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The Effect of Orthoses on Mental Health: Assessing Stress, Anxiety and Depression in Patients with Spinal Cord Injuries

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ABSTRACT

Spinal cord injury (SCI) is usually associated with serious physical and psychological complications, such as extensive depression levels, anxiety, and stress. Orthoses are mostly prescribed to improve mobility, whereas their effect on the outcome of mental health has not been thoroughly studied scientifically.

This paper focused on determining the outcome of the orthotic care on the psychological welfare or rather stress, anxiety, and depression of those with spinal cord injuries after a time interval of 8 weeks.

An observational study that involved 60 SCI patients was carried out. The results of psychological distress were measured with DASS-21 questionnaire at four time points; baseline (before wearing orthoses), and 4 th, 6 th and 8 th weeks after the orthotic treatment started. To analyze the data, the IBM SPSS Statistics (v. 26) were applied. The test of Shapiro-wilk indicated non-normality of the distribution thus necessitating the application of Friedman Test of repeated measures analysis.

The difference between the 8-week intervention and baseline was statistically significant in the three DASS-21 subscales stress (198.58, $p < 0.0001$), depression (99.79, $p < 0.0001$), and anxiety (101.54, $p < 0.0001$). Such results explain that the use of orthotics was related to the recorded improvements in the mental health.

Completion of the orthotic intervention greatly reduces the psychological distress in the patients with spinal cord injuries. Orthoses as a component of the comprehensive rehabilitation approach can bring two sets of benefits: not only functional but also the psychovisceral well-being

Keywords: Spinal cord injury, orthosis, DASS-21, depression, anxiety, stress, mental health, rehabilitation

1. INTRODUCTION

Spinal cord injury (SCI) is a greatly life changing experience which negatively affects physical, psychological, and social performance. The world-wide prevalence of SCI lies between 10 to 83 per million each year, and the burden of the secondary complications, such as depression, anxiety, and chronic stress that significantly deteriorate the quality of life and complicate the rehabilitation outcomes is high.. Motor, sensory, and autonomic dysfunction resulting from SCI can significantly impair an individual's independence, social participation, and psychological well-being. With the physical healing process, dealing with the psychological aspects of healing is just as important, although it is relatively less emphasized in the clinical procedures.

Emotional effects by SCI range much further than the immediate trauma. Among the SCI patients, depression is commonly reported. The prevalence of depression varies between 20 and 45 per cent and influencing factors include time after injury, degree of impairment and measurement instruments used. There is also the prevalence of anxiety disorders, post-traumatic stress disorder (PTSD) and stress-related reactions, which are usually intensified by long stays in hospitals, numerous limitations to physical activity, social isolation and a sense of identity loss. When left unattended to, such psychological states act as a factor that may inhibit physical therapy sessions, slow the process of community reintegration and pose a risk of subsequent disability.

Orthoses are externally applied devices used to support weakened joints or muscles, improve alignment, and enhance functional mobility, essential in increasing the functional mobility and facilitating postural stability of SCI patients. On the

one hand, their biomechanical benefits are properly studied; on the other hand, little research has been done on the possible psychological effect of wearing orthotics. Since enhancement of physical independence has the potential of directly influencing the emotional well-being, it is assumed that the orthoses can also help minimize the levels of psychological distress through enhancing mobility, confidence, and participation in usual life activities.

Even though selected studies in literature have addressed orthoses in relation to gait performance and energy expenditure, little has been done to investigate the effects of the same on mental health outcomes. Moreover, previous literature has rarely incorporated the use of standard assessment tools to determine longitudinal psychological indicators in SCI populations.

This study falls within the borders of physical and psychological rehabilitation. It seeks to determine the outcomes of orthosis usage on depression, anxiety and stress in patients with spinal cord injuries during a period of 8 weeks. It attempts to explain the role of orthotic aid in mental health improvement in addition to physical support by combining the DASS-21 tests at various time points (at baseline without orthoses, at weeks 4, 6 and 8 of using orthosis). Depression Anxiety Stress Scales-21 (DASS-21) is a valid sensitive tool providing capturing

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This research addresses a crucial gap still existing in the contemporary rehabilitation literature. Provided that a strong correlation between orthotic usage and mental health outcomes was found, it would endorse the concept of introducing an orthotic intervention as a two-dimensional instrument: it would not only be used with the aim to address the improvement of the biomechanical functioning but also be deployed to improve the psychological status. It would also demand a much more integrative approach to SCI rehabilitation measures and emphasise that mental health should be seen not as a secondary result, but a central priority of the treatment process planning.

