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Research article

The use of the 360 MD Huber platform in rehabilitation of lumbar radiculopathies, chronic period

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Abstract: Background: Low back pain (LBP) is a common medical condition with a negative impact on quality of life and work. It also leads to financial costs for the health system by increasing the costs of medical treatment. Numerous studies have focused on the effects of exercise, with some highlighting the role of protective studies in LBP while other studies have shown no beneficial. There is moderate-certainty evidence that therapeutic exercise is beneficial in the treatment of chronic low back pain compared with other treatment modalities. Muscle strengthening and the creation of spinal mobility through specific exercise is a recognized therapeutic approach to the prevention and treatment of LBP. The main objecvtive is to evaluate the effectiveness of a physi-cal therapy program utilizing the 360 Huber platform on the quality of life for individuals with chronic lumbar radiculopathy. **Methods**: A randomized controlled trial was conducted with 30 participants diagnosed with chronic lumbar radiculopathy. Participants were divided into an ex-perimental group (n=20) receiving the 360 Huber platform-based rehabilitation protocol, and a control group (n=10) continuing standard care. The intervention included 15 sessions of physical therapy on the 360 Huber platform, complemented by electrotherapy and therapeutic massage. The Oswestry Disability Index (ODI) was administered pre- and post-intervention to assess changes in functional outcomes and quality of life. **Results**: The experimental group demonstrat-ed a significant reduction in ODI scores, with an average decrease of 1.85 points (10.11%) from 18.30 to 16.45. The paired t-test analysis revealed a statistically significant difference ($p < 0.001$) and a very large effect size (1.11), indicating substantial improvements in functional outcomes. The control group showed no significant changes. **Conclusion**: The rehabilitation protocol using the 360 Huber platform, combined with electrotherapy and therapeutic massage, effectively im-proves functional outcomes and quality of life for patients with chronic lumbar radiculopathy. The study highlights the potential of integrating advanced technology with traditional physical therapy methods to enhance treatment efficacy. Future research with larger sample sizes and longer follow-up periods is recommended to confirm these findings and explore additional therapeutic modalities.

Keywords: lumbar radiculopathy, 360 Huber platform, physical therapy, Oswestry Disability Index, chronic pain, rehabilitation

1. Introduction

Lumbar disc hernia is the main cause worldwide of interrupting the physical and professional activities of young people, according to the World Health Organization (WHO), being also the main cause of radiculopathy [1]. Under these conditions, it becomes a financial problem for society and is also one of the main causes of disability and decreased productivity. The average period of absence from work involving a disease of the lumbosacral region is 7 days. About half of the days off due to low back pain are attributed to 15% of people with a leave of absence of more than one month. Lumbar disc hernia is a serious pathology, causing low back pain, neurological deficits, and sphincter problems, which involves a significant social cost, and conservative and surgical treatment. Between 80% and 90% of social and healthcare costs are associated with low back pain, and in 10% of cases, it becomes chronic and causes disability [2,3].

The incidence of herniated discs occurs in 5 to 20 people, compared to 1000 adults per year, usually the onset is at the age of 30 to 50 years, predominantly in males [4]. At the same time, it has been shown that people aged 25-55 are approximately 95% more likely to develop a herniated disc at either the L4-L5 or L5-S1 levels [5].

The therapeutic approach is varied, so the surgical treatment of lumbosacral radiculopathy is limited to subjects with persistent root symptoms after 6 to 8 weeks of conservative treatment, those with advanced neurological symptoms, or cases of horsetail syndrome [5]. New, less invasive techniques are being developed to treat these patients, clear interpretation of signs, symptoms, and especially red flag warning signs, radiographic imaging, and diagnostic tools on the one hand, and conservative and surgical interventions on the other part, are a necessity [6].

Regarding conservative treatment, it includes a multitude of ways to combine the means of medical recovery. The therapeutic approach to radiculopathy in the lumbar spine cannot be conceived without physical therapy, the only one able to restore the mobility and functionality of the lumbosacral junction [7].

The study of mechanical vibrations, with control over the parameters of frequency, amplitude, and duration, as well as the particular application in the human body, in spinal discopathies [8] showed that there are applications of mechanical vibrations that address for optimizing the function of the intervertebral disc in the degenerative pathology of the spine, this representing a new concept. Also, the combination of drug treatment, electrotherapy and muscle relaxant massage with physical therapy proved superior to treatment in which physical therapy was not included [9]. Ferreira et al. compared the effects of three different treatment programs: general exercises, motor control exercises, and manual therapy (spinal manipulation) in patients with chronic LBP [10]. Two physiotherapy interventions using physical exercise for motor control and graded physical activities are frequently used in the last decades, they were developed on evidence-based theoretical models Macedo [11].

