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LITERATURE REVIEW

The management of post-stroke pain

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ABSTRACT

Stroke is a metabolic illness that causes significant impairment in the working-age population. Disability develops due to the consequences of neurological deficiencies and the failure of the medical rehabilitation process. Post-stroke pain is one of the causes of this failure. In a post-stroke patient, pain is an unpleasant physical and emotional experience. In contrast, range of motion barriers might cause the medical rehabilitation procedure to fail. This paper aims to review the various methods of post-stroke pain management that can be used as an alternative therapy that helps post-stroke patients' rehabilitation. The PubMed database was used to search for different kinds of literature. The study includes clinical studies, pilot studies, and randomized control trials published between January 2015 and June 2023. The authors omit several publications to ensure that the final selection of papers includes only the most relevant and reputable sources of information on post-stroke pain, post-stroke pain management, and pain as a measure of outcome. There are 28 publications to be reviewed. The most prevalent cause of post-stroke pain was hemiplegic shoulder pain in numerous studies that have an impact on the post-stroke recovery process. In conclusion, the options for post-stroke therapy range from conservative rehabilitation to interventional therapy. Several innovative experimental rehabilitation treatment approaches have been studied. However, the findings do not outperform conventional rehabilitation treatment.

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INTRODUCTION

Stroke is a metabolic disease that has a high mortality and morbidity rate. It decreases productivity in adults aged 15 to 49. Stroke-related death and disability account for 15% of healthy life lost in those aged (Feigin et al., 2022). The impairment is caused by the inability of these patients to complete the physical rehabilitation phase and recover to a normal or near-normal quality of life. Pain is one of the causes of this failure (Payton & Soundy, 2020). Pain is a significant issue in stroke patients. The total pain prevalence in post-stroke patients was 29.56% (Paolucci et al., 2016). Post-stroke pain (PSP) affects several regions of the body, including the shoulder, knee, and brain, and has a detrimental impact. PSP affects several body regions, including the shoulder, knee, and brain, and significantly impacts these patients' daily activities and return to work (Broussy et al., 2019; Mendigutía-Gómez et al., 2020). Hemiplegic shoulder pain has been found to harm stroke outcomes (Roy et al., n.d.). Patients with greater PSP levels had a higher prevalence of impairment.(Rahmatian et al., 2023) PSP can lead to impairment as a result of a reduction in physical function, which can harm rehabilitation outcomes (Treister et al., 2017). Survivors who had more frequent pain reported worse quality of life, self-perceived health status, and post-stroke recovery interference (Westerlind et al., 2020). It impedes recovery after a stroke. These produce significant discomfort and limited activity and can significantly inhibit recovery (Andersen, 1985; Garland, 1985; Griffin, 1986).

PSP causes patients to have a negative emotional experience and impairs their capacity to complete the post-stroke rehabilitation procedure. Unfortunately, caregivers and professionals continue to ignore pain as a subjective experience during examinations. It is also typical for analgesic medicines, including NSAIDs and opioids, to be abused. These can emerge due to the clinical inability to identify the primary cause of PSP pathogenesis. These can also occur due to patients seeking assistance to deal with discomfort. The use of opioid analgesics and NSAIDs has an impact on the cognitive function of stroke patients undergoing physical rehabilitation. The cognitive characteristics of analgesic medications are complicated and diverse. Opioids, tricyclic antidepressants, and anticonvulsants have all been linked to decreased cognitive performance in a variety of categories (Moriarty et al., 2011).

Detailed data collection on the various forms of PSP and their treatment is required. This information is necessary to understand the pathophysiology and offer an overview of PSP therapeutic options. Early PSP detection is needed to save individuals from developing chronic pain issues. Acute nociceptive pain can progress to chronic pain by the process of central and peripheral sensitization. Therefore, this paper aims to review the various methods of post-stroke pain management that can be used as an alternative therapy that helps post-stroke patients' rehabilitation.