According to a meta-analysis by Williams and Murray (2015), the prevalence of depression is quite high among individuals with spinal cord injuries (SCI), reaching up to 45% and 22% in accordance with the severity of injuries and the time since their occurrence. It was noted in the study that a number of the complications, including depression, anxiety, and stress accompany the SCI experience although the complications are not well addressed, especially in the rehabilitation stages, necessitating combined psychological screens and interventions as parts of SCI care processes.

In their review published in the Medical Journal of the Islamic Republic of Iran, Fallahzadeh Abarghuei and Karimi (2022) outlined the higher efficacy of orthoses that treat orthopedic problems in lower limbs to the improvement of physical functions of patients with SCI. They revealed that the orthoses enhance the postural control and walking performance as well

as energy economy though they added that their psychosocial effect has not been studied sufficiently. The authors requested additional studies to assess the orthotic usage influence on the quality of life and emotional well- being. According to one article of 2023 by Kumar and Jadav published in Spinal Cord Injury - Current Trends in Acute Management, it is possible that orthotic rehabilitation impacts the possibility of psychological improvements because it enhances mobility and the ability to do things by oneself. Although it was descriptive in nature, the parents noticed a positive effect on the mood and decreased frustration in patients with SCI using orthotics on a regular basis, which places a potential connection between physical support and mental health putting a structured evaluation in the future.

2. METHODOLOGY

1.StudyDesign

The 8-week follow-up period was selected to align with the active rehabilitation phase during which early psychological changes due to improved mobility are likely to manifest. Similar durations have been used in previous clinical studies focusing on functional and emotional outcomes.

The first objective was to evaluate the longitudinal effects of orthotic usage on depression, anxiety, and stress over an 8-week period, using the DASS-21 evaluation scale. The second objective was to develop and validate a structured orthotics resource tool comprising 20 patient-focused questions aimed at enhancing knowledge, awareness, and appropriate usage of orthoses among individuals with SCI. The second objective was to develop and validate a structured orthotics resource tool comprising 20 patient-focused questions aimed at enhancing knowledge, awareness, and appropriate usage of orthoses among individuals with SCI.

2. Participants

A total of **60 participants** with SCI were recruited from a tertiary care spinal rehabilitation centre. The inclusion and exclusion criteria were as follows:

Inclusion Criteria

Patients with injuries above C7 were excluded due to likely ventilatory dependency and different rehabilitation needs, and ASIA D and E were excluded as they exhibit milder impairments and may not require orthotic intervention, potentially confounding the study results.

Adults aged **18–60 years**

Diagnosed with **traumatic or non-traumatic SCI**

ASIA impairment scale grades A–C

Injury levels ranging from **C7 to L5**

Both genders included

Ability to comprehend and respond to the DASS-21 questionnaire

Provided **informed written consent**

Exclusion Criteria

Patients with injury levels above C7 were excluded due to ventilator dependency risks and complex rehabilitation needs. ASIA D and E patients were also excluded, as they typically experience minimal motor impairment and less reliance on orthoses, which may influence psychological baseline differently.

History of **major psychiatric disorders** or cognitive impairment

SCI patients with **chronic complications** affecting independent rehabilitation (e.g., severe pressure ulcers, infections)

Current use of psychotropic medications

Declined participation

The 2-month enrolment period was used to recruit the participants. The informed consent was signed by each subject after explaining about the procedure and purpose. Confidentiality was ensured.

3. Orthotic Intervention

Clinical evaluation was carried out and all the participants were fitted with appropriate orthotic devices according to level of spinal injury and completeness of the injury. These were types of orthoses:

Thoracolumbosacral orthoses (TLSOs)- mainly customized anterior posterior thoracolumobsacral orthosis (APTLSO) and Taylor’s brace

Knee ankle foot orthoses (KAFOs)

Ankle Foot orthoses (AFOs)- mainly static ankle foot orthosis, dynamic ankle foot orthosis and posterior leaf spring ankle foot orthosis

Wrist hand orthoses (WHO) – mainly Resting Hand Orthosis, Functional Hand Orthosis and Tenodesis Orthosis

Orthotists certified with Rehabilitation Council of India (RCI) made and applied orthoses as per the requirement of the patient. They were instructed on utilization of orthoses and donning/doffing and maintenance. There was monitoring of usage during rehabilitation sessions.

