Mt. Rainier independently. Although Reiki serves as an extraordinary example of what is possible, hundreds of organizations focus upon adapting differing sports to diverse participants with SCI who may have less ambitious goals. Downhill skiers, for example, can

utilize the “bi-ski” which allows participants with complete tetraplegia to turn, or assist in turning, by isolated head rotation.

Sailing, like adaptive skiing, allows participants with a SCI to enjoy a relaxing sport or even compete with other racers without such an injury. Pulley systems afford a mechanical advantage to the operator and, oftentimes, maneuver the boat independently. The ongoing advancement and growth of recreational opportunities for people with a spinal cord injury was likely unimaginable 30 years ago. Future innovation will undoubtedly enable participants to continue to contradict preconceived limitations of their ability.

Adaptations for hunting and fishing have also been explored and improved. Devices to hold and stabilize a rifle as well as cast a fishing pole are available. Also, specialized advances in all terrain vehicles and wheelchairs allow access to more remote areas for sporting opportunities.

Elite athletes with SCI enjoy the benefits of ongoing advances in wheelchair technology. Sports specific wheelchairs are commonplace in basketball as well as track competition. Chairs designed for long distance racing are made with light and strong metals including titanium with wheels designed by the same companies that tailor bicycles for top “able-bodied” competitors. These wheelchairs most often place rider’s legs in a more flexed in a position to prevent fatigue, maximize rider mechanical efficiency, and make the rider more aerodynamic. This position could place the rider at greater risk for decubitus ulcer due to weight shift to the ischial tuberosities. Chairs designed for basketball must withstand significant impact with other wheelchairs and remain easy to maneuver. The front casters of the chair are placed nearer to the rear axel creating a shorter turning radius. The camber or vertical tilt of the wheels is often exaggerated to offset the relative instability created by the sharper turning radius. While sport

specific wheelchairs undoubtedly enhance the performance of serious competitors, they are expensive and impractical to own for many athletes. Cooperative efforts to make these chairs available to more children and adults are underway.

6. Safety Concerns and Potential Complications

Thermoregulation is impaired after SCI due to altered somatic and autonomic nervous systems that control sweating and blood flow to the skin below the level of injury [21]. Studies demonstrate individuals with higher-level injuries and more complete lesions have greater impairment of thermoregulatory capacity [48]. Furthermore, anticholinergic medications utilized for bladder management can further impair ability to perspire. Upper body and head sweat rates among individuals with tetraplegia has been found to be increased [42] but this likely has a minimal impact upon risk reduction of hyperthermia. Participants with SCI should be well educated about the risk of hyperthermia and take proper precautions when exercising. Methods to enhance thermoregulatory capacity are described later in this review.

Minimizing heat stress during exercise is imperative given the altered thermoregulation of individuals with SCI. Studies of able-bodied athletes reveal decreased risk among individuals who train regularly. This decreased risk is due to reduced threshold temperature for perspiration, increased plasma volume and increased cardiac output that increase blood available for temperature regulation [49]. Specific studies of thermoregulation among athletes versus non-athletes with SCI has not been performed but proper aerobic training is still likely most important in prevention of hyperthermia. Training should generally take place in a cool environment as most researchers indicate this will enhance physiologic response when challenged by exercise in a hot environment [52]. Specifically, training should be avoided in

temperatures that exceed 21 degrees Celsius and 50% humidity. Training or competing while injured or ill enhances risk of hyperthermia and should also be avoided. Athletes should ensure they acquire sufficient sleep and wear lightweight and loose fitting clothing to facilitate evaporative cooling. Finally, athletes should meticulously track their weight in order to monitor fluid loss. Generally, one liter of fluid should be consumed for every kilogram of weight loss. The intensity or duration of workout should be decreased if weight loss exceeds 4% body mass during any activity [52].

Athletes in wheelchairs are obviously vulnerable to soft-tissue injuries resultant from overuse involving the upper extremities. Such injuries are the most common in surveys conducted and more often involve the shoulder joint. The results of such an injury can be devastating to the patient with SCI who is temporarily unable to perform activities of daily living or independent locomotion. Not surprising, re-injury occurs more often in athletes who choose to restart sports before achieving pain-free status from prior injury. Education about sports injuries and their cause is imperative in reducing such exacerbations. Injury preventing activities should include stretching, strengthening and warm-up. Specific strengthening of less recruited muscles, such as the scapular retractors, to prevent muscle imbalance is also warranted.

The glenohumeral joint is stabilized by the rotator cuff muscles and allows for much greater movement than the hip joint. The closed-kinetic chain activity and weight-bearing demands placed on this relatively unstable joint in all individuals in wheelchairs creates significant vulnerability to injury. The risk is increased significantly with demands of sport, especially track, road racing, and basketball [8]. Up to one-third of such injuries are severe resulting in more than three weeks restriction from sports. Bicipital tendon injury has been reported as the most common injury associated with wheelchair sports [14]. Complete tear of the

tendon of the long head of the biceps is not uncommon and should be considered in the differential diagnosis of an athlete with persistent pain a week after injury and despite appropriate therapeutic measures. Similarly, rotator cuff tears and tendonitis are also quite common. The long-term success of surgical repair of rotator cuff tears among users of wheelchairs is yet to be studied [45] further supporting preventive measures. Impingement syndromes are also not uncommon among athletes and non-athletes in wheelchairs who often perform overhead activities. One study [5] of athletes with SCI and impingement syndrome found the patients had weak rotator cuff muscles. This weakness may have been etiologic of or may have developed secondary to disuse from the painful syndrome. Regardless, rotator cuff strengthening is warranted in any long-term wheelchair user given the functional consequences of injury.

