International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 23s, 2025
https://www.theaspd.com/ijes.php

Effectiveness Of Low-level Laser Therapy In Muscle Recovery And Quality Of Life In Patients With Incomplete Spinal Cord Injury: A Randomized Controlled Trial

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Abstract
Background: *Incomplete Injuries of Spinal cord, result in significant motor and sensory impairments, which substantially diminish individuals' quality of life (QoL). Although rehabilitation focus to improve motor recovery and QoL, many iSCI patients still struggle with persistent motor deficits. Low-level laser therapy (LLLT) has shown promising results into a painless modality having potential neuroprotective and neuroregenerative effects for iSCI patients.*
Purpose: *The study sought to find the efficacy of LLLT combined with conventional therapy to promote motor recovery and life's quality in incomplete spinal cord injury patients.*
Participants: *This RCT involved 104 iSCI participants (29.8% female, 70.2% male, mean age 34.24± 5.61 years) and distributed into two groups.*
Methods: *Experimental group was given LLLT plus conventional physiotherapy, and control group was given Placebo LLLT plus conventional physiotherapy. The evaluations were done at pre-intervention and post intervention after 4 weeks on lower extremity motor score (LEMS) and QoL assessment using the LEMS-ASIA and WHOQOL-BREF respectively.*
Result: *Independent t test was performed between the groups for LEMS-ASIA scores from baseline to 4th week of the study and Mann Whitney U-test was done for WHOQOL-BREF. Both groups showed improvement, however the LLLT group demonstrated better improvement in LEMS (23.44 ± 13.30 to 32.67 ± 9.91, p=0.000) as compared to placebo LLLT group (20.36±12.14 to 27.59±12.11, p=0.000) as well as in QoL (median 63(44-87) (pre) to 72 (48-89) (post), P=0.000) in LLLT group in comparison to placebo (60(44-90) (pre) to 63(44-96) (post), P=0.000) suggesting a positive impact on QOL.*
Conclusion: *This study indicates LLLT is positively effective on motor function and QOL. The findings may be an effective measure for both clinicians and the patient community.*
Keywords: *Motor recovery,Neural plasticity, Photobiomodulation, Quality of life*

INTRODUCTION:

Spinal cord injuries (SCI), including incomplete SCI (iSCI), result in significant motor and sensory impairments, which substantially diminish individuals' quality of life (QoL) [1-5]. Although rehabilitation aims to improve QoL, many iSCI patients still struggle with persistent motor deficits [6,7,8]. These injuries often lead to long-term disability, requiring lifelong medical care, rehabilitation, and significant lifestyle adjustments [9, 10]. The extent of recovery in iSCI, however, is highly variable, and while some individuals may experience significant improvement, others may have limited or no functional recovery despite intensive rehabilitation [5, 6, 7]. A few studies have focused specifically on incomplete injuries, and the results have been mixed [11, 12]. Some studies report significant improvements in motor function, while others show little to no benefit. Additionally, the impact of low level laser therapy (LLLT) on the broader aspects of recovery, such as QOL and psychosocial well-being, has not been thoroughly explored in the

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context of iSCI. Therefore, there is a need for more robust clinical trials to evaluate the efficacy of LLLT in enhancing outcomes for individuals with iSCI, particularly with respect to motor recovery and overall QoL [13, 14]. The study gap can be addressed by critically evaluating effects of LLLT on motor improvement and life's quality with iSCI patients. Through a systematic assessment of these outcomes, this research aims to gain important insights into whether LLLT can serve as an effective adjunct therapy to traditional rehabilitation strategies, offering a potential avenue for improving motor functions and improving QOL of individuals with incomplete spinal cord injury.

