Physiotherapy Care for Adults with Paraplegia due to Traumatic Causes: A Review

Nalina Gupta[1*], Kavitha Raja[2]
1. PhD Scholar, School of Physiotherapy, RK University, Rajkot, Gujarat, India
2. Principal, JSS College of Physiotherapy, JSS University, Mysore, Karnataka, India

ABSTRACT

Purpose: *This review aimed to identify the practice guidelines/ recommendations for physiotherapy management in acute /post-acute/ chronic/long-term phase of rehabilitation of clients with paraplegia due to traumatic causes.*

Methods: *Of the 120 articles retrieved, 26 met the inclusion criteria. After quality appraisal, 16 articles were included in the study. Data were extracted under the sub-headings of physiotherapy care in acute, chronic and long-term community stage; expected outcomes; effect of physical interventions; morbidities; wheelchair characteristics and standing.*

Results: *There is strong evidence in support of strength and fitness training, and gait training. Parameters of strength training (frequency, duration and intensity) vary. There is lack of evidence on passive movements, stretching, bed mobility, transfers and wheelchair propulsion. Preservation of upper limb functions is an important consideration in caring for clients with paraplegia.*

Conclusion: *Many areas of rehabilitation interventions remain inadequately explored and there is a need for high quality studies on rehabilitation protocols. Client preferences and feasibility are other areas that should be explored.*

Key words: *Practice guidelines and paraplegia, standards of care and paraplegia, physiotherapy guidelines and spinal cord injury, physiotherapy care and paraplegia; physiotherapy care and traumatic spinal cord injury, physiotherapy care and traumatic paraplegia*

INTRODUCTION

Physiotherapy is a key component in the rehabilitation of persons with spinal cord injury. Persons with paraplegia have a better survival rate than those with

* **Corresponding Author:** Nalina Gupta, PhD Scholar, School of Physiotherapy, RK University, Rajkot, Gujarat, India. Email:nals235@yahoo.co.in

tetraplegia, especially in countries like India. Due to lack of adequate social welfare benefits, affected persons in India often have to bear the costs of medical treatments themselves. Specialised spinal cord centres are few and clients are treated in general medical centres. Hence it is important to understand the most effective strategies in order to improve care in terms of cost and effectiveness.

This review is an attempt to explore the evidence for physiotherapy care for clients with paraplegia of traumatic causes. The objective is to identify the practice guidelines/ recommendations for physiotherapy management in acute /post-acute/ chronic/ and long-term phase of rehabilitation of clients with paraplegia (ASIA A/B) of traumatic causes.

METHOD

The review team comprised of four physiotherapists of varying academic and clinical experience (between 8-30 years).

The search engine/databases searched were: Cochrane database/PubMed/SCIRE/ PEDro /CINAHL/EMBASE, and the key words used were: practice guidelines and paraplegia, standards of care and paraplegia, physiotherapy guidelines and spinal cord injury, physiotherapy care and paraplegia.

Inclusion Criteria: Evidence-based practice is the strategy that takes into consideration best research evidence in the context of feasibility and patients' preferences. Hence, clinical practice guidelines, consumer guides, systematic reviews and randomised controlled trials were included. Domains selected were physiotherapy in acute, chronic and long-term community SCI (paraplegia), expected outcomes, morbidities, effect of physical activity/physical interventions, mobility of clients with paraplegia, wheelchair specifics and standing. Articles from all countries and publication dates since (and inclusive of) 1990 were included.

Exclusion Criteria: Studies on tetraplegia/tetraparesis, incomplete SCI, children, advanced therapeutic interventions such as robot-assisted training, and transcranial electrical and magnetic stimulation were excluded from the study. To control for evidence magnification, articles were left out if they were already part of an included systematic review.

Procedure of Article Selection: Titles and abstracts were screened. Hand search was conducted in reference citations/bibliographies of relevant articles to extract additional titles. Duplicates were identified and removed.