The general program of exercises included joint mobilizations, stretching, and aerobic exercises, the exercise program aimed at motor control involved specific torso muscles using ultrasound feedback. This study indicated that the motor control exercise group and the spinal manipulation therapy group performed slightly better than the general exercise group at eight weeks.

In general, it has been shown that the evolution of acute radiculopathy does not undergo significant changes. In these conditions, physiotherapy has a recognized role in improving symptoms. Very good results have been observed with the use of aggressive non-surgical treatment (an exercise program associated with epidural infiltrations with steroids) in the treatment of lumbar disc hernia associated with radiculopathy during its chronic period. The established protocol is the basis of many current exercise programs used in the treatment of lumbar disc herniation associated with radiculopathy. Epidural lumbar infiltrates with steroids have become a common adjunct in the treatment of lumbosacral radiculopathy. These infiltrates are best used in combination with a physical therapy program in the rehabilitation process, and their role is to facilitate physical therapy by reducing pain and inflammation. The

effectiveness of the ethanol gel is also promising, the main advantages of this method, which is performed under local anesthesia in the outpatient department, are the relatively low cost, simplicity, and as long ethanol is injected, a theoretically lower risk of infection than other intradiscal treatments [12].

The study aims to highlight the beneficial effects of a physical therapy program on the 360 MD Huber platform on the quality of life of people with lumbar radiculopathy, a chronic period. To achieve this goal, we established the following hypothesis: exercise to adapt motor control, which is reflected in the strategy of coordinating the muscle groups of the trunk, and upper and lower limbs ensures functional independence for people diagnosed with lumbar radiculopathy during its chronic period.

2. Materials and Methods

2.1 Participants

The study included two groups: an experimental group and a control group. The experimental group comprised 20 participants diagnosed with lumbar radiculopathy in its chronic period. These participants were aged between 32 and 59 years (Mean = 43.55, SD = 9.53). Of these, 9 participants were female (45%) and 11 were male (55%).

The control group included 10 participants who met the same inclusion and exclusion criteria as the experimental group. Specifically, the inclusion criteria for both groups were as follows: adults diagnosed with lumbar disc disease phase III, stage 2 compression, with a duration of symptoms lasting longer than 3 months, and a pain intensity rating on the visual analog scale (VAS) between 3 and 4, indicating moderate pain. The exclusion criteria were also the same: adults with lumbar disc disease phase III, stage 2 compression, with symptoms lasting less than 3 months, or a pain intensity rating on the VAS of less than 5.

2.2 Procedures

Data were collected from both the experimental and control groups. Participants' demographic information (first name, last name, age, gender, diagnosis) was recorded, and the Oswestry Disability Index (ODI) questionnaire was administered at the start and completion of the rehabilitation protocol (from January 17, 2022, to March 14, 2022).

The experimental group underwent a rehabilitation protocol that included a physical therapy program performed on the 360 Huber platform, along with electrotherapy and massage. In contrast, the control group did not participate in this specific intervention but continued with their usual care routines as prescribed by their healthcare providers.

All participants were treated on an outpatient basis at the Department of Recovery, Physical Medicine, and Balneology at the Central Military Emergency University Hospital "Dr. Carol Davila." Ethical considerations were observed according to international guidelines, including the Helsinki Declaration, and approval was obtained from the Ethics Commission of the Faculty of Physical Therapy, University of Physical Education and Sports Bucharest.

2.3 Instruments

To evaluate the results, we applied the Oswestry Scale (ODI), frequently used to assess the quality of life of people with dysfunction caused by low back pain [13]. This scale can appreciate the impact that the lumbar pain status has on the development of the daily activities of the individual. The most frequently used variant is the one prepared by the Medical Research Council in 2000, it respects the properties of the functional evaluation scales - reproducibility, consistency, validity, and responsiveness [13].

Quotes are standard from 0 for the first answer to 5; the final score is calculated by summing the quotations for each sector of the scale. The score can be compared to the

theoretical maximum possible score - 50 when answers were given for the ten sectors of the scale, and the calculated percentage expresses the impact on the quality of life of low back pain, respectively, the severity of disabilities reflected in quality of life.