METHODOLOGY:

2.1 Study Design and Participants

The RCT was performedat ISIC. The study protocol has been approved by Indian Spinal Injuries Centre (Ref: ISIC/RP/2023/024) and Amity University's (AUUP/IEC/JULY/2022) and CTRI (CTRI/2023/04/052093). One hundred four adults aged between 18-45 years were enrolled. Exclusion criteria were complete SCI, cognitive impairment, contraindications for LLLT. Prior to enrolling anyone, Patient information sheets shall be provided for all the subjects and obtain their written informed consent. After the neurological assessment, demographic data were collected, and participants were selected depending on eligibility criteria.

2.2 Inclusion criteria: The participants will be recruited for the study that had experienced from 6 months to 1 year iSCI prior to enrolment and grade C and D [10, 15].

2.3 Exclusion criteria: Any history of neurological or musculoskeletal problem or skin rashes, pigmentation or skin allergy [16].

2.4 Sample size calculation: Assess changes in outcome measures with the estimation of sample size with the use of G*power version 3.1.2 software. The final sample size will be N=104, with d-value= 0.805 [14], α= 0.05, power = 0.95 considering the drop-out rate of 20%. Prior to employing, PIS shall provide for all subjects.

Before starting the study, the assessment will be done by using lower extremity motor score (LEMS) [17] and QOL using the WHO QOL-BREF questionnaire [18].

2.5 Randomization and Intervention

Patients were divided into either control group as: Placebo LLLT + conventional physiotherapy and the experimental Group: LLLT+ conventional physiotherapy with a computer-generated randomization sequence.

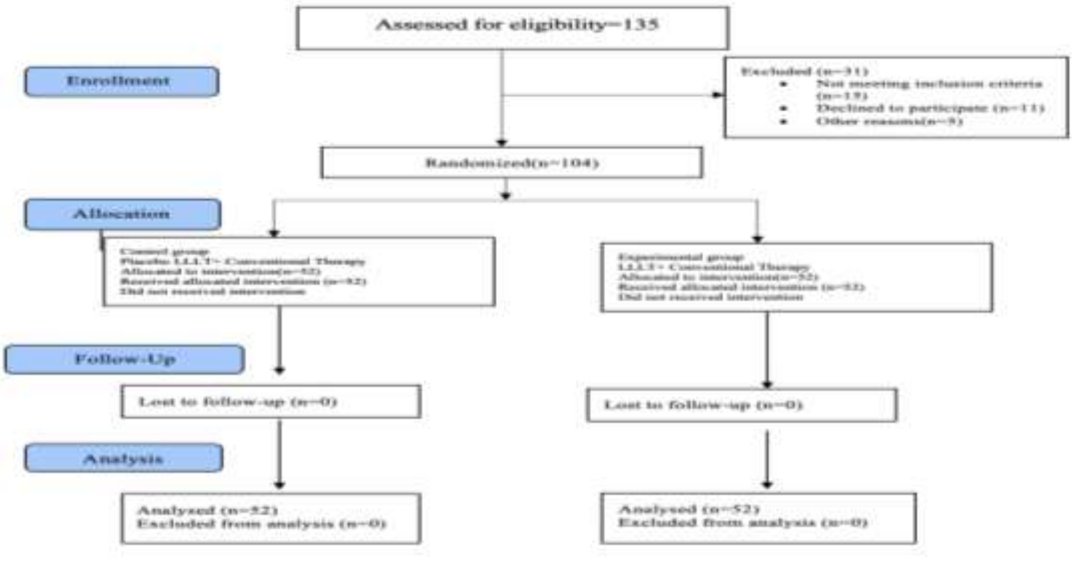

Fig.1. CONSORT (Consolidated Standards of Reporting Trials) flowchart. Low-Level laser therapy along with Conventional therapy and Placebo Low-Level laser therapy group along with Conventional Therapy.

Protocol

In the experimental group, low-level laser therapy was given in the lateral decubitus position on 9 points which weremarked around the fractured vertebrae as per the study protocol [19]. After 60 seconds within time frame of 9 minutes, a sound was generated by the equipment to show radiation emission commencement and conclusion. All the subjects went through twelve sessions with in a time span of 4 weeks, and for the remaining days, they practiced conventional physiotherapy exercises each day for 4 weeks [13,14].

