ATATÜRK ÜNİVERSİTESİ YAYINLARI
ATATURK UNIVERSITY PUBLICATIONS

Research Article *Araştırma Makalesi* DOI: 10.61745/ jsmsau.1464941

The Effects of Spinal Cord Stimulation on Sleep, Quality of Life and Anxiety and Depressive Symptoms in Patients with Chronic Pain

Kronik Ağrılı Hastalarda Spinal Kord Stimülasyonu Uygulamasının Uyku, Yaşam Kalitesi, Anksiyete ve Depresif Semptomlar Üzerine Etkisi

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ABSTRACT

Objective: The aim of this study was to investigate whether spinal cord stimulation (SCS), a neuromodulation technique, causes any changes in sleep, quality of life, anxiety and depressive symptoms before and after the procedure in patients with chronic pain.

Methods: The study was completed with 14 patients who were planned to undergo SCS for treatment-resistant chronic neuropathic pain and who applied to the psychiatry outpatient clinic for pre-treatment consultation. Patients were evaluated twice, before and 1 month after treatment. Patients were evaluated with LANNS Pain Scale, Hamilton Depression Scale (Ham-D), Hamilton Anxiety Scale (HAM-A), Pittzburg Sleep Quality Inventory (PUKI), and Quality of Life Scale Short Form (WHOQOL-Bref). Scale scores before and after the treatment were compared using a two-sample dependent t-test.

Results: Depressive disorder was detected in 85.8% of the cases, anxiety disorder in 71.5%, and sleep disorder in 78.6%. The cases' LANSS pain scale scores were 19.00±5.11 pre-treatment and 7.57±4.59 post-treatment, the difference being statistically significant (P=0.001). Significant differences were observed between pre- and post-test HAM-D, HAM-A, PSQI, quality of life (QoL) general health, QoL physical health, or QoL psychological health scores (*P*=.002, *P*=.014, *P*=.002, *P*=.002, *P*=.002, and *P*=.001, respectively). However, no significant differences were determined between pre- and post-test QoL social relationships or QoL environmental health scores (*P*=.160 and *P*=.831, respectively)

Conclusion: Our data in this study suggest that SCS not only effectively reduces pain in treatment-resistant chronic pain, but also mediates significant improvements in sleep quality, anxiety and depressive states.

Keywords: Chronic pain, spinal cord stimulation, sleep, quality of life, anxiety, depression

ÖZ

Amaç: Bu çalışmanın amacı, bir nöromodülasyon tekniği olan omurilik stimülasyonunun (SCS) kronik ağrılı hastalarda işlem öncesi ve sonrasında uyku, yaşam kalitesi, anksiyete ve depresif belirtilerde herhangi bir değişikliğe neden olup olmadığını araştırmaktır.

Yöntem: Çalışma, tedaviye dirençli kronik nöropatik ağrı nedeniyle SCS yapılması planlanan ve tedavi öncesi konsültasyon için psikiyatri polikliniğine başvuran 14 hasta ile tamamlandı. Hastalar tedaviden önce ve tedaviden 1 ay sonra olmak üzere iki kez değerlendirildi. Hastalar LANNS Ağrı Ölçeği, Hamilton Depresyon Ölçeği (Ham-D), Hamilton Anksiyete Ölçeği (HAM-A), Pittzburg Uyku Kalitesi Envanteri (PUKI), Yaşam Kalitesi Ölçeği Kısa Formu (WHOQOL-Bref) ile değerlendirildi. Tedavi öncesi ve tedavi sonrası ölçek puanları bağımlı iki örnekli t testi kullanılarak karşılaştırıldı.