2.4 Rehabilitation Protocol

The rehabilitation protocol applied to the experimental group consisted of a comprehensive program involving electrotherapy, therapeutic massage, and a specialized physical therapy exercices program performed on the 360 Huber platform—a multiaxis motorized platform equipped with built-in force sensors. This platform ensures the correct direction of force during exercises targeting the affected muscle groups. It also allows participants to work safely under the guidance of trained physiotherapists, with the program tailored to their physical and cognitive abilities, thus ensuring effective neuromuscular rehabilitation.

The 360 Huber platform is highly versatile, with over 300 integrated protocols, making it suitable for both rehabilitation and prophylaxis programs aimed at maintaining and improving health. The treatment objectives using the 360 Huber platform focused on four fundamental characteristics of movement: muscular flexibility and joint mobility, muscle strength, motor control (balance), and muscular and cardiovascular endurance.

The electrotherapy component included the application of medium-frequency interference currents with muscle relaxants, and anti-inflammatory, analgesic, and peripheral circulation stimulation effects. Specifically, 6-pole interferential currents were applied to the lumbar paravertebral area. Additionally, High-Intensity Laser Therapy (HILT) was employed to reduce inflammation, relieve pain, and stimulate the lymphatic system at the peripheral level. The massage therapy, focused on the dorsal-lumbar region, had a relaxing and tension-relieving effect.

Participants underwent a physical therapy program that consisted of 15 sessions, with a frequency of two sessions per week. Each session lasted for one hour, with 40 minutes dedicated to active exercises on the 360 Huber platform. The program included exercises of varying difficulty levels, selected from the platform's software. Participants received direct feedback via a monitor, which allowed them to view their performance in real-time and make necessary adjustments to ensure correct execution.

For each exercise level, participants could accumulate a maximum of 100 points. Progression to a higher difficulty level occurred when participants achieved at least 70 points. This system ensured that exercises were appropriately challenging and adapted to the participants' evolving capabilities.

During the sessions, passive breaks of 5 minutes were incorporated to prevent fatigue. If any pain or discomfort occurred, the session was immediately interrupted, and the next session resumed at a lower difficulty level to ensure participant safety and comfort.

The primary objectives of the rehabilitation protocol were pain relief, maintaining spinal mobility, increasing flexibility and muscular strength, and ultimately improving the participants' quality of life. By achieving these objectives, the protocol aimed to address the functional limitations associated with chronic lumbar radiculopathy and enhance overall well-being.

This detailed description of the rehabilitation protocol provides a clearer understanding of the interventions applied in the study, emphasizing the multi-faceted approach used to achieve the desired therapeutic outcomes.

2.5 Statistical data

Statistic data processing contains descriptive statistics and inferential statistics. With the help of descriptive statistics, we analyzed the data in terms of intrinsic characteristics, through statistical indicators: mean, median (the central tendency of the data), dispersion or scattering (standard deviation, coefficient of variability, extreme values, and amplitude), effect size, frequencies [14]. From the inferential statistics, we used statistical methods with the help of which the relations between the variables are

targeted, respectively the prediction and the understanding of the evolution of the participant's quality of life following the application of the rehabilitation protocol.

For this purpose, we used the parametric test: the dependent t-test, to verify whether, after the period of application of the physiotherapy program, significant progress was found or not, at the value of the significance threshold $p < 0.05$ [14].

3. Results

The results presented compare the outcomes of the experimental group, who underwent the specialized physical therapy program, with the control group, who did not participate in the specific intervention but followed standard care practices.

Table 1. Representation and percentage of participants by gender

Gender	Female	Male
Experimental Group	9 (45%)	11 (55%)
Control Group	5 (50%)	5 (50%)

Figure 2 shows the average ages by gender (female, male), it is highlighted that female participants have an average age of 42.9 years and males 44.3 years.

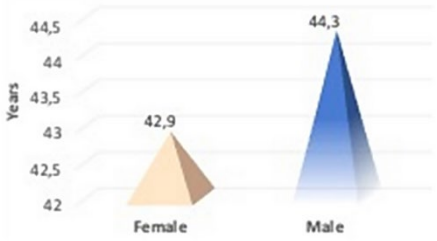

Figure 2. Average age by gender

Descriptive and interference statistics of the Oswesty score, are presented in Table 2, it is observed that the average of the results for the quality of life obtained by the study participants decreased on average by 1.85 points (10.11%) from 18.30 at the initial test to 16.45 points at the final evaluation.

The confidence interval for the mean difference is (-2.63; -1.07). In the two tests, the results obtained are homogeneously dispersed.