Elbow pain, often due to extensor muscle tendonitis, is reported to occur in 14-16% of athletes in wheelchairs [50]. Olecranon bursitis and triceps tendonitis are also common. Persistent lateral epicondylitis may indicate entrapment of the radial nerve. Such pain may warrant electrodiagnostic investigation that is less sensitive in detecting radial nerve pathology than in other peripheral nerves [12].

Entrapment neuropathies are quite common among athletes in wheelchairs. Carpal tunnel syndrome in been estimated at 50 to 72% of this population and a 100% prevalence among paralympic weightlifters. Ulnar neuropathy occurs in as many as 50% of these athletes and is most commonly due to entrapment at Guyon's canal [4].

[insert table 1 about here]

7. Recommendations and Conclusions

While activity, whether sports or recreation, appears beneficial to both the physical and psychological health of individuals with SCI, caution must be used in defining or mandating activities. The use of sport and recreation is beneficial to individuals across age ranges and disability types but safety considerations must be observed. Health professionals should get used to asking about and encouraging such activities in their populations.

The potential benefit of participation in sport and recreation has been documented. However, the studies that examine the benefits of such participation are often retrospective in design with small cohorts. Further prospective and randomized trials using larger cohorts, although difficult to perform, are certainly warranted. Furthermore, certain benefits to such participation are difficult to objectively measure. Attention should be given to standardizing the measures used in studies so that results can be compared. Objective assessments need to measure not only the effect of sport and recreation on the person with SCI but also on family members. The ability for a person with SCI to participate in recreational activities relatively independently along side of family members is likely therapeutic to both. While it may be difficulty to capture or quantify the psychological changes that can result from participating in activities previously thought out of reach or unimaginable, from achieving a level of participation unimagines prior to engaging in the activity, the effect of these activities on self-confidence, self-esteem and quality of life is very real.

The interdisciplinary rehabilitation team should encourage participation in sport and recreation stressing safety, enjoyment, cooperation and camaraderie. However, they should also realize that peers with SCI will have more influence and should be utilized for recruitment whenever possible. The rehabilitation team needs to remain aware that no ideal patient exists for

such participation especially as adaptations become more advanced. Finally, the physiatrist should be familiar with the common soft tissue injuries and nerve entrapments associated with wheelchair sports and educate patients about preventative measures.

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Table 1: Safety Concerns and Considerations

Risk/Injury	***Signs/Symptoms***	***Prevention***	***Treatment***	***Special Concerns***
Hyperthermia (elevated body temperature)	Symptoms: Feeling "overheated" with progression to extreme fatigue, dizziness, nausea, mental confusion, and finally loss of consciousness with risk of death. Signs: heavy perspiration early with progressiong to dry and flushed skin later. Lethargy	Adequate water intake before, during, and after event. Avoid training and competing in temperatures above 21 degrees Celsius and 50% humidity. Wear loose fitting and light weight clothing. Do not train or compete when feeling ill.	Seek cool environment and obtain adequate re-hydration In more severe cases with mental confusion, persistent temperature elevation despite cooling efforts or temperature>103 seek medical attention.	People with SCI are at risk for hyperthermia because "normal" defense mechanisms such as perspiration and blood flow to extremities for cooling are altered.
Dehydration	Fatigue, dizziness, nausea with subsequent potential fainting and confusion	Adequate water intake before, during and after event ensuring weight loss after strenuous activity does not exceed 4% of body weight.	Re-hydration with at least 1 liter of water per kg of weight loss. Seek medical attention for confusion or persistent fainting	After SCI, mechanisms to maintain blood pressure are not as effective thus enhancing vulnerability to dehydration.
Shoulder Injuries	Commonly-Pain with movement especially overhead activities. Loss of range of motion. Crepitus, or grinding sound can also be present.	Special attention to stretching as well as strengthening less used muscles of the shoulder is vital. DO NOT EXERCISE WITH PERSISTENT PAIN. Specific exercises to stretch and strengthen the "rotator cuff muscles" are beneficial in preventing injury in anyone but especially wheelchair users who place a much higher physical demand on their shoulder joints.	Rest or relative rest until pain absent. Ice / apply cold compress to decrease inflammation Gradual re-entry into sport with emphasis on warm-up, stretching and gradual strengthening. Seek medical attention if pain severe, recurrent, or does not subside after 1 week of rest.	Because shoulder injuries are very common and potentially devastating, they are given special attention. A shoulder injury can have consequences far beyond inability to participate in sport; it can also result in lost independence and inability to work.
Other joint, muscle and tendon injuries	Pain-localized or diffuse and, most often, exacerbated with certain movement. Bursitis can result in swelling, especially involving the elbow.	Adequate warm-up with attention to stretching and sport-specific strengthening. DO NOT EXERCISE WITH PERSISTENT PAIN.	Similar to shoulder injuries	Exacerbation and recurrence of muscle injuries is common in people with SCI due to dependence on arm musculature for daily living. The best "medicine" is

Nerve Entrapment	Pain that can be diffuse in hands and at night with numbness, tingling, and weakness often occurring later.	Carpal Tunnel and other nerve entrapment syndromes are difficult to prevent. However, when diagnosed early the outcome is more favorable.	Early in the progression splinting and steroid injection can be helpful. Later, minor surgery is often necessary and quite effective early in disease course.	prevention. Again, because people with SCI rely so heavily on their hands and arms, nerve entrapments are more common. If you have the described symptoms, don't wait to consult a physician.