The protocol was same for both the group but no irradiation was emitted in the control group.

Table 1. Low-Level Laser Therapy Parameters [12]

DOSIMETRY	VALUES
Centre λ	810 nm
NOHD	2.00m
Operating mode	Continuous
Mode of method	Contact method
Treatment	Three sessions/every week/4 weeks
Number of sites radiated	9 points

Outcome Measures

1. **LEMS** quantifies the aggregated the muscular strength of lower extremity key muscles [20-22]·
2. **QOL**: The WHO WQOL-BREF, which is a broad assessment tool developed to evaluate the subjective QOL which evaluates the physical, psychological, social and environmental [23, 24].

Statistical Analysis:

Analysis of data was conducted by the SPSS software. The average difference of LEMS from Pre-intervention to the 4th week as LEMS found to be normally distributed done by paired t-test, and was applied to assess the average change in QoL scores from pre-intervention to 4thweek, wilcoxon signed-rank test was used. To assessing the mean difference in LEMS between both the groups, an independent t-test was conducted, and the mann-whitney u-test was applied to check the median difference in QoL between the groups.

RESULTS:

Baseline clinical characteristics and demographics were similar between the groups ($p > 0.05$). Gender distribution was even, without differences observed: 71.2% of males and 28.8% of females in the experimental group, and males 69.2% and females 30.8% in control. Overall mean age in participants was 34.24 ± 5.61 years, ranging between 23 to 45 years. In the experimental group, the mean age was 34.06 ± 5.61 years, the range of age was between 23-45 years and 34.45± 5.16 years whereas, and the range of age was between 23-43 years in control group. The duration post-injury was between 6 to 12 months, the mean was 8.25 ± 1.71 months.

Table No. 2: Change in LEMS and WHO QOL Scores Between groups

International Journal of Environmental Sciences
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	Groups	n	Mean±SD / Med (range)	P-value
PRELEMS RIGHT	Experimental Group	52	12.00±7.31	0.163
	Control Group	52	10.08±6.63	
PRELEMS LEFT	Experimental Group	52	11.44±7.53	0.412
	Control Group	52	10.29±6.71	
PreLEMS Total	Experimental Group	52	23.44±13.30	0.221
	Control Group	52	20.36±12.14	
POST-LEMS RIGHT	Experimental Group	52	16.67±5.41	0.016
	Control Group	52	13.88±6.12	
POST LEMS LEFT	Experimental Group	52	16.00±5.35	0.054
	Control Group	52	13.71±6.54	
PostLEMS Total	Experimental Group	52	32.67±9.91	0.021
	Control Group	52	27.59±12.11	
Pre WHOQOL-Total	Experimental Group	52	63(44-87)	0.345
	Control Group	52	60(44-90)	
Pre WHOQOL-Domain 1	Experimental Group	52	18.5(12-26)	0.304
	Control Group	52	18(12-26)	
Pre WHOQOL-Domain 2	Experimental Group	52	15(11-22)	0.471
	Control Group	52	15(11-24)	
Pre WHOQOL-Domain 3	Experimental Group	52	7(4-10)	0.547
	Control Group	52	7(4-11)	
Pre WHOQOL-Domain 4	Experimental Group	52	20.5 (13-32)	0.586
	Control Group	52	19 (14-32)	
Post WHOQOL Total	Experimental Group	52	72(48-89)	0.041
	Control Group	52	63(44-96)	
Post WHOQOL Domain 1	Experimental Group	52	20 (12-26)	0.026
	Control Group	52	29 (12-28)	
Post WHOQOL Domain 2	Experimental Group	52	18 (12-22)	0.018
	Control Group	52	16 (11-24)	
Post WHOQOL Domain 3	Experimental Group	52	8 (5-10)	0.595

	Control Group	52	7.5 (5-10)	
Post WHOQOL Domain 4	Experimental Group	52	25 (14-32)	0.118
	Control Group	52	24 (16-34)	

The experimental group has better right motor function (p= 0.016), left side (p= 0.054) and overall motor function (p= 0.021) indicating a good difference. The experimental seems to increase psychological well-being and life quality, but its effects on physical health and environment were less clear or not significant. The treatment had no significant effect on social relationships.