Table 2. Statistical indices for the initial, final score of the Osvestry Scale for the experimental group

Statistical indicators	**Oswestry Scale Score**		**Statistical indicators differences results (Final Score – Initial Score)**		
	Initial	Final			
Average	18.30	16.45	Average difference	-1.85	
Median	18.00	16.00	Decrease	10.11%	
Standard deviation	2.34	2.46	95% confidence interval	(-2.63; -1.07)	
Minimum	14.00	12.00		df	19
Maximum	22.00	21.00	Bilateral dependent t-test	t	4.97
Amplitude	8.00	9.00		p	< 0.001
Coefficient of variability	12.8%	15.0%	Effect size	1.11	

The effect size (1.11) shows a very large difference between the averages. The difference of the means, according to the bilateral t test, is statistically significant, p <0.001 <0.05, for t = 4.97 and df = 19.

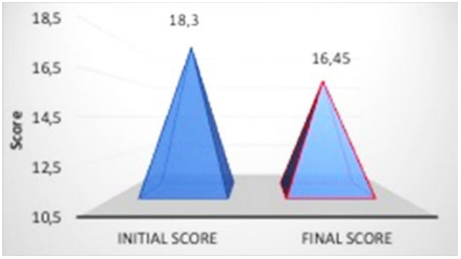

Figure 2. Averages (initial and final) Oswestry Scale score

Figure 3 shows the scores of the Oswestry scale, respectively the individual progress obtained by the participants after the application of the rehabilitationprotocol, which contained the physical therapy program on the 360 Huber platform), which means an increase in functional independence and an improvement in the quality of life.

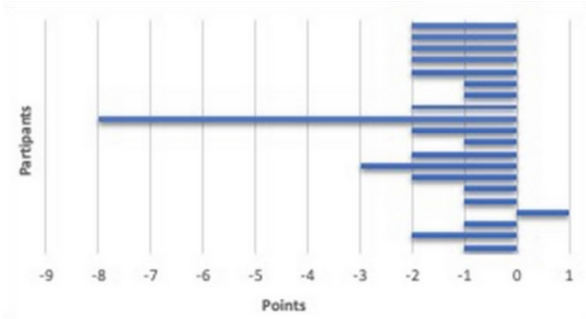

Figure 3. The individual progress of the Oswestry Scale score

4. Discussion

The primary objective of this study was to evaluate the effectiveness of a rehabilitation protocol utilizing the 360 Huber platform on the quality of life of individuals with chronic lumbar radiculopathy. The findings demonstrate a significant improvement in functional outcomes for participants in the experimental group who underwent the physical therapy program compared to the control group.

The results of the present study highlight the prevalence of lumbar radiculopathy in males 55%, compared to females 45% in the experimental group.

According to the current literature, there is no evidence that a gender gap in pain perception is relevant to LBP [15]. Several laboratory studies have been performed to examine gender differences in pain perception using various stimuli [16], and an insignificant distinctive pattern in the relationship between gender and pain sensitivity has been observed. The evidence is inconclusive when analyzing gender and LBP.

The statistical analysis of the Oswestry Disability Index (ODI) scores was conducted using a paired t-test to assess the significance of the difference between initial and final scores within the experimental group. This parametric test was chosen due to the nature of the data, which are continuous and normally distributed. The criteria for determining significance were set at a p-value of less than 0.05. The analysis revealed a significant reduction in ODI scores, with a mean decrease of 1.85 points

(10.11%), a confidence interval for the mean difference of (-2.63; -1.07), and a very large effect size (1.11), indicating a substantial improvement in functional outcomes. These statistical measures underscore the robustness of the results, confirming that the observed changes are both statistically significant in the context of the intervention's impact on patient's quality of life.

Research indicates a strong correlation between daily strenuous physical labor and a higher incidence of herniated discs among male patients [17]. Additionally, studies reveal that an increased body mass index (BMI) is linked to a higher prevalence of musculoskeletal disorders. Elevated BMI not only impacts metabolic health but also increases susceptibility to muscular and skeletal issues, including low back disorders [18]. Therefore, maintaining an optimal BMI is crucial for preventing and managing these conditions.

In clinical guidelines [19] and systematic reviews 3 [20] Hayden's therapeutic physical exercise is the most frequently recommended therapeutic intervention for nonspecific low back pain (LBP). However, exercise therapy did not show superior efficacy, with the effect size for low back pain being small to moderate [22] compared to other interventions (ultrasound, usual care, spinal manipulation therapy, advice to stay active and educational brochure) [21]. Also, no significant differences were revealed between the results obtained by applying the various approaches to physical exercise, [23] thus McKenzie therapy or stabilization exercises did not produce an important difference in results compared to other types of physical exercise therapy [21].