MATERIAL AND METHODS

The author used the PubMed platform to search for publications with the phrases "stroke" OR "post-stroke" AND "pain" to conduct a complete literature study on the management of post-stroke pain. To ensure a full overview of the literature on this issue, the study includes clinical studies, pilot studies, and randomized control trials published between January 2015 and June 2023. Only publications published in English and full-text articles were considered for the review.

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The search returned many prospective information sources, including 277 publications about stroke and pain. The authors omit several publications to ensure that the final selection of papers includes only the most relevant and reputable sources of information on PSP, PSP management, and pain as a measure of outcome. There are 28 publications to be reviewed (see Figure 1).

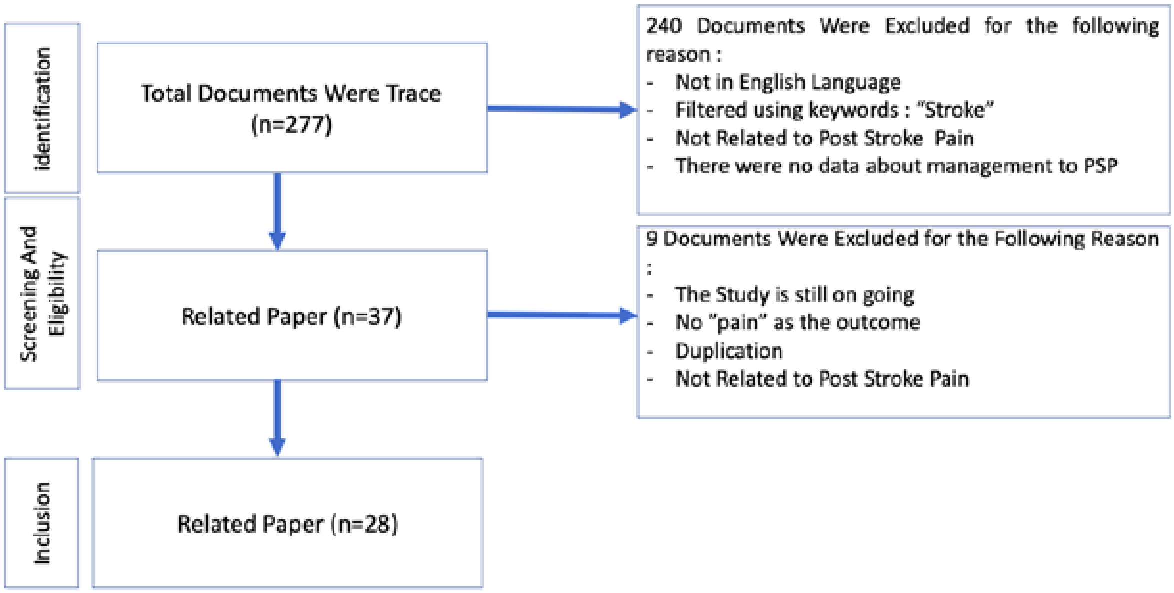

Figure 1. PRISMA Flowchart

Result

Management of Post Stroke Pain

The author summarizes various treatments for post-stroke pain based on several publications, including research, pilot studies and ongoing studies. Most of the post-stroke pain treated in this study was hemiplegic shoulder pain. Pain clinical outcomes were assessed using a standardized assessment scale as listed in the following table.

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Study	Participants Population	Sample Size	Mean Age (Years)	Type of Post Stroke Pain	Intervention	Duration of Intervention	Pain Outcome	Result
(Jan et al., 2017)	Post Stroke Patients	38	52.92 ± 11.67	Hemiplegic Shoulder Pain	I :Low level light amplification by stimulated emission of radiation (LASER) C: Interferential current (IFC) treatment from IFC machine (ENRAF-NONIUS), by a four-pole method with Dipole vector (automatic)	10 min once a day for 10 days on single shoulder joint	VAS Shoulder pain and disability index (SPADI)	There was a significant difference (p<0.05) between the experimental and control groups in terms of VAS, shoulder pain, and disability index.
(Borboni et al., 2017)	Post stroke patients	35	I : 68 ± 9 (full paralysis) C : 67 ± 8(partial paralysis)	Hemiplegic Wrist Pain	Robot-Assisted Rehabilitation of Hand Paralysis	2 weeks	VAS	statistically significant difference between the groups (P<0 .005)
(Jeon et al., 2017)	Subacute stroke patients	21	I : 50.7 ± 10,4 C: 56.9 ± 12.1	Hemiplegic Shoulder Pain	I : task-oriented electromyography triggered stimulation C : cyclic functional electrical stimulation	30 minutes, five times a week for four weeks.	VAS	There was a substantial improvement in VAS findings in the experimental group when compared to the control group (p<0.05).