Experimental group has a higher median WHO QOL score (72) comparing to the control Group (63), suggesting a good life quality perception the experimental group. P-value of 0.041 is less than 0.05, showing a statistical difference. This suggests that the experimental group reports a significantly good QOL comparison to the control Group.

Table No. 3: Change in LEMS and WHO QOL scores from Pre-intervention to Post-intervention within groups

	Group	N	Pre mean±sd / median (range)	Post mean±sd / median (range)	Value-p
LEMS RIGHT	Experimental group	52	12.00±7.306	16.67±5.41	<0.001
	Control Group	52	10.08±6.63	13.88±6.12	<0.001
LEMS LEFT	Experimental group	52	11.44±7.53	16.00±5.35	<0.001
	Control Group	52	10.29±6.71	13.71±6.54	<0.001
LEMS Total	Experimental group	52	23.44±13.30	32.67±9.91	<0.001
	Control Group	52	20.36±12.14	27.59±12.11	<0.001
WHOQOL	Experimental group	52	63(44-87)	72(48-89)	<0.001
	Control Group	52	60(44-90)	63(44-96)	<0.001

Both groups show improvement in the right and left lower extremity motor score from pre to post.

But the experimental group shows a greater improvement in motor function on the right and left sides compared to control Group, both terms of mean score and standard deviation.

Median WHO QOL score increased from 63(44-87) (pre) to 72(48-89) (post), suggesting a positive impact on life's quality in the experimental group and median WHO QOL score increased from 60 (44-90) (pre) to 63(44-96) (post) in the control group, showing a smaller increase in QOL than the experimental group.

The experimental group also showed a larger improvement in WHO QOL compared to the control group, though both groups showed positive changes.

DISCUSSION:

This study indicates that LLLT combined with standard rehabilitation significantly enhances motor recovery and QoL in comparison to a placebo treatment.

The study's outcome, motor recovery, was measured with the LEMS-ASIA, which demonstrated significant improvements in the experimental group receiving LLLT alongside conventional therapy. The experimental group showed a mean improvement of 9.23 points in total LEMS, but the control group exhibited a smaller improvement of 7.23 points, suggesting that LLLT provides a superior therapeutic effect in promoting motor recovery in individuals with iSCI.

These findings align with preclinical studies, which have indicated that LLLT can promote neural regeneration, enhance synaptic plasticity, and stimulate axonal growth. LLLT has many impacts on cellular and molecular level by focusing on chromophores that is cytochrome c oxidase [25, 26]. The absorption spectra of LLLT results into nitric oxide photo dissociation from cytochrome c-oxidase and results into increase in protein activity transport of electron, increases respiration in mitochondria, and production of ATP. It also alters the cell redox state, which triggers the activity of signaling pathways and increases the production of transcription factors required in proliferation and survival of cells, repair and regeneration of tissues [27-29]. By providing a non-invasive means of stimulating biological processes at the cellular level, LLLT could potentially overcome some of the limitations of conventional rehabilitation, offering greater functional recovery.