Bulgular: Olguların %85,8'inde depresif bozukluk, %71,5'inde anksiyete bozukluğu, %78,6'sında uyku bozukluğu saptandı. Olguların LANSS ağrı skalası skorları tedavi öncesi 19,00±5,11, tedavi sonrası 7,57±4,59 idi ve aradaki fark istatistiksel olarak anlamlıydı (*P*=,001). Ön test ve son test HAM-D, HAM-A, PUKİ, yaşam kalitesi (QoL), genel sağlık, QoL fiziksel sağlık veya QoL psikolojik sağlık puanları arasında anlamlı farklılıklar gözlendi (*P*=,002, *P*=,014, *P*= ,002, *P*=,002, *P*=,002 ve *P*=,001 sırasıyla). Ancak ön test ve son test QoL sosyal ilişkiler veya QoL çevre sağlığı puanları arasında anlamlı farklılık saptanmadı (sırasıyla *P*=,160 ve *P*=,831)

Sonuç: Bu çalışmadaki verilerimiz, SCS'nin tedaviye dirençli kronik ağrıda sadece ağrıyı etkili bir şekilde azaltmakla kalmadığını, aynı zamanda uyku kalitesi, anksiyete ve depresif durumlarda da önemli iyileşmelere aracılık ettiğini göstermektedir.

Anahtar Kelimeler: Kronik ağrı,omurilik stimülasyonu, uyku, yaşam kalitesi, anksiyete, depresyon.

Geliş Tarihi/Received 02.05.2024
Kabul Tarihi/Accepted 24.07.2024
Yayın Tarihi/Publication Date 25.08.2024

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Cite this article: Zengil S, Tör İH. The Effects of Spinal Cord Stimulation on Sleep, Quality of Life and Anxiety and Depressive Symptoms in Patients with Chronic Pain. *Atatürk Univ Fac Med J Surg Med Sci*. 2024;3(2): 19-25

INTRODUCTION

Chronic pain is a condition with a duration exceeding three months, requiring a multifaceted and multifactorial therapeutic approach, which may include emotional, cognitive and motivational compromise, and may be characterized by impaired functioning in all areas and decreased quality of life. [1] It is one of the leading causes of disability worldwide and affects approximately 20% of the global population. [2] Since chronic pain leads to impaired functioning, it causes significant socioeconomic effects on both the patient and the society, in addition to its negative effects on sleep and quality of life parameters. [3] Therefore, prevention of chronic pain is as important as rehabilitation in terms of public health. [4]

Chronic pain is frequently accompanied by sleep disorders. [5] Pain may be both the cause and the consequence of sleep disturbance. The presence of pain leads to sleep disturbance and depressive symptoms, while pain is experienced more severely in the presence of sleep disturbance and depression and this continues as a vicious cycle. [6] The physical and psychological effects of chronic pain also affect quality of life. [7] Studies emphasize the relationship between mood disorders and acute and/or chronic pain. Prolonged exposure to pain also leads to deterioration of the mental state. At the same time, anxiety and depression seem to be associated with more severe perception and less tolerance of pain.

Chronic neuropathic pain is one of the important causes of chronic pain. Shoulder pain and failed back surgery syndrome are the two leading causes of chronic neuropathic pain. [6] Neuromodulation is a relatively safe option in the treatment of chronic pain due to its low side effects and potential reversibility. Spinal cord stimulation (SCS), one of the neuromodulation techniques, has come to represent the basis of pain management in a large number of chronic painful conditions, including refractory radiculopathy, chronic regional pain syndrome, postoperative chronic pain, and especially failed lumbar surgery syndrome. [9] In recent years, its use has also increased in painful chronic conditions such as epidural fibrosis, post herpetic neuralgia, reflex sympathetic dystrophy, phantom pain, malignancy pain associated with vertebral metastases, and faecal and urinary incontinence. [10] In SCS, a low-voltage electric current is applied to the spinal cord. This prevents the transmission of pain in the relevant region to the central nervous system. It is performed using electrodes connected to the epidural space posterior to the dorsal columns of the spinal cord. These electrodes are connected to different levels of the spinal cord depending on the site of pain and connected to a pulse generator placed under the skin. [11]

It seems inevitable that this bidirectional interaction between chronic pain and sleep, anxiety, and depression will progress as a vicious cycle and negatively affect quality of life. Based on the idea that reducing or eliminating pain with SCS applications is the most radical solution to break this vicious cycle, we planned this study. The aim of this study is to examine whether SCS application causes any changes in sleep quality, anxiety and depression symptoms before and after the procedure in patients with chronic pain and how it affects quality of life. Our hypothesis was that sleep and quality of life would improve following SCS, and that anxiety and depressive symptoms would decrease.