Of the 120 articles retrieved, 26 met the inclusion criteria. These were reviewed and appraised individually by three reviewers. Appraisal tools selected were as follows: AGREE II- Appraisal of Guidelines, Research and Evaluation (Siering et al, 2013; McMaster University, 2013; McMaster University, 2013) for clinical practice guidelines; CASP- Critical Appraisal Skills Programme (CASP, 2006) for systematic reviews; Quantitative method forms and guidelines for randomised controlled trials (Law and MacDermid, 2014). Figure 1 depicts the methodology adopted. Rating system for hierarchy of evidence (Melnyk and Fineout, 2005) was considered for this review, as seen in Appendix 1.

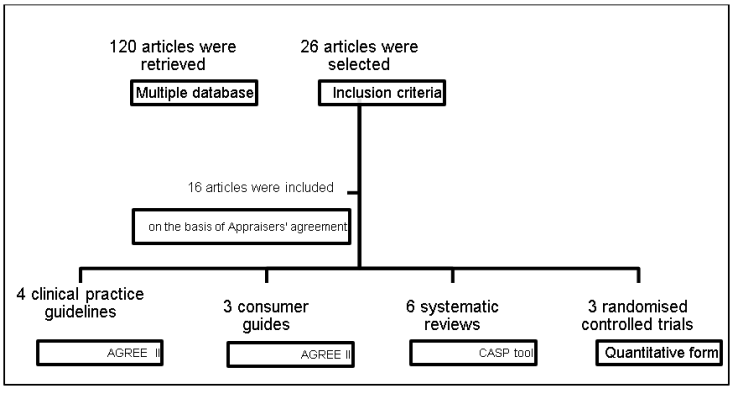
Articles were selected for review if the following criteria were met:

i) 70-80% agreement on 6 domains and overall recommendation 5,6,7/7 on AGREE II

ii) Agreement on 8 questions out of 10 and overall recommendation-Yes on CASP

In cases when one rater graded the article significantly lower than the others, a consensus meeting was conducted at which differences were reviewed and agreement reached. In cases where agreement was not possible even at this stage, the senior reviewer's opinion was sought and consensus was considered as agreement between any three reviewers.

Figure 1: Flow Chart of Methodology



Key: AGREE- Appraisal of guidelines, research and evaluation, CASP-Critical appraisal skills programme

RESULTS

Of the 26 articles appraised, 16 articles met the recommended level of agreement. Of these, 4 were clinical practice guidelines, 3 were consumer guides, 6 were systematic reviews and 3 were randomised controlled trials.

Study characteristics are shown in Table 1. For ease of presentation, they have been categorised into various sections such as physiotherapy in acute, chronic and long-term community SCI; expected outcomes; physical activity/effect of physical interventions; morbidities; wheelchair characteristics and standing.

Table 1: Characteristics of Included Studies (n=16)

Author name and publication year Appraisal tool score Level	Type of study	Objective	Methodology	Results Recommendations	Remarks, if any
1. Physiotherapy in acute, chronic and long term community SCI					
i) Consortium of spinal cord medicine, 2008 AGREE II: 6/7 Recommended Level I	Clinical Practice Guideline	To develop a guideline for early acute management of SCI		ROM exercises Strengthening Pulmonary care Prevent skin breakdown Bed mobility Transfers Locomotion Orthosis Orthostatic hypotension	Physiotherapy treatment plan is outlined, not mentioned in detail
ii) Chronic spinal cord Injury: National Guidelines, 2008 AGREE II: 5/7 Recommended Level I	Clinical Practice Guideline	To develop a guidance for good care in chronic SCI in acute hospital settings		Respiratory care Splinting Stretching Passive mvts. standing	Physiotherapy treatment plan is outlined, not mentioned in detail
2. Expected Outcomes for people with T6-S5					
i) Consortium for spinal cord medicine, 2012 AGREE II: 5/7 Recommended Level VII	Consumer guide	To list the expected outcomes for people with T1-T9 SCI		May have poor balance Independent in bed mobility, transfers and wheelchair use Indoor and outdoor mobility using a wheelchair	Consumer guide development process is not mentioned