The secondary outcome life's quality as assessed by the WHO QOL-BREF, with median QoL scores increasing from 63 (44-87) to 72 (48-89). In contrast, the control group had a more modest increase, from 60 (44-90) to 63 (44-96). The p-value of 0.041 indicates that experimental group experienced a significantly improvement on QoL. This highlights the broader benefits of LLLT beyond motor recovery, suggesting its potential impact on enhancing the psychosocial well-being of individuals with iSCI. Improved QoL is often associated with better psychological outcomes, reduced pain, and improved physical function, all of which were likely influenced by the combined effect of LLLT and rehabilitation exercises [30]. The enhanced QoL observed in the experimental group could be attributed to both the direct effects of LLLT on cellular regeneration and the synergistic impact of rehabilitation exercises. The experimental group's smaller improvement, despite similar exposure to physiotherapy, further supports the added benefit of LLLT in enhancing the overall rehabilitation experience [31].

Results of this research are similar to recent study investigating effects of LLLT on SCI recovery, although many of those studies have focused primarily on complete SCI. For example, earlier research has demonstrated LLLT's ability to reduce inflammation, improve neural function, and promote tissue healing, but the specific effects on incomplete spinal cord injuries have been less thoroughly explored [32]. The current study extends previous findings by focusing on individuals with iSCI, where recovery potential is greater and more variable, thus providing a clearer picture of LLLT's efficacy in this patient population. However, it is important to note that while the results are promising, previous research on LLLT in SCI rehabilitation has yielded mixed outcomes. Some studies have reported negligible benefits or no significant improvement, potentially due to variations in treatment protocols, dosages, or patient populations. The current study's rigorous design, including randomization, placebo control, and standardized treatment protocols, strengthens its contribution to the field and provides compelling evidence for the efficacy of LLLT in combination with rehabilitation [33].

Limitations of the study and Future Directions: With the promising results, the research has some limitations needs warrant consideration. First, size of sample , while adequate, may not have been large enough to capture all potential variability in the response to LLLT, particularly in terms of the psychological and social aspects of QoL. Future trials with longer follow-up periods would be essential to find whether the improvements observed in this trial are sustained over time.

Conclusion:

This research is significant in lending substantial evidence towards the application of LLLT as an adjunctive care to conventional rehabilitation. The improvements that have been achieved in both the motor function and the QOL indicate that LLLT may be an effective tool to further improve the recovery outcomes for patients with iSCI. More research, with long time follow-up and big sample size, are needed for verification of these results and to determine the long-term effects and generalizability of LLLT in SCI rehabilitation.

Interest of Conflict: No conflict of interest.
Fundings : Nil

Authors Contributions
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Methodology: Prof. (Dr.) Jasobanta Sethi[2], Divya Rathore[1], Chitra Kataria[3]
Writing: Divya Rathore[1],Prof. (Dr.) Jasobanta Sethi[2]
Supervision: Prof. (Dr.) Jasobanta Sethi[2], Chitra Kataria[3]

Acknowledgements: None.

REFERENCES:

1. Hong N. Photobiomodulation as a treatment for neurodegenerative disorders: current and future trends. Biomed Eng Lett. 2019;9:359-66.
2. Farivar S, Malekshahabi T, Shiari R. Biological effects of low level laser therapy. J Lasers Med Sci. 2014;5:115-9.
3. Paula AA, Nicolau RA, Lima M de O, Salgado MAC, Cogo JC. Low-intensity laser therapy effect on the recovery of traumatic spinal cord injury. Lasers Med Sci. 2014;29(6):1849-59.
4. Naeser MA, Hamblin MR. Potential for transcranial laser or LED therapy to treat stroke, traumatic brain injury, and neurodegenerative disease. Photomed Laser Surg. 2011;29:443-6.
5. Raineteau O, Schwab ME. Plasticity of motor systems after incomplete spinal cord injury. Nat Rev Neurosci. 2001;2(4):263-73.
6. Little JW, Ditunno JI, Stiens SA, Harris RM. Incomplete spinal cord injury: Neuronal mechanisms of motor recovery and hyperreflexia. Arch Phys Med Rehabil. 1996;77(6):509-18.
7. Hammell KW, Miller WC, Forwell SJ, Forman BE, Jacobsen BA. Fatigue and spinal cord injury: A qualitative analysis. Spinal Cord. 2009;47(1):44-9.
8. Winchester P, McColl R, Querry R, Foreman N, Mosby J, Tansey K, et al. Changes in supraspinal activation patterns following robotic locomotor therapy in motor-incomplete spinal cord injury. Neurorehabil Neural Repair. 2005;19(4):313-24.
9. Heald E, Hart R, Kilgore K, Peckham PH. Characterization of volitional electromyographic signals in the lower extremity after motor complete spinal cord injury. Neurorehabil Neural Repair. 2017;31(6):583-91.
10. Richardson A, Samaranayaka A, Sullivan M, Derrett S. Secondary health conditions and disability among people with spinal cord injury: A prospective cohort study. J Spinal Cord Med. 2021;44(1):19-28.
11. Chou RC, Taylor JA, Solinsky R. Effects of hybrid-functional electrical stimulation (FES) rowing whole-body exercise on neurologic improvement in subacute spinal cord injury: secondary outcomes analysis of a randomized controlled trial. Spinal Cord. 2020;58(8):914-20.
12. Chariff MD, Olszak P. Tri-wave laser therapy for spinal cord injury, neuropathic pain management, and restoration of motor function. In: Proceedings of Mechanisms for Low-Light Therapy X. SPIE; 2015. p. 93090G.
13. da Silva FC, Gomes AO, da Costa Palácio PR, Politti F, Teixeira da Silva D, Mesquita-Ferrari RA, et al. Photobiomodulation improves motor response in patients with spinal cord injury submitted to electromyographic evaluation: randomized clinical trial. Lasers Med Sci. 2018;33(4):883-90.
14. da Silva FC, Silva T, Gomes AO, da Costa Palácio PR, Andreo L, Gonçalves MLL, et al. Sensory and motor responses after photobiomodulation associated with physiotherapy in patients with incomplete spinal cord injury: clinical, randomized trial. Lasers Med Sci. 2020;35(8):1751-8.
15. Silva T, de Queiroz JR, Turcio KHL, Tobelem D, Araújo TR, Coutinho KSL, et al. Effect of photobiomodulation combined with physical therapy on functional performance in children with myelomeningocele: A protocol randomized clinical blind study. PLoS One. 2021;16(10):e0258781.
16. Hashmi JT, Huang YY, Osmani BZ, Sharma SK, Naeser MA, Hamblin MR. Role of low-level laser therapy in neurorehabilitation. PM R. 2010;2(12 Suppl):S292-305.
17. da Silva FC, Gomes AO, Costa Palácio PR, Politti F, Teixeira da Silva D, Mesquita-Ferrari RA, et al. Photobiomodulation improves motor response in patients with spinal cord injury submitted to electromyographic evaluation: randomized clinical trial. Lasers Med Sci. 2018;33(4):883-90.
18. Mohammadzadeh E, Amiri AH, Fekrazad R, Leitgeb RA, Mayr W, Article KE. The effect of photobiomodulation on bone mineral density in individuals with complete spinal cord injuries with osteoporosis. 2023. Available from: https://doi.org/10.21203/rs.3.rs-2297941/v1.
19. Rochkind S. Phototherapy in peripheral nerve regeneration: From basic science to clinical study. Neurosurg Focus. 2009;26:E1.