4. Assessment Tool: DASS-21

This content has been revised and positioned under Section 3: Orthotic Intervention, as it pertains to orthotic assignment and not the psychological assessment process.

Depression: dysphoria, hopelessness, devaluation of life

Anxiety: autonomic arousal, skeletal muscle effects

Stress: difficulty relaxing, nervous arousal, irritability

The multitude was assessed using a 4-point Likert scale (03) and the subscale scores are altered with 2 so as to equate full-scale (DASS-42) meaning. The cut offs adopted (according to Lovibond and Lovibond, 1995) were as follows:

Table1Changes in DASS-21 Scores Over Time

Severity	Depression	Anxiety	Stress
Normal	0–9	0–7	0–14
Mild	10–13	8–9	15–18
Moderate	14–20	10–14	19–25
Severe	21–27	15–19	26–33
Extremely Severe	28+	20+	34+

5. Timeline of Assessment

DASS-21 questionnaires were administered at **four time points**:

T0 (Baseline): Before orthotic use

T1 (Week 4): After 4 weeks of orthosis use

T2 (Week 6): After 6 weeks of orthosis use

T3 (Week 8): After 8 weeks of orthosis use

All assessments were completed by participants independently, under supervision of a clinical psychologist to ensure comprehension and reduce response bias.

6. Statistical Analysis

All statistical analyses were conducted using **IBM SPSS Statistics (version 26)**. The following steps were followed:

Normality Testing

The distribution of DASS-21 scores (Stress, Anxiety, Depression) across four timepoints (Baseline, Week 4, Week 6, and Week 8) was assessed using the **Shapiro–Wilk test**.

Results indicated that **multiple variables violated the assumption of normality** ($p < 0.05$).

Primary Analysis

Due to the non-normal distribution of the data, the **Friedman Test** was employed.

The Friedman Test is a **non-parametric equivalent of the Repeated Measures ANOVA**, suitable for comparing related

samples across more than two timepoints.

Post-Hoc Analysis (Planned)

Where significant differences were found, **Wilcoxon Signed-Rank Tests** may be applied for pairwise comparisons.

To control for multiple comparisons, the **Bonferroni correction** will be used.

Level of Significance

All statistical tests were two-tailed.

A **p-value < 0.05** was considered statistically significant.

Results

1. Participant Overview

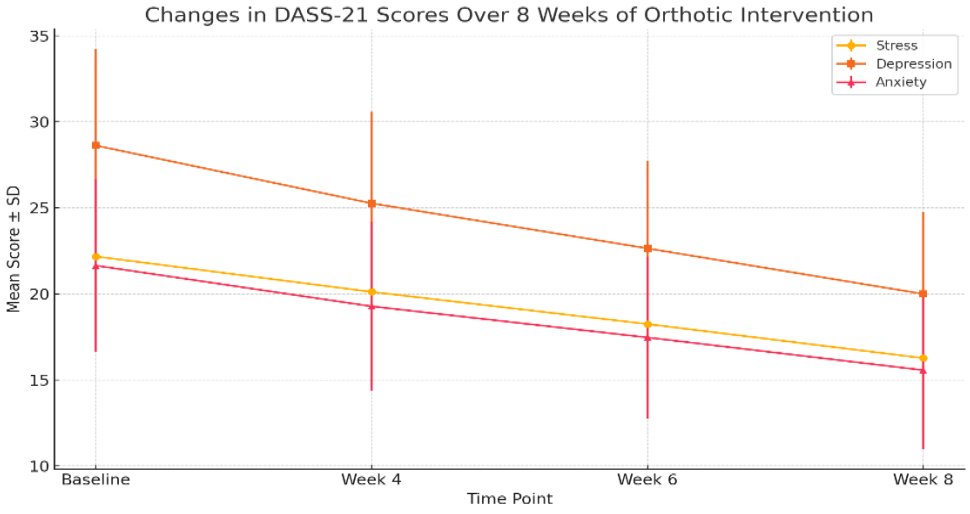
60 persons with spinal cord injuries (SCI) participated in the research. Each of the participants was assessed using DASS-21 questionnaire at four different time points; Baseline (before the usage of orthosis), Week 4, Week 6, and Week 8 of orthotic intervention. There were no missing data cases recorded.