ii) Consortium for spinal cord medicine, 2002 AGREE II: 5/7 Recommended Level VII	Consumer guide	To know the expected outcomes for people with T10-L1 SCI		Independent in mobility activities. Walking: some assistance	Consumer guide development process is not mentioned
iii) Consortium for spinal cord medicine, 2002 AGREE II:5/7 Recommended Level VII	Consumer guide	To know the expected outcomes for people with L2-S5 SCI		Independent with mobility activities (Bed mobility, transfers, wheelchair use, standing and walking) Walking: some assistance	Consumer guide development process is not mentioned
3. Physical Activity/ Effects of Exercise Intervention					
i) Wolffe DL et al, 2013/SCIRE CASP Recommended Level I	Systematic Review	To describe the level of evidence for physical activity and its effects on various aspects of health and wellness in SCI	Articles:1980-2006 RCT-PEDro Non RCT- Downs and Black appraisal tool	BWSTT & FES are more appropriate for those with great muscle impairment	
ii) Hicks AL et al, 2011/Canada CASP Recommended Level I	Systematic Review	Effect of exercise on physical fitness in SCI	Articles included: Until 2010 Case studies, experimental and quasi-exp. studies were included PEDro-RCT Downs and Black – non RCT Only 8 RCTs	Addition of arm ergometry Body weight as an outcome Combination of strength training and arm ergometry 2-3 times/week at 70-80% max HR or 60-65 Vo2 peak	In acute SCI, evidence is insufficient but there is no decrement in physical fitness parameters In chronic SCI, exercise improves physical capacity and muscular strength.
iii) Harvey L et al, 2011/Australia Quantitative form Recommended Level II	RCT	To evaluate whether intensive motor training programme for ability to sit unsupported is effective in individuals with recently acquired paraplegia	Experimental group: additional 30 minutes of motor training 3 times/week for 6 weeks… 252 exercises were in cards Control group Bangladesh site: additional 5 minutes of training 3 times a week but not those from Australia site	Additional training programme for unsupported sitting was not found to be effective Training of ADL has a carryover effect on unsupported sitting	Two groups in two countries

iv) Harvey LA et al, 2009/Australia CASP Recommended Level II	Systematic Review	Quantitative analysis of all RCTs to determine the effect of physical therapy in subjects with SCI	Data included till December 2007 4543 abstracts-----31 trials included PEDro tool	Evidence for strength and fitness training, gait training and acupuncture	
4. Morbidity and Paraplegia					
i) Pain and Upper Limb Preservation					
i) Mulroy S et al, 2011/USA Quantitative form Recommended Level II	RCT	To find out the effect of home-based exercise programme and instructions to optimise performance for UE tasks in reducing shoulder pain Also to find out the impact of intervention on physical activity and participation	12 weeks intervention+ 4 week follow- up (16 weeks) Home exercise programme (HEP): stretching phase, resisted phase, endurance and instructions for transfers (9) and wheelchair propulsion (10) Attention control group: 1 hour video/education	HEP group showed decrease in shoulder pain accompanied by significant improvement in muscle strength, health related and overall self-reported QOL Increase in activity or participation level was not demonstrable	
ii) Kemp BJ et al, 2011/USA Quantitative form Recommended Level II	RCT	Inter-relationship among pain, social participation and quality of life	Treatment group: 3 stretching and 4 strengthening exercises using elastic bands/ hand weights while sitting in WC Frequency: 3 times in a week for 12 weeks. Instructions regarding UE activities Control: video and written material on shoulder fn	There is an association of decrease in pain and increase in social participation Association between decrease in pain and increase in QOL No association between social participation and QOL	Important to incorporate clinically significant change than statistically sig
iii) Consortium spinal cord medicine, 2005 AGREE II:6/7 Recommended Level I	Clinical Practice Guideline	Preservation of upper limb functions following spinal cord injury		Upper limb ergonomics, exercises, treatment of pain	