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(Huang et al., 2017)	Post Stroke Patients	21	I : 56 ±13 C : 59 ±13	hemiplegic shoulder pain.	I : therapeutic Kinesio taping C : conventional rehabilitation protocol	3 weeks	NRS Shoulder Pain and Disability Index (SPADI),	After treatment, there were significant differences in numerical pain (p=0.008) and SPADI (p<0.001) ratings in favor of the KT group. However, there were no significant between-group variations in the NRS (p = 0.705) or SPADI (p = 0.251) scores following intervention.
(Lempka et al., 2017)	Post Stroke pain patients	9	52±9,8	Central Post Stroke Pain	deep brain stimulation (DBS)	3 months,	Affective Pain Rating Index of the Short-form McGill Pain Questionnaire	There were no statistically significant changes in several outcome measures linked to the emotional domain of pain.
(Hochsprung et al., 2017)	First time Post stroke survivor	31	I 1 : 63 ± 11.63	Hemiplegic Shoulder Pain	I1 : Kinesio Tapping I2 : NMES Neuromuscular	4 weeks	VAS	Shoulder discomfort did not emerge in any of the groups during

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			I2 : 60.85 ± 13.15 C: 63.71 ± 6.10		Electrical Stimulation C : conventional treatment (careful shoulder handling and daily mobilizations)			the first month (p=0.001), but increased afterwards. In the between-groups study, all groups improved equally in disability and function, with no significant differences detected (p > 0.05).
(Chuang et al., 2017)	Post Stroke Patients (stroke more than 3 months)	38	I : 58,89 ± 11,93 C : 62,61 ± 9,59	Hemiplegic Shoulder Pain	I : EMG-triggered NMES C : TENS percutaneous neuromuscular elec- trical stimulation (NMES) transcutaneous electrical nerve stimulation (TENS)	3 times a week for 4 weeks	Numerical Rating Scale supplemented with a Faces Rating Scale, and the short form of the Brief Pain Inventory. The secondary outcome measures were the upper-limb subscale of the Fugl-Meyer Assessment, and pain-free passive	At the one-year follow-up, EMG-triggered NMES with bilateral arm training was related with decreased pain intensity during active and passive shoulder movement (P =0.007, P =0.008), lower worst pain intensity (P = 0.003), and better pain-free passive

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							shoulder range of motion.	shoulder abduction (P =0.001) and internal rotation (P =0.004).
(Pan et al., 2018)	Stroke patients	120	I : 64,5 C: 63,5	hemiplegic shoulder pain	modified wheelchair arm-support	at least 60 minutes a day, six days a week, for four weeks (total 12 weeks)	VAS NRS	substantial changes in the Visual Analogue Pain Scale or Numeric Pain Rating Scale
(Zhou et al., 2018)	Post Stroke Patients	90	I1 : 59.3510±78 I2: 58.509±07 C: 63.7811±17	hemiplegic shoulder pain	I1 : Routine rehabilitation + NMES (15Hz, pulse width 200ms) was applied to supraspinatus and deltoids (medial and posterior parts) I2: Routine rehabilitation + TENS (100Hz, pulse width 100ms) was used on the same areas C: Routine rehabilitation	4 weeks	NRS	TENS and NMES can both successfully enhance HSP, with NMES clearly outperforming TENS in terms of long-term analgesia maintenance.

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(Creamer et al., 2018)	Post stroke patients	60	I : 56.1 ± 11.1 C : 55.7± 8.6	hemiplegic shoulder pain	I : Intrathecal Baclofen C : conventional medical management	(21 days for CMM arm and 2–25 days for ITB arm), followed by a 6-month active trial.	NPRS	There were substantial treatment effects in favor of ITB vs CMM for improvements in Numeric Pain Rating Scale scores for real pain from baseline to month 6.
(Karaahmet et al., 2019)	Acute-Subacute Stroke patiens	21	I : 58 ± 17,5 C: 58 ±15,4	Hemiplegic Shoulder Pain and Subluxation	I : Functional electrical Stimulation-cycling	4 weeks	NRS	There is a significant variation in pain NRS ratings.
(Kim et al., 2019)	Post Stroke Patients	38	I : 65.99±4 C : 64.78±3	hemiplegic shoulder pain	I : Robotic-Assisted Shoulder Rehabilitation Therapy C : Conventional physical therapy	30 minutes per day, 5 times per week for 4 weeks.	VAS	On the visual analog scale, significant time and group interaction effects were seen.
(Ralph et al., 2020)	Chronic Stroke	22	I : 57.3±4.95 C: 61.65±8.66	hemiplegic shoulder pain	I : etanercept (ENBREL®, Pfizer, USA) single-use injectable dose -- subcutaneously into the posterior cervical interspi-nous midline (into the interspace midway between		vertical Numerical Pain Rating Scale (vNPRS)	Perispinal etanercept may give considerable and long-term improvements for chronic post-stroke pain management.

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					C6-C7 or C7-T1 vertebra) C : sterile saline (suitable for human injection) as a clear colorless solution, with the same appearance as for the etanercept			
(Pain et al., 2020)	6-24 months post stroke	20	I : 63,4 C: 60,9	Hemiplegic Shoulder Pain	I : the 3D-SPA mobilization protocol	4 weeks	PI-NRS: Sleep and functional reach	When compared to controls, the 3D-SPA group had a substantial effect size (OR = 9.33) for reduced discomfort during sleep.
(Galhardoni et al., 2019)	Patients with central neuropatic pain after stroke or spinal cord injury	98	55.02 ± 12.13	central neuropathic pain	active PSI-rTMS, ACC-rTMS, sham-PSI-rTMS, or sham-ACC-rTMS arms stimulation of the anterior cingulate cortex (ACC) or the posterior superior insula	12 weeks	BPI = Brief Pain Inventory NPSI = Neuropathic Pain Symptoms Inventory	Pain interference with daily activities, pain dimensions, neuropathic pain symptoms, mood, medication usage, cortical excitability assessments, or quality of life

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					(PSI) against sham deep (d) repetitive (r) transcranial magnetic stimulation (TMS)			were not affected.
(Shin et al., 2019)	Post stroke patients	60		Hemiplegic Shoulder Pain	I : sham electroacupuncture , consists of needling on 6 unilateral acupoints (LI4, LI15, TE14, SI9, SI11, and GB21) with electronic stimulation C : non-penetrating Park sham device and fake electronic stimulation	3 weeks	VAS pain rating scale	On going study
(Sezgin Ozcan et al., 2019)	patients with poststroke complex regional pain syndrome (CRPS)	28	64.3 ± 11.66	complex regional pain syndrome (CRPS)	I : 3 week conventional rehabilitation program (5 days/week, 2-4 hours/day) + 15 sessions additional fluidotherapy application C: 3 week conventional rehabilitation program (5	3 weeks	visual analog scale for pain severity painDETECT questionnaire for presence and the severity of neuropathic pain.	Significant improvements were found in both groups for the pain visual analog scale and painDETECT (P<0,005). THE pain DETECT scores were greater in

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					days/week, 2-4 hours/day)			fluidotherapy group than the control group (P <0,005).
(Kasapoğlu-Aksoy et al., 2020)	First stroke and complaint of HSP for at least 3 weeks , more than 6 months after onset of stroke	60	I :58,47 ± 14,68 C : 59,89 ± 10,57	Hemiplegia Shoulder pain	I: Intramuscular injection botulinum toxin type-A into pectoralis major and teres minor muscle C : Suprascapular Nerve block	2 weeks and 6 weeks	VAS	I : Significant improvement in pain VAS score on week 2 and 6 C : Significant improvement in pain VAS score on week 2
(Korkmaz et al., 2022)	Post stroke patients	44	I : 65.7 ± 11.6 C : 60.4 ± 12.1	Hemiplegia Shoulder pain accompanied by partial thickness rotator cuff tear	I : high-intensity laser therapy C :	3 sessions of the intervention per week for 3 weeks.	VAS Shoulder Pain and Disability Index (SPADI)	When the clinical data in the post-treatment period were compared to pre-treatment values within the groups, a statistically significant improvement in the parameters of VAS, ROM, FIM, SPADI, NHP, and PTRCT size in the HILT group (all P 0.05) was noted.

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(Terlemez et al., 2020)	Acute stroke within previous 24 months	30	P : 57,5 I1(Local Anestesi) : 64 I2 (LA + CS) : 60	Hemiplegic Shoulder Pain	P : Localanesthetic (LA) injection into the trapezius muscle I1: LA injection into thesuprascapular notch I2 : LA and corticosteroid (CS) injections into the suprascapularnotch	VAS	the LA+CS group demonstrated a higher VAS decrease than the placebo group at 1 month
(Hernandez-Ort et al., 2020)	Ischemic Stroke patiens	19		Hemiplegic Shoulder Pain	I: Dry Needling Within or Outside Trigger Points All participants received two treatment sessions including a rehabilitation program consisting of modulatory inter- ventions for muscle tone and motor control.	NPRS	The reduction in shoulder discomfort was greater in the TrP dry needling group than in the non-TrP dry needling group, especially at two and four weeks (P 14 0.01).
(Aras et al., n.d.)	Post stroke patients	30	I : 65,2 ± 10,2 C: 64 ± 12,4	Hemiparetic Shoulder Pain	I : Suprascapular Nerve Pulsed	VAS	The decrease in VAS score was statistically significantly larger in the

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					Radiofrequency Treatment C : suprascapular nerve block (NB) with lidocaine			PRF group (3.5 1.9 vs. 1.2 1.0) and third month (4.2 1.7 vs. 1.2 0.9) compared to the NB group (P 0.01).
(Serrezuela et al., 2020)	Post Ischemic Stroke	16	I : 63.4 ± 15.9 C : 64 ± 19.7	Hemiplegic Shoulder Pain	I : Robotic Therapy C : Conventional Rehabilitation Therapy	3 months	Painful shoulder severity	Robotic treatment has a positive impact on pain reduction and abolition.
(Aprile et al., 2021)	Post stroke patients	224	69.0 ±11.2	Hemiplegic Shoulder Pain	I : robotic rehabilitation C : upper limb conventional rehabilitaiton	daily for 45 min, five days a week, for 30 sessions	Numerical Rating Scale and the Douleur Neuropathique	Both therapies considerably decreased moderate/severe pain and the neuropathic component.
(Pérez-De la Cruz, 2020)	Stroke patients	45	I : 63,8 ± 13,6 C : 62,7 ± 13,4	Hemiplegic Shoulder Pain	I : aquatic Ai Chi therapy, C : physiotherapy treatment on dry land	two sessions of physiotherapy per week for 12 weeks (a total of 24 sessions). Each session was 45 min	VAS	Significant changes in the VAS were discovered in the experimental group.
(Uzdu et al., 2021)	Post stroke patients	44	I : 59.5 ± 12.9	hemiplegic shoulder pain	I: PRP injections		(VAS)	PRP injections were shown to

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			C: 60.11 ± 10.9		C; placebo injections			be no better than a placebo.
(Tan & Jia, 2021)	Patients with HSP	36	I : 51.1±11.4 C: 53.9±13.0	Hemiplegic Shoulder Pain	I : Ultrasound-Guided BoNT-A (Botulinum Toxin A) Injection Into the Subscapularis C: placebo		visual analogue scale score	Participants who received the BoNT-A injection reported a substantial reduction in pain (visual analogue scale, 1.39 [95% CI, 2.41 to 0.36]; P=0.002).
(Saha et al., 2021)	Post stroke patients	38	I : 57.40±4.91 C: 59.73±6.11	poststroke shoulder-hand syndrome	I : stroke rehabilitation program +Mirror Therapy C : stroke rehabilitation program	30 min a day for 5 days a week for 4 weeks	NPRS	When compared to the control group, improvements were more significant (p 0.05) in the experimental group with mirror treatment for all three measures.
(Lannin et al., 2022)	Post Stroke Patients	140	I : 62 C : 60	Hemiplegic Shoulder Pain	I : botulinum toxin-A plus 3 months of evidence-based movement training C : botulinum toxin-A plus a handout of exercises	3 months	VAS	no differences between groups

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Discussion

The Type and Pathophysiology of Post Stroke Pain

Several forms of post-stroke pain and their pathogenesis have been described in the prior literature, including central post-stroke pain, complicated regional pain syndrome, pain associated with stiffness and subluxation, and painful condition of the hemiplegic shoulder (Treister et al., 2017). According to our analysis of the literature, the most prevalent cause of post-stroke pain was hemiplegic shoulder pain in numerous studies. This contradicts previous epidemiological research. Musculoskeletal pain is the leading cause of post-stroke pain in all stages of stroke, followed by shoulder pain, CPSP, headache, and pain-related spasticity (Paolucci et al., 2016). The most often addressed is hemiplegic shoulder discomfort, which impacts the post-stroke recovery process. Following a stroke, individuals' daily lives are hampered by shoulder discomfort (Lindgren et al., 2007).

Hemiplegic Shoulder Pain

Hemiplegic shoulder discomfort can be caused by a variety of factors, including shoulder subluxation, post-stroke stiffness and contractures, and rotator cuff abnormalities (Treister et al., 2017). Shoulder subluxation occurs when the glenohumeral joint's mechanical integrity is disrupted, leading in a perceptible separation between the acromion and the humeral head (Figure 2).

Spasticity is described as a velocity-dependent increase in muscle tone that is accompanied by a hyperactive stretch reflex. The subscapularis is an internal rotator of the shoulder that also helps in arm abduction and extension from a flexed posture (Figure 3).

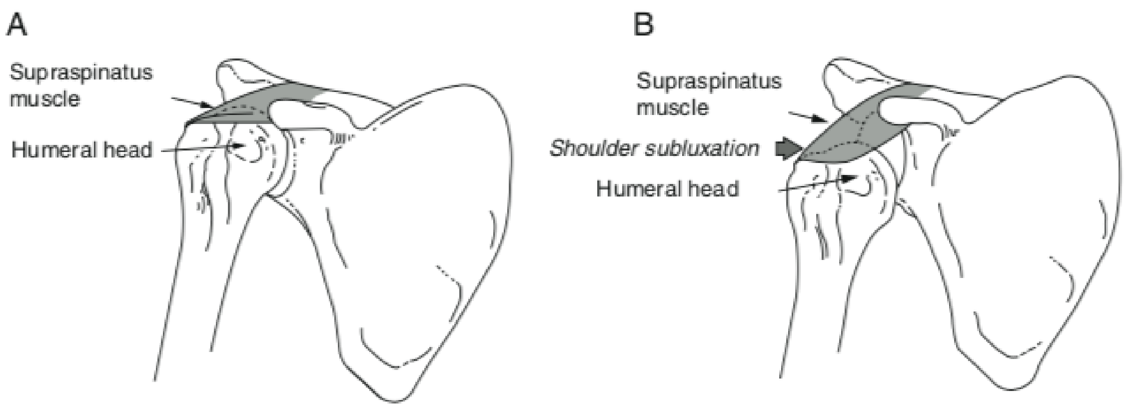

Figure 2. Normal shoulder (A) and shoulder subluxation (B): the supraspinatus is flaccid during the early phase of hemiplegia. The weight of the arm might cause humeral head subluxation toward the inferior margin of the glenoid cavity (Treister et al., 2017).

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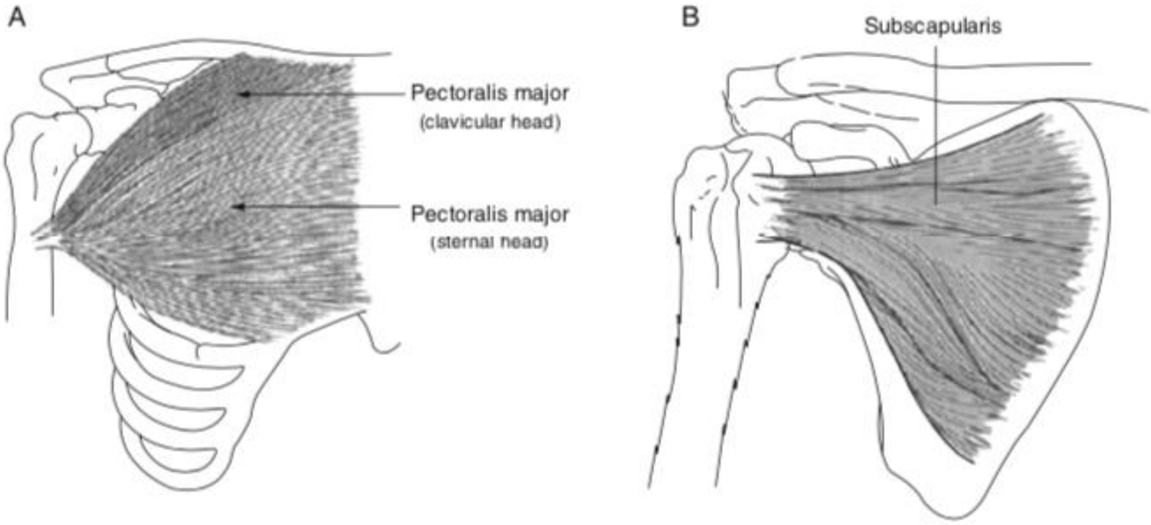

Figure 3. Normal Muscle (A) and Subscapularis: one of the primary internal rotators of the shoulder. (B) In hemiplegic spasticity, the subscapularis is tonically activated as part of the synergistic flexor group, limiting not just external rotation but also shoulder abduction and flexion (Treister et al., 2017).

Central Post Stroke Pain (CPSP)

Central poststroke pain (CPSP), a kind of neuropathic pain induced by central nervous system injury following cerebrovascular accidents, is one of the most prevalent stroke sequelae (Klit et al., 2009). CPSP has been linked to a variety of variables, including sensory deafferentation, spinothalamic dysfunction, and central sensitization and disinhibition in pain networks (Boivie et al., 1989; Hosomi et al., 2013; Wasner et al., 2008). The spinothalamic tract, which transmits pain, temperature, and deep touch from the body, is the most researched tract related with pain. The spinothalamic lot runs from the lateral section of the spinal cord to the ventral posterolateral nucleus (VPL) of the thalamus, eventually terminating in the postcentral gyrus (Figure 4). CPSP can be caused by lesions or damage to any region of this tract; however, some structures are more strongly connected with this condition than others (Treister et al., 2017).

Complex Regional Pain Syndrome

Complex regional pain syndrome (CRPS) is defined by pain as well as sensory, autonomic, trophic, and motor abnormalities (Marinus et al., 2011). A difference is established between CRPS-1 and CRPS-2, in which a nerve lesion cannot be found (Marinus et al., 2011).

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