20. Devivo M. A demographic profile of new traumatic spinal cord injuries: Change and stability over 30 years. J Spinal Cord Med. 2020;43(1):5-9.
21. Roberts TT, Leonard GR, Cepela DJ. Classifications In Brief: American Spinal Injury Association (ASIA) Impairment Scale. Clin Orthop Relat Res. 2017;475(5):1499-504.
22. Vafaei-Nezhad S, Hassan MP, Noroozian M, Aliaghaei A, Tehrani AS, Abbaszadeh HA, et al. A review of low-level laser therapy for spinal cord injury: Challenges and safety. J Lasers Med Sci. 2020;11(4):363-8.
23. Stegeman DF, Hermens HJ. Standards for surface electromyography: The European project "Surface EMG for non-invasive assessment of muscles (SENIAM)." 2007.
24. Bluvshtein V, Front L, Itzkovich M, Aidinoff E, Gelernter I, Hart J, et al. SCIM III is reliable and valid in a separate analysis for traumatic spinal cord lesions. Spinal Cord. 2011;49(2):292-6.
25. WHOQOL Group. The World Health Organization Quality of Life (WHOQOL)-BREF. 2004.
26. Toma RL, Tucci HT, Antunes HKM, Pedroni CR, De Oliveira AS, Buck I, et al. Effect of 808 nm low-level laser therapy in exercise-induced skeletal muscle fatigue in elderly women. Lasers Med Sci. 2013;28(5):1375-82.
27. Yekta AHA, Tabeii F, Salehi S, Sohrabi MR, Poursaeidesfahani M, Hassabi M, et al. Effect of low-level laser therapy on muscle strength and endurance and post-exercise recovery of young adults: A double-blind, placebo-controlled, randomized clinical trial. Ann Appl Sport Sci. 2021;9(2):1-9.
28. De Oliveira AR, Vanin AA, De Marchi T, Antonialli FC, Grandinetti VDS, de Paiva PRV, et al. What is the ideal dose and power output of low-level laser therapy (810 nm) on muscle performance and post-exercise recovery? Study protocol for a double-blind, randomized, placebo-controlled trial. Trials. 2014;15(1):66.
29. Cordeiro da Silva F, Silva T, Gomes AO, Costa Palácio PR, Andreo L, Gonçalves MLL, et al. Sensory and motor responses after photobiomodulation associated with physiotherapy in patients with incomplete spinal cord injury: Clinical, randomized trial. Lasers Med Sci. 2020;35(8):1751-8.
30. Kirshblum SC, Waring W, Biering-Sorensen F, Burns SP, Johansen M, Schmidt-Read M, et al. Reference for the 2011 revision of the International Standards for Neurological Classification of Spinal Cord Injury. J Spinal Cord Med. 2011;34(6):547-54.
31. Marino RJ, Jones L, Kirshblum S, Tal J, Dasgupta A. Reliability and repeatability of the motor and sensory examination of the International Standards for Neurological Classification of Spinal Cord Injury. J Spinal Cord Med. 2008;31(3):227-33.
32. Walden K. A clinical guideline for performing the SCIM III Spinal Cord Independence Measure III (SCIM III) [Internet]. 2016. Available from: www.rickhanseninstitute.org.
33. Catz A, Itzkovich M, Agranov E, Ring H, Tamir A. SCIM ± spinal cord independence measure: A new disability scale for patients with spinal cord lesions. Spinal Cord. 1997;35(12):850-7.
34. Hill MR, Noonan VK, Sakakibara BM, Miller WC. Quality of life instruments and definitions in individuals with spinal cord injury: A systematic review. Spinal Cord. 2010;48(7):438-50.
35. Hitzig SL, Craven BC, Panjwani A, Kapadia N, Giangregorio LM, Richards K, et al. Randomized trial of functional electrical stimulation therapy for walking in incomplete spinal cord injury: Effects on quality of life and community participation. Top Spinal Cord Inj Rehabil. 2013;19(4):245-58.
36. Mussttaf RA, Jenkins DF, Jha AN. Assessing the impact of low level laser therapy (LLLT) on biological systems: a review. International journal of radiation biology. 2019 Feb 1;95(2):120-43.
37. Ramezani F, Razmgir M, Tanha K, Nasirinezhad F, Neshastehriz A, Bahrami-Ahmadi A, Hamblin MR, Janzadeh A. Photobiomodulation for spinal cord injury: a systematic review and meta-analysis. Physiology &Behavior. 2020 Oct 1;224:112977.