ii) Spasticity					
i) HseihJTC et al, 2012/Canada/ SCIRE CASP Recommended Level I	Systematic Review	Spasticity following SCI	1980-2006 Multiple database SCIRE methodology PEDro score for RCTs and Downs and Black tool for non-RCTs	Multidimension test battery is required for assessment of spasticity Treatment: Passive leg movements, Hippotherapy, Electrical passive pedalling, Rhythmic passive movements, Externally applied forces, Passive stretch, Hydrotherapy, FES assisted cycling, Passive cycling, FES assisted walking acts, ES Long- term use of ES may also increase spasticity, TENS, Massage Cryotherapy	Most of the studies have shown short-term effects
iii) Bone Loss					
i) Sorensen FB et al, 2009/Denmark and Australia CASP Recommended Level I	Systematic Review	Evidence related to non-pharmacological means of prevention and treatment of bone loss after SCI	Interventions on human subjects Articles in all languages 45 studies were explored Only 2 studies showed adequate randomisation	Weight bearing activities need to be aggressive and included early Electrical stimulation for 2-3 times /week and continued for a longer time to prevent decline in bone mass is recommended	
5. Wheelchair Characteristics and Standing					
i) Titus L et al, 2014 /SCIRE project Canada CASP Recommended Level I	Systematic Review	To review the literature pertaining to wheeled mobility and seating equipments	1980-2006 Pedro-RCT Downs and Black-non RCT	Forward position of the rear wheel improves push rim biomechanics Adjustable axle position improves wheelchair propulsion Use of ultralight wheelchair Body weight management Tyres with less than 50% of inflation increases energy expenditure	Inconclusive evidence regarding stroke patterns Pressure mapping system- not well documented More research is needed

				Flexible hand rims reduces wrist and finger flexor activity/UL strain (level 4) Use of lateral trunk supports Spinal/pelvis posture No one cushion is suitable for all SCI Leaning forward at least 45 degrees and lateral leaning 15 degrees- redistribute pressure Limit the use of push-ups/vertical lifts as it leads to repetitive strain injuries Backrest recline to 120 degrees decreases pressure at ischial tuberosity but more research is required Inverse relationship between tilt angle and pressure at the sitting surface	
ii) Physiotherapy Lead Clinicians, 2013/UK, Ireland AGREE II: 6/7 Recommended Level I	Clinical Practice Guideline	Clinical guideline for standing adult following spinal cord injury	12 papers of primary research and 3 systematic reviews out of 91 articles were selected	Standing must be initiated as soon as client is physiologically stable and it is practically possible 3 or more than 3 times a week 30-60 minutes duration	

Key: SCI-spinal cord injury, NMES- neuro-muscular electrical stimulation, BWSTT- body weight support treadmill training, FES- functional electrical stimulation, ADL- activities of daily living, OM- outcome measure, WUSPI, wheelchair user shoulder pain inventory, QOL- quality of life, IFT- interferential therapy, ROM- range of motion, LL- lower limb, ES- electrical stimulation, TENS- transcutaneous electrical nerve stimulation, CPGs - clinical practice guidelines, UL- upper limb, UE- upper extremity

i) **Physiotherapy in Acute, Chronic and Long-term community SCI:** Two clinical practice guidelines were included in the study. Consortium of spinal cord medicine in 2008 mentioned the role of physiotherapy in acute SCI as prevention of secondary complications such as skin breakdown, maintenance of range of motion and strength, and mobility activities with or without an aid (Consortium of Spinal Cord Medicine-Clinical Practice guidelines, 2008; Chronic spinal cord injury-National guidelines, 2008).

ii) **Expected Outcomes for People with T6-S5 Lesion:** Independent ambulation with assistive devices within the first year of injury was identified as an expected outcome for people with lesion at T6-S5. Those with higher thoracic level of lesion can be expected to become independent in his/her mobility activities (Expected Outcomes T1-T9, 2002; Expected Outcomes T10-L1, 2002; Expected Outcomes L2-S5, 2002).

iii) **Physical Activity/Effect of Physical Interventions in SCI/Paraplegia:** One guideline, three systematic reviews and one randomised controlled trial were included in this section. Harvey et al (2009) had found enough level II evidence for strength and fitness training and gait training. Trials for strength and fitness training involved either active exercises of upper limbs, with or without electrical stimulation, or electrical stimulation of the lower limbs. Trials for gait training involved weight support systems, mechanical orthosis or use of electrical stimulation (Harvey et al, 2009). Hicks et al (2011) emphasised the addition of arm ergometry in early rehabilitation. Body weight support treadmill training and functional electrical stimulation should be used in severe muscle impairment (Wolfe et al, 2013). Additional training of unsupported sitting on functional activities was not found to be effective (Harvey et al, 2011).