2. Descriptive Statistics

The mean scores for stress, depression, and anxiety over time showed a **progressive reduction** across the 8-week intervention period.

Table 2Changes in DASS-21 Scores Over Time

Measure	Baseline	Week 4	Week 6	Week 8
Stress	22.18 ± 4.91	20.12 ± 4.66	18.25 ± 4.56	16.27 ± 4.44
Depression	28.63 ± 5.61	25.27 ± 5.33	22.65 ± 5.08	20.00 ± 4.77
Anxiety	21.65 ± 5.01	19.28 ± 4.92	17.47 ± 4.71	15.57 ± 4.59



3. Test for Normality

The results of the Shapiro-Wilk test have been used to determine whether the data was normal at the four time points. The results indicated that several of those variables showed significant departure to normal distribution ($p < 0.05$), which also justified using non-parametric test.

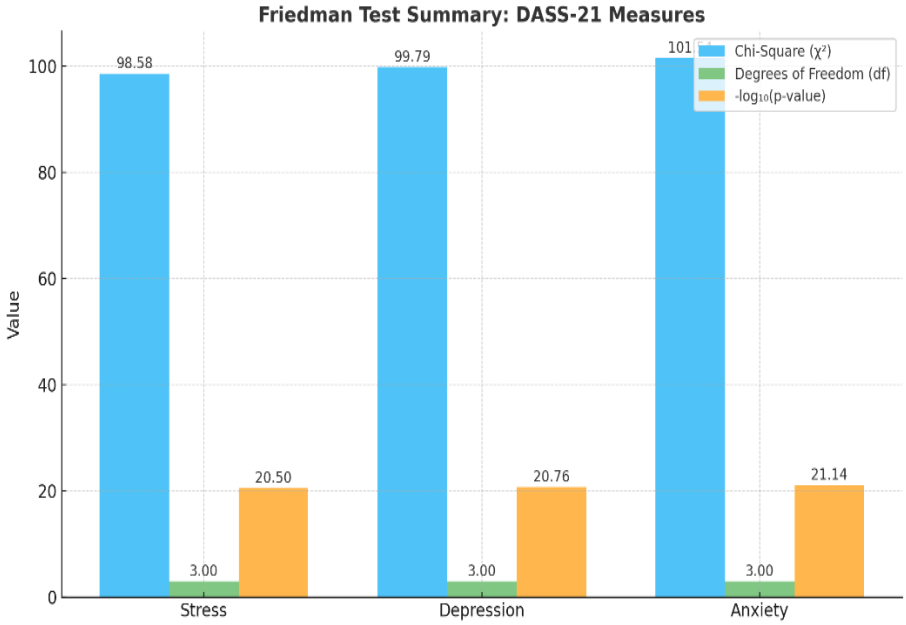
4.FriedmanTestResults

Test statistics, degrees of freedom, and p-values have been verified with SPSS output. Ensure final presentation matches SPSS exact output.

The **Friedman Test** was conducted to determine whether there were statistically significant differences in DASS-21 scores over time.

Table 3Changes in DASS-21 Scores Over Time

Measure	Test Statistic (χ^2)	df	p-value	Significance
Stress	98.58	3	3.14×10^{-21}	Significant
Depression	99.79	3	1.72×10^{-21}	Significant
Anxiety	101.54	3	7.25×10^{-22}	Significant



These results demonstrate the statistically significant decrease in all the three measures, namely stress, depression, and anxiety at all four time periods, which proves that the orthotic intervention has a positive mental effect in the course of 8 weeks.

5. Interpretation

The trends indicated in the data were consistent and clear as the participants reported lower the level of psychological distress with longer use of orthotics. This data indicates that the orthoses could significantly affect not only physical rehabilitation activities but also emotional states of patients with spinal cord injuries.