METHODS

Ethical issues: The study was approved by the Erzurum Regional Training and Research Hospital ethical committee, Turkey (decision no. 2022/17-160 dated 07.11.2022). It was conducted in compliance with international declarations and guidelines.

Data collection: This study was conducted at Erzurum City Hospital between December 2022 and December 2023. Patients with treatment-resistant chronic neuropathic pain after failed back surgery syndrome (BBCS) who were planned to undergo SCS for pain management were included in the study. Twenty-three male and female patients between the ages of 18-65 years who applied to the psychiatry clinic for psychiatry consultation before SCS treatment and who volunteered to participate in the study and signed the informed consent form were included in the study. The patients were evaluated twice, before and one month after treatment. Nine patients were excluded for failing to take part in the post-treatment evaluation. The study was thus concluded with 14 patients. The participants were assessed using a sociodemographic data form, the Leeds Assessment of Neuropathic Symptoms and Signs (LANSS) Pain Scale, the Hamilton Depression Rating Scale (HAM-D), the Hamilton Anxiety Rating Scale (HAM-A), the Pittsburg Sleep Quality Index (PSQI), and the World Health Organization Quality of Life Brief Version (WHOQOL-Bref).

Data Collection Tools: Sociodemographic Data Form: This was used to investigate the participants' sociodemographic and clinical characteristics and histories.

LANSS Pain Scale: This tool was developed by Bennett. [12] The validity and reliability of the Turkish-language version were confirmed by Yücel et al. in 2004. It is used in the evaluation of neuropathic pain and in differentiating neuropathic pain

and nociceptive pain. [13]

Pittsburgh Sleep Quality Index (PSQI): This scale was developed by Buysse et al. for the evaluation of sleep quality. [14]The validity and reliability of the Turkish-language version were confirmed by Ağargün et al. in 1996. [15] The scale's Cronbach's alpha reliability coefficient is 0.804.

World Health Organization Quality of Life Brief Version (WHOQOL-Bref): This scale was developed by the WHOQOL Group as a shorter version of WHOQOL-100 produced by the same group. [16]It consists of four domains, physical health, psychological health, social relationships, and environmental health. The validity and reliability of the Turkish-language version were established by Eser et al. [17] The scale's Cronbach alpha reliability values are 0.83 for physical health, 0.66 for psychological health, 0.53 for social relationships, and 0.73 for environmental health.

Hamilton Depression Rating Scale (HAM-D): This tool was developed by Hamilton for the purpose of evaluating depressive symptoms and severity.[18] The validity and reliability of the Turkish-language version were established by Akdemir et al. [19]

Hamilton Anxiety Rating Scale (HAM-A): This scale was developed by Hamilton for the determination of anxiety symptoms and severity. [20] The validity and reliability of the Turkish-language version were established by Yazıcı et al. [21]

Statistical Analysis

Statistical analyses were carried out on IBM SPSS version 22.0 software (IBM SPSS Corp., Armonk, NY,). Normality of distribution of the study variables was checked using the Kolmogorov-Smirnov and histogram tests. Descriptive data were expressed as mean ± standard deviation (SD). Categorical variables were analysed using the chi-square test. Non-normally distributed variables were analysed using the two related samples test. *P* values <.05 were regarded as statistically significant.

RESULTS

Fourteen patients (six women and eight men) were enrolled in the study. The cases' sociodemographic characteristics are shown in tables 1 and 2.

Depressive disorder was determined in 85.8% of the cases, anxiety disorder in 71.5%, and sleep disorder in 78.6%. Descriptive data for severity of anxiety and depression and sleep disorders according to HAM-D, HAM-A, and PSQI scores are shown in Table 3.

Pre-treatment (pre-test) and post-treatment (post-test) scores were compared using the independent samples t test. The cases' LANSS pain scale scores were 19.00±5.11 pre-treatment and 7.57±4.59 post-treatment, the difference being statistically significant (*P*=.001). Significant differences were observed between pre- and post-test HAM-D, HAM-A, PSQI, quality of life (QoL) general health, QoL physical health, or QoL psychological health scores (*P*=.002, *P*=.014, *P*=.002, *P*=.002, *P*=.002, and *P*=.001, respectively). However, no significant differences were determined between pre- and post-test QoL social relationships or QoL environmental health scores (*P*=.160 and *P*=.831, respectively). **(Table 4)**

DISCUSSION

This prospective study examined whether there would be any changes in sleep, quality of life or anxiety and depressive symptoms after SCS treatment in patients with chronic pain. A statistically significant difference in mean LANSS Pain Scale scores was observed after SCS. This finding suggests that there was a significant reduction in pain following SCS administration. In addition, there was a significant decrease in the PSQI scores of the patients after SCS (*P*=.002), indicating a significant improvement in sleep quality. Several studies have shown that pain has a detrimental effect on sleep quality. Özdemir et al. examined 62 patients with pain in their retrospective study and reported that 51% of them had regularized sleep hours after treatment. [22] It is an expected finding that sleep quality is more positively affected by SCS that reduces or prevents the pain experienced, and our data are consistent with previous literature.

Table 1: Descriptive statistics for demographic quantitative variables

	Minimum	Maximum	Mean ± SD
Age (years)	36	60	45.64 ± 8.23
Duration of disease (years)	2	22	7.64 ± 4.94

Values expressed as mean ± SD, minimum, and maximum

Table 2: Descriptive statistics for demographic qualitative variables

		n	%
Gender	Female	6	42.9
	Male	8	57.1
Marital status	Married	2	14.3
	Single	12	85.7
Education	Elementary	4	28.6
	Secondary	7	50.0
	Higher	3	21.4
Work status	Working	9	64.3
	Not working	5	35.7
Diagnosis	Post laminectomy	10	71.4
	Other	4	28.6
History of surgery	Yes	12	85.7
	No	2	14.3

Data are expressed as numbers and percentages (%)

Table 3: Descriptive statistics for clinical variables

		n	%
Depression	None	2	14.3
	Mild	2	14.3
	Moderate	6	42.9
	Severe	4	28.6
Anxiety	None	4	28.6
	Minor	6	42.9
	Major	4	28.6
Sleep disorder	Not present	3	21.4
	Present	11	78.6

Data are expressed as numbers and percentages (%)

Table 4: A comparison of the groups' pre- and post-treatment scale scores

	Pre-Test (n=14)	Post-Test (n=14)	*P*
LANSS pain scale	19.00±5.11	7.57±4.59	**.001***
HAM-D	21.29±10.62	12.14 ±5.52	**.002***
HAM-A	13.57±13.00	10.64±10.25	**.014***
PSQI	8.93±4.81	4.86±4.45	**.002***
QoL-general health	34.8±17.09	66.96±15.20	**.002***
QoL-physical health	37.01±20.65	64.28±12.21	**.002***
QoL-psychological health	69.04±10.93	86.60±8.36	**.001***
QoL-social relationships	67.26±23.22	70.23±23.28	.160
QoL-environmental health	72.10±16.15	72.10±17.31	.831

Independent Two Samples t Test, LANSS: Leeds Assessment of Neuropathic Symptoms and Sign, HAM-D: Hamilton Depression Rating Scale, HAM-A: Hamilton Anxiety Rating Scale, PSQI: Pittsburgh Sleep Quality Index, QoL: Quality of Life

Anxiety and depression are more common and clinically significant in patients with chronic pain than in healthy individuals. In patients with chronic pain, both the pain itself and the presence of difficulties that affect quality of life lead to the emergence of a depressed mood and anxiety. This relationship is bidirectional. In other words, pain and decreased quality of life lead to depressive symptoms, and the presence of depressive symptoms increases the perception of pain and impairs quality of life. Effective treatment of chronic pain reduces both anxiety and depressive symptoms and is also important in improving quality of life. [23] Anxiety also plays an important role in acute pain, as fear of pain and/or anticipatory anxiety may lead to a more pronounced pain perception. However, anxiety symptoms can rapidly decrease with successful pain management. Changes in monoamine neurotransmitters, including serotonin, dopamine and norepinephrine, are involved in both chronic pain and depression. Clinical studies have reported that chronic pain often triggers depression as a result of the stressful situation the individual is in and the prevalence of depression in patients with chronic pain is 85%. [24] In the presence of depression caused by chronic pain, the prognosis is worse than in patients with only chronic pain without depression. There is a close connection between chronic pain and depression in terms of emergence and development, and the two exacerbate each other. This leads to difficulties in the treatment of chronic pain accompanied by depression. [25] Corallo et al. reported that patients with chronic pain had high anxiety and depressive symptoms and significant improvement was observed when pain was reduced. [26] Similarly, in this study, we observed a significant improvement in anxiety and depression scores after SCS compared to pre-treatment values. In addition, another study emphasized the relationship between SCS failure and the presence of psychiatric disorders such as PTSD, depression and anxiety. [27] In this study, we could not record a case without a reduction in pain levels after SCS treatment. Therefore, we could not evaluate failed SCS.

Quality of life is severely impaired in patients with chronic pain. [28] Reducing discomfort in patients with chronic pain or improving impaired quality of life is another important objective of treatment. Significant decreases, indicating improvement, were observed in the QoL general health, physical health, and psychological domain scores post-treatment compared to pre-treatment in this study. Mekhail et al. examined quality of life in SCS outcomes and reported marked clinical and significant improvement in both physical and emotional functioning and in sleep quality. [29] Similar results have been observed in other studies. [30] However, we determined no significant difference between pre- and post-treatment QoL social relationships or QoL environmental health domains. One reason for this may be that they include factors that may be partially independent of the individual, although another reason may be that we only observed the cases for one month. Positive changes may probably be observed in the QoL social relationships and environmental health domains with longer follow-ups, such as for six months or one year.

One of the limitations of our study is that the patients' previous treatments before scs treatment could not be followed up and the patients could not be standardized in this respect. Another limitation is that the patients were followed up for 1 month in our study. It is possible that the data may differ with longer follow-up periods such as 6 months or 1 year.

In conclusion, this study the application of SCS not only effectively reduced pain in treatment-resistant chronic pain, but also mediated significant improvements in sleep quality, anxiety, and depressive states. These data shed useful light on the effects of chronic pain and effective pain management on sleep, anxiety, depression and quality of life and should be considered a preliminary study. More detailed information will be available with longer follow-up studies involving larger populations.

Ethics Committee Approval: Ethics committee approval was obtained from Erzurum Regional Training and Research Hospital ethical committee, Türkiye (Date: 07.11.2022, Number: 2022/17-160)
Informed Consent: In this article, the personal information of the participants has not been used for any purpose other than intended. All participants were informed about their participation in the research study and their written informed consent was obtained
Peer-review: Externally peer-reviewed.
Author Contributions: Concept- **SZ,İHT**; Design- **SZ,İHT**; Supervision- **SZ,İHT**; Resources- **SZ,İHT**; Data Collection and/or Processing- **SZ**; Analysis and/or Interpretation- **SZ**; Literature Search- **SZ**; Writing Manuscript- **SZ**; Critical Review- **İHT**;
Conflict of Interest: The authors have no conflicts of interest to declare.
Financial Disclosure: The authors declared that this study has received no financial support.
Etik Komite Onayı: Etik kurul onayı Erzurum Bölge Eğitim ve Araştırma hastanesi Etik Kurul Başkanlığı'ndan alınmıştır (Tarih: 07.11.2022, Sayı:2022/17-160)
Hasta Onamı: Bu makalede, katılımcıların kişisel bilgileri amaçlanan amaç dışında herhangi bir amaçla kullanılmamıştır. Tüm katılımcılar araştırma çalışmasına katılımları hakkında bilgilendirildi ve yazılı bilgilendirilmiş onamları alındı.
Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir- **SZ,İHT;** Tasarım- **SZ,İHT**, Denetleme- **SZ,İHT**, Kaynaklar- **SZ,İHT**; Veri Toplanması ve/veya İşlemesi- **SZ;** Analiz ve/veya Yorum- **SZ;** Literatür Taraması- **SZ**; Yazıyı Yazan- **SZ;** Eleştirel İnceleme- **İHT.**
Çıkar Çatışması: Yazarlar, çıkar çatışması olmadığını beyan etmiştir.
Finansal Destek: Yazarlar, bu çalışma için finansal destek almadığını beyan etmiştir.

REFERENCES

1. Uyar M, Köken İ. Kronik ağrı nörofizyolojisi. *TOTBİD Dergisi.* 2017;16(2). doi:10.14292/totbid.dergisi.2017.12.
2. Goldberg DS, McGee SJ. Pain as a global public health priority. *BMC Public Health*. 2011;11(1). doi:10.1186/1471-2458-11-770
3. Moreno-Ligero M, Moral-Munoz JA, Salazar A, Failde I. mHealth Intervention for Improving Pain, Quality of Life, and Functional Disability in Patients With Chronic Pain: Systematic Review. *JMIR Mhealth and Uhealth*. 2023;11:e40844. doi:10.2196/40844
4. Grider JS, Manchikanti L, Carayannopoulos A, et al. Effectiveness of Spinal Cord Stimulation in Chronic Spinal Pain: A Systematic Review. *Pain Physician*. 2016;19(1):E33-E54.
5. Haack M, Simpson N, Sethna N, Kaur S, Mullington J. Sleep deficiency and chronic pain: potential underlying mechanisms and clinical implications. *Neuropsychopharmacology*. 2019;45(1):205-216. doi:10.1038/s41386-019-0439-z
6. Sribastav SS, Peiheng H, Jun L, et al. Interplay among pain intensity, sleep disturbance and emotion in patients with non-specific low back pain. *PeerJ*. 2017;5:e3282. doi:10.7717/peerj.3282
7. Duenas M, Ojeda B, Salazar A, Mico JA, Failde I. A review of chronic pain impact on patients, their social environment and the health care system. *Journal of Pain Research*. 2016;Volume 9:457-467. doi:10.2147/jpr.s105892
8. Michaelides A, Zis P. Depression, anxiety and acute pain: links and management challenges. *Postgraduate Medicine*. 2019;131(7):438-444. doi:10.1080/00325481.2019.1663705
9. Lam CM, Latif U, Sack A, et al. Advances in Spinal Cord Stimulation. *Bioengineering*. 2023;10(2):185. doi:10.3390/bioengineering10020185
10. Deer TR, Mekhail N, Provenzano D, et al. The appropriate use of neurostimulation of the spinal cord and peripheral nervous system for the treatment of chronic pain and ischemic diseases: the Neuromodulation Appropriateness Consensus Committee. *Neuromodulation*. 2014;17(6):515-550. doi:10.1111/ner.12208
11. Bennett M. The LANSS Pain Scale: the Leeds assessment of neuropathic symptoms and signs. *Pain*. 2001;92(1):147-157. doi:10.1016/s0304-3959(00)00482-6
12. Yucel A, Senocak M, Orhan EK, Cimen A, Ertas M. Results of the leeds assessment of neuropathic symptoms and signs pain scale in Turkey: A validation study. *Journal of Pain*. 2004;5(8):427-432. doi:10.1016/j.jpain.2004.07.001
13. Ağargün MY, Kara H, Anlar O. Pittsburgh Uyku Kalitesi İndeksi'nin geçerliği ve güvenirliği. *Türk Psikiyatri Derg.* 1996;7:107-11.
14. What quality of life? The WHOQOL Group. World Health Organization Quality of Life Assessment. *World Health Forum*. 1996;17(4):354-356.
15. Eser SY, Fidaner H, Fidaner C, et al. Yaşam kalitesinin ölçülmesi. WHOQOL-100 ve WHOQOOL-BREF", *3P Dergisi.* 1999;7(2):5-13.
16. Hamilton M. A Ratıng Scale For Depressıon. *Journal of Neurology Neurosurgery & Psychiatry*. 1960;23(1):56-62. doi:10.1136/jnnp.23.1.56
17. Akdemir A, Örsel S, Dağ İ, et al. Validity and reliability of Hamilton Depression Rating Scale (HDRS) and its use in clinic. *J Psychiatry Psychology Psychopharmacology*. 1996;4:251-259.
18. Hamilton M. The Assessment Of Anxıety States By Ratıng. *British Journal of Medical Psychology*. 1959;32(1):50-55. doi:10.1111/j.2044-8341.1959.tb00467.x
19. Yazıcı K, Demir B, Tanrıverdi N, et al. Hamilton anksiyete değerlendirme ölçeği, değerlendiriciler arası güvenirlik ve geçerlik çalışması. *Türk Psikiyatri Derg.* 1998;9:114-7.
20. Akbas M. Spinal cord stimulation in 62 patients: retrospective evaluation. *Ağrı - the Journal of the Turkish Society of Algology*. Published online January 1, 2016. doi:10.5505/agri.2016.08870.
21. Burke D, Lennon O, Fullen BM. Quality of life after spinal cord injury: The impact of pain. *European Journal of Pain*. 2018;22(9):1662-1672. doi:10.1002/ejp.1248
22. Williams L, Jones WJ, Shen J, Robinson RL, Weinberger M, Kroenke K. Prevalence and impact of depression and pain in neurology outpatients. *Journal of Neurology Neurosurgery & Psychiatry*. 2003;74(11):1587-1589. doi:10.1136/jnnp.74.11.1587
23. Sheng J, Liu S, Wang Y, Cui R, Zhang X. The Link between Depression and Chronic Pain: Neural Mechanisms in the Brain. *Neural Plasticity*. 2017;2017:1-10. doi:10.1155/2017/9724371
24. Corallo F, De Salvo S, Floridia D, et al. Assessment of spinal cord stimulation and radiofrequency. *Medicine*. 2020;99(3):e18633. doi:10.1097/md.0000000000018633
25. Patel SK, Gozal YM, Saleh MS, Gibson JL, Karsy M, Mandybur GT. Spinal cord stimulation failure: evaluation of factors underlying hardware explantation. *Journal of Neurosurgery Spine*. 2020;32(1):133-138. doi:10.3171/2019.6.spine181099
26. Leadley RM, Armstrong N, Reid KJ, Allen A, Misso KV, Kleijnen J. Healthy Aging in Relation to Chronic Pain and Quality of Life in Europe. *Pain Practice*. 2013;14(6):547-558. doi:10.1111/papr.12125
27. Josephson C, Keezer M, Wiebe S. Error in Figure. *JAMA Neurology*. 2022;79(4):420. doi:10.1001/jamaneurol.2022.0022
28. Kuo CC, Tsai ST, Huang XL, Chen YC. Potential benefits of spinal cord stimulation treatment on quality of life for

paralyzed patients with spinal cord injury. *Tzu Chi Medical Journal*. 2023;35(2):131. doi:10.4103/tcmj.tcmj_102_22