iv) **Morbidities and Paraplegia:** Two guidelines and two randomised controlled trials for pain were included. Home exercise programme of shoulder musculatures, along with recommendations for transfers and wheelchair propulsion, was found to be effective in decreasing shoulder pain and increasing quality of life (Kemp et al, 2011; Mulroy et al, 2011). Upper limb activities must be preserved and ergonomics should be followed to alleviate pain (Clinical Practice Guidelines for Healthcare Professionals, 2005). Multi-dimensional battery of tests must be used for the assessment of spasticity (Hsieh et al, 2012). There are various ways of reducing spasticity such as elimination of noxious stimuli, passive movements, hydrotherapy,

hippotherapy, TENS, FES, electrical stimulation, splinting, stretching, tone inhibiting techniques, etc (Hsieh et al, 2012). Most of these techniques have short-term effect, as mentioned in Table 1. Weight-bearing activities and therapeutic standing must be initiated early in the rehabilitation for prevention of bone loss (Sorensen et al, 2009). Electrical stimulation, 2-3 times a week, helps prevent bone loss if continued for a long time (Sorensen et al, 2009).

v) Wheelchair Characteristics and Standing: Various wheelchair characteristics for improved push rim biomechanics and energy expenditure have been described, as can be seen in Table 1. However there is inconclusive evidence of wheelchair stroke patterns, and the pressure mapping system was not well documented (Titus et al, 2014). A clinical practice guideline on standing adults following SCI (2013) has recommended that standing be initiated as soon as the client is physiologically stable and it is practically possible. Standing must be done three times or more in a week, for 30-60 minutes (Clinical Practice Guidelines, Lead Clinicians, 2013).

DISCUSSION

Clinical practice guidelines for acute, chronic and community phases of rehabilitation were found. These guidelines have outlined the role of physiotherapy but elaborate descriptions of physiotherapy techniques were lacking.

In early phases of rehabilitation, the role of physiotherapy revolves around prevention of secondary complications, respiratory care, maintenance of range of motion, and passive exercises. The frequency for position changes has not been specified in any guideline. The reason may be that this has been an accepted routine of nursing care in most developed countries. However this is an important factor in developing countries where rehabilitation is not yet a mainstream healthcare specialty. The traditional practice of turning the client every 2 hours has not been subjected to scientific enquiry and is an area that must be researched. Complications from skin breakdown are very challenging for most individuals with SCI and are expensive in terms of medical costs and time wasted in rehabilitation (Singh et al, 2010). Stretching is one of the roles described in all phases of rehabilitation but recent studies have found ankle stretch (duration-30 minutes, 5-7 times/week for 4 weeks) and hamstring stretch (duration-30 minutes, 5 times/week for 4 weeks) ineffective in improving ankle and passive hip range of motion. Authors did not find enough evidence supporting passive movements and stretching exercises

in SCI (Harvey et al, 2009). Traditional methods like passive movements and stretching exercises remain questionable in term of effectiveness. In India, most acute physiotherapy focus is on these exercises, while this time might well be spent in more focussed strategies. High quality studies are required to explore these factors.

There is adequate evidence supporting strength training, fitness training and gait training in persons with spinal cord injury (Harvey et al, 2009). Seven randomized controlled trials were reported pertaining to the effect of exercise on strength and endurance (Wolfe et al, 2013). Exercises mentioned were resistance training, neuro-muscular electrical stimulation, body weight support treadmill training (BWSTT), and intense exercises such as cycle ergometry. BWSTT and functional electrical stimulation (FES) are recommended in cases of severe muscle impairment (Wolffe et al, 2013). Adding arm ergometry in the initial phase of rehabilitation is important, as stated by Hicks et al (2011).Strength training is recommended 2-3 times a week, at 70-80% of maximum heart rate or 60-65% Vo2 peak (Hicks et al, 2011).

Shoulder pain is one of the common complaints among clients with paraplegia. Recommendations on transfers and wheelchair propulsion can help in reducing this pain and improving quality of life of these individuals (Kemp et al, 2011; Clinical practice guidelines for Healthcare Professionals, 2005). Recommendations given in literature are specific to wheelchair characteristics and propulsion techniques (Titus et al, 2014). Non-availability of wheelchairs conforming to such specifications is a significant barrier in India and similar countries which would potentially deliver less than optimum rehabilitation outcomes (Burns and Connell, 2012). This must be a focus of policy recommendations and continuing education for rehabilitation professionals. Upper limb functions in clients with paraplegia need to be preserved since it is involved in all their mobility activities (Clinical practice guidelines for Healthcare Professionals, 2005). There are various strategies proposed in literature regarding spasticity reduction but most of them have shown short-term effects (Hsieh et al, 2012). Overall the level of evidence for most procedures is lacking, either in research rigour or in description of procedures. Hence there is an urgent need to draw up extensive guidelines that can be tested stringently.

There is potential for future studies in this direction. Another important aspect for research is to identify client priorities, and knowledge and practice of professionals.

The current study was an attempt to review relevant articles (clinical practice guidelines, consumer guides, systematic review articles and randomised controlled trial).One particular focus was on rehabilitation guidelines from low and middle-income countries; however the authors were unable to find guidelines from such countries.

Limitations

The search criteria of English language articles or articles which had English translations was a limitation. Articles related to advanced therapeutic interventions such as robot-assisted training, and transcranial electrical and magnetic stimulation were excluded from the study.

CONCLUSION

There is strong evidence supporting strength and fitness training and gait training in individuals with paraplegia/SCI. Parameters of strength training (frequency, duration and intensity) vary. There is lack of evidence on passive movements, stretching, bed mobility, transfers and wheelchair propulsion. Preservation of upper limb functions is an important factor to be considered in the case of clients with paraplegia.

There are many other areas of rehabilitation interventions that have not been adequately explored. There is a need for high quality studies on rehabilitation protocols, as well as on topics like client preferences and feasibility.

REFERENCES

Burns AS, Connell CO (2012). The challenge of spinal cord injury care in the developing world. The Journal of Spinal Cord Medicine; 35(1): 3-8. http://dx.doi.org/10.1179/2045772311Y.0000000043

Chronic spinal cord injury: management of patients in acute hospital settings (2008). National Guideline; 1-15. Available from: http://www. Rcplondon.ac.uk/sites/default/files/concise-chronic-spinal-cord-injury-2008.pdf

Spinal Cord Injury Centre (2013). Clinical guideline for standing adult following spinal cord injury. Physiotherapy Lead Clinicians United Kingdom and Ireland: 1-44.

Clinical Practice Guideline for Health Care Professionals (2005). Preservation of upper limb function following spinal cord Injury. The Journal of Spinal Cord Medicine; 28(5): 433- 470.

Consortium for Spinal Cord Medicine Clinical Practice Guidelines (2008). Early acute management in adults with SCI. The Journal for Spinal Cord Medicine; 31(4): 403-479.

Critical Appraisal Skills Programme (CASP): Making sense of evidence (2006). Public Health Resource Unit; England.

Expected Outcomes: A guide for people with T1-T9 Spinal Cord Injury (2002). Available from: http://www.pva.org/scicpg.org

Expected Outcomes: A guide for people with L2-S5 Spinal Cord Injury (2002). Available from: http://www.pva.org/scicpg.org

Harvey LA, Lin CWC, Glinsky JV, Wolf A De (2009). The effectiveness of physical interventions for people with spinal cord injury. Spinal Cord; 47: 184-195. http://dx.doi.org/10.1038/sc.2008.100

Harvey LA, Ristev D, Hossain MS, Bowden JL, Boswell-ruys CL, Ben M (2011). Training unsupported sitting does not improve ability to sit in people with recently acquired paraplegia: A randomised trial. Journal of Physiotherapy; 57: 83-90. http://dx.doi.org/10.1016/S1836-9553(11)70018-2

Hicks AL, Ginis KAM, Pelletier CA, Ditor DS, Foulon B, Wolfe DL (2011). The effects of exercise training on physical capacity, body composition and functional performance among adults with spinal cord injury: a systematic review. Spinal Cord; 49:1103-1127. http://dx.doi.org/10.1038/sc.2011.62

Hsieh JTC, Wolfe DL, McIntyre A, Janzen S, Townson AF, Short C, Connolly SJ, Mehta S, Curt A (2012). Spasticity following spinal cord injury. Spinal Cord Injury Rehabilitation Evidence. Version 4.0.

Kemp BJ, Bateham AL, MulroySJ, Thompson L, Adkins RH, KahanJS (2011). Effects of reduction in shoulder pain on quality of life and community activities among people living long term with SCI paraplegia: a randomised control trial. The Journal of Spinal Cord Medicine; 34(3): 278-284. http://dx.doi.org/10.1179/107902611X12972448729486

Law M, MacDermid JC (2014). Quantitative methods forms and guideline. Evidence based rehabilitation: a guide to practice; Third Edition. ThorofarE, NJ; SLACK incorporated; 375-389.

McMaster University (2013). National collaborating centres for methods and tools. User's Manual: Instructions for using AGREE II. Hamilton, ON: Available from: http://www.nccmt.ca/registry/view/eng/100.html

Melnyk MB, Fineout E (2005). Nursing resources: Levels of Evidence (I-VII). Rating system for the hierarchy of evidence: quantitative questions. Evidence based practice in nursing and healthcare: a guide to best practice. Available from: http://reserachguides.ebling.library.wisc.edu/content.php?pid

Mulroy SJ, Thompson L, Kemp B, Hatchett PP, Newsam CJ, Lupold DG, Haubert LL, Eberly V, Ge TT, Azen SP, Winstein CJ, Gordon J (2011). Strengthening and optimal movements for painful shoulders (STOMPS) in chronic spinal cord injury- a randomised controlled trial. Phys Ther; 91: 305-324. http://dx.doi.org/10.2522/ptj.20100182

Siering U, Eikermann M, Hausner E, Eber WH, Neugebauer EA (2013). Appraisal tools for clinical practice guidelines - A systematic review. PLOS ONE; 8(12): e82915-1-15. http://dx.doi.org/10.1371/journal.pone.0082915

Singh R, Singh R, Rohilla RK, Siwach R, Verma V, Kaur K (2010). Surgery for pressure ulcers improves general health and quality of life in patients with spinal cord injury. J Spinal Cord Med.; 33(4): 396-400. http://dx.doi.org/10.1080/10790268.2010.11689718

Sorensen FB, Hansen B, Lee BSB (2009). Non-pharmacological treatment and prevention of bone loss after spinal cord injury- a systematic review. Spinal cord; 47:508-518. http://dx.doi.org/10.1038/sc.2008.177

Tharion G, Nagarajan G, Bhattacharji S (2008-09). Guidelines for the care of persons with spinal cord injury in the community.Government of India- WHO collaborative programme. Available from: http://www.thespinalfoundation.in/uploads/2/9/7/5/29758897/who_manual_spinal_cord_injury.pdf

Titus L, Moir S, Casalino A, McIntyre A, Connolly S, Trenholm K (2014).Wheeled mobility and seating equipment following spinal cord injury. Spinal Cord Injury Rehabilitation Evidence. Version; 5: 1-77.

Wolfe DL, McIntyre A, Ravenek K, Martin Ginis KA, Latimer AE, Eng JJ, Hicks AL, Hsieh JTC (2013). Physical Activity and SCI. Spinal Cord Injury Rehabilitation Evidence Version 4.0.

Appendix 1: Rating System of Hierarchy

Levels	
Level I	Evidence from a systematic review of all relevant randomised controlled trials (RCTs), or evidence-based clinical practice guidelines based on systematic reviews of RCTs
Level II	Evidence obtained from at least one well-designed Randomised Controlled Trial (RCT)
Level III	Evidence obtained from well-designed controlled trials without randomisation, quasi-experimental
Level IV	Evidence from well-designed case-control and cohort studies
Level V	Evidence from systematic reviews of descriptive and qualitative studies
Level VI	Evidence from a single descriptive or qualitative study
Level VII	Evidence from the opinion of authorities and/or reports of expert committees