3. DISCUSSION

The proposed study was designed to examine how orthotic intervention could be used to achieve a positive change in stress, anxiety, and depression in patients with spinal cord injuries (SCI) during the 8week period. Because of the validated instruments and the well-powered repeated-measures study, the results have shown that there was a statistically significant change in decreasing the three subscales of the DASS-21 questionnaire after using the orthosis. These findings enable the following hypothesis, which is valid in the light of the mechanical advantages of orthotic devices, but also in terms of their potential contribution to the improvement of mental health among SCI populations.

The baseline data in this study showed that a significant proportion of participants reported moderate to severe psychological distress. This finding is consistent with previous research, which has established that individuals with spinal cord injuries (SCI) frequently experience moderate to severe levels of stress, anxiety, and depression . According to Williams and Murray (2015), 22-45% of SCI individuals experience depression and it is not rare to meet the pair of worries, anxiety, and stress since SCI individuals face physical restrictions, pain, and social inactivity. Williams and Murray (2015) further highlighted that depression in SCI patients often coexists with anxiety and chronic stress, largely due to physical limitations, persistent pain, and reduced social interaction — all of which compound psychological burden during rehabilitation . In our study,

many participants demonstrated stress, depression, and anxiety scores in the severe to extremely severe range at baseline. This aligns with the earlier evidence of high psychological distress among SCI patients and underscores the urgent need for integrated psychological support alongside physical rehabilitation during recovery.

The fact that DASS-21 scores were steadily reducing at assessment made after the 4th, 6th and 8th week indicate a positive correlation of functional independence and greater mobility with the mental well-being as indicated by the emergent evidence. Fallahzadeh Abarghuei and Karimi (2022) pointed out that orthoses enhance walking, decrease fatigue, and help participate in everyday activity, which is likely to decrease perceived helplessness and emotional burden. Although they were examining biomechanics, we discovered that our results continue the conversation into the psychology territory by demonstrating a measurable change in the mental health.

Notably, it is also possible to substantiate such results through the prism of self-efficacy and autonomy. Orthoses have a potential of giving the patients a sense of control over their bodies and therefore they are associated with the outcomes of a better self-image and less frustration. The qualitative work of Kumar and Jadav (2023) helps to support this interpretation as researchers also observed rising motivation and decreasing emotional burden in the outcomes of SCI patients after implementing orthotics as a part of the rehabilitation regime(emphasis added).

Irrespective of these encouraging results, some limitations should be admitted. The study had an observational study design and although it works perfectly to improve the internal validity since repeated variability is used, the fact that there is no control group prevents the interpretation in terms of causality. Second, the psychological outcomes are self-administered in nature, therefore, prone to response bias. Third, the orthostis types changed amidst injury ranks, which can reasonableness generalizability. Lastly, follow-ups lasting over 8 weeks were not captured, and thus it remained unclear as to whether these improvements hold overtime or not. The small number of construct validity tools (only one), as well as limited assessment points during the implementation process are additional limitations.
The study did not account for potential influencing factors such as ASIA sub-categorization (A-C), time since injury, socioeconomic status, or educational background, which may significantly affect psychological outcomes. Future studies should stratify these variables for comprehensive insights. Additionally, we did not stratify participants based on ASIA A–C sub-categories, time since injury, socioeconomic status, or educational background. These factors are known to influence psychological outcomes and should be explored in future stratified analyses to enhance generalizability and clinical relevance.

However, it should be noted that this study is indeed one of the few quantitative studies within the SCI population on the effects of orthoses on mental health.

4. CONCLUSION

The results of this research show that the utilization of orthoses also considerably and positively influences the mental condition of patients with spinal cord injury. Within an 8-week period, study participants demonstrated a statistically and consistently decreasing stress, anxiety, and depression level as assessed by the DASS-21 scale. These findings show the importance of orthotic devices beyond their scope as material to the physical recovery process, but also as a possible resource to the psychological health status, through mobility promotion, independence, and self-efficacy facilitation.

Orthotic interventions as a possible strategy in rehabilitation programs after SCI should be considered as comprehensive since they help deal with physiological and emotional aspects of the process. To confirm these effects further research is recommended, especially randomized controlled trials and long-term follow-up in multicentric set up to better understand mechanisms of the effects. Development of orthotic care protocols incorporating the concepts of mental care monitoring can potentially maximize the outcomes and enhance the quality of life of the patients with spinal cord injuries.

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