In the context of chronic lumbar degenerative pathology, there is a lack of studies examining the effects of rehabilitation treatments combined with specific physiotherapy programs and balneotherapy using natural factors on serum serotonin levels in affected patients [24]. However, a recent study has demonstrated that magnetotherapy can increase serum serotonin levels in this condition [25].

In the present study the average values of the Oswestry scale score are shown in Table 2 and Figure 2, it is observed that in their case also the final tests show an improvement of the score by 1.85 points. With the help of this scale, one can appreciate the impact that the lumbar pain status has on the development of daily activities on the experimental group.

Figure 3. shows that most subjects have an improvement in the quality of life expressed by lowering the limitation of quality of life due to pain and severity of functional disability. The percentage obtained in the final test, 36.6%, expresses the impact on the quality of life of low back pain, respectively, moderate disability reflected in the quality of life.

The results of the study on higher scores for quality of life with age (Figure 3.) in patients with chronic pain are consistent with previous research that investigated patients with chronic pain [26].

These findings are consistent with previous research indicating that physical therapy plays a crucial role in managing chronic lumbar radiculopathy. For example, Ferreira et al. (2016) compared various treatment programs and found that physical exercises and manual therapy were effective in improving outcomes for chronic low back pain [10]. Similarly, Macedo (2014) highlighted the benefits of motor control exercises and graded physical activities, aligning with our results that emphasize the importance of tailored exercise programs [11].

The integration of nerve conduction studies with clinical and paraclinical examinations in patients with lumbar radiculopathy enhances the detection of functional abnormalities [27]. This comprehensive approach enables a more precise and thorough assessment of the patient's condition, facilitating the rapid and effective identification of dysfunctions that can impact the treatment plan and rehabilitation.

The success of the 360 Huber platform-based rehabilitation protocol suggests that integrating advanced technology with traditional physical therapy methods can significantly enhance patient outcomes.

Clinicians should consider incorporating such platforms into rehabilitation programs to provide patients with interactive, adaptive, and progressive exercise options. Additionally, the benefits observed from combining physical therapy with electrotherapy and massage highlight the importance of a holistic approach in managing chronic lumbar radiculopathy.

While the study's findings are promising, several limitations must be acknowledged. The sample size was relatively small, with only 20 participants in the experimental group and 10 in the control group. This limitation may affect the generalizability of the results. Additionally, the study did not account for long-term outcomes beyond the intervention period, which is crucial for understanding the sustained impact of the rehabilitation protocol.

Future research should aim to include larger sample sizes and longer follow-up periods to assess the long-term efficacy and sustainability of the rehabilitation program. Furthermore, exploring the effects of combining the 360 Huber platform with other emerging therapeutic modalities could provide additional insights into optimizing treatment strategies for chronic lumbar radiculopathy.

5. Conclusions

The findings of this study suggest that a physical therapy program utilizing the 360 MD Huber platform, in combination with electrotherapy and massage, is an effective and well-tolerated treatment option for patients with chronic lumbar radiculopathy. The reduction in ODI scores by an average of 1.85 points (10.11%) demonstrates that this multi-faceted approach effectively enhances functional outcomes and reduces disability associated with chronic low back pain.

The statistically significant reduction in ODI scores, with a p-value of < 0.001 and a very large effect size of 1.11, confirms the robustness of the findings. The paired t-test analysis underscores the effectiveness of the rehabilitation protocol in producing meaningful changes in the patient's functional capabilities and overall well-being.

The improvements observed with the 360 Huber platform-based rehabilitation protocol align with previous research highlighting the importance of physical therapy in managing chronic lumbar radiculopathy. While other therapies such as motor control exercises and manual therapy have shown efficacy, the integration of advanced technology like the 360 Huber platform offers enhanced adaptability and interactivity, potentially providing superior outcomes.

The small sample size and the short duration of the study limit the generalizability and long-term applicability of the findings. Future research should include larger sample sizes and extended follow-up periods to evaluate the long-term effectiveness and sustainability of the rehabilitation protocol. Additionally, exploring the integration of the 360 Huber platform with other innovative therapeutic modalities could further optimize treatment strategies for chronic lumbar radiculopathy.

Overall, the study contributes valuable insights into the application of advanced rehabilitation technologies and reinforces the importance of tailored, multi-faceted treatment approaches for managing chronic lumbar radiculopathy.

Institutional Review Board Statement: The study was conducted by the provisions of the Helsinki Declaration and was approved by the Ethics Committee of the Faculty of Physical Therapy, University of Physical Education and Sports in Bucharest no.162/03 2022.

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Data Availability Statement: Data are contained within the main text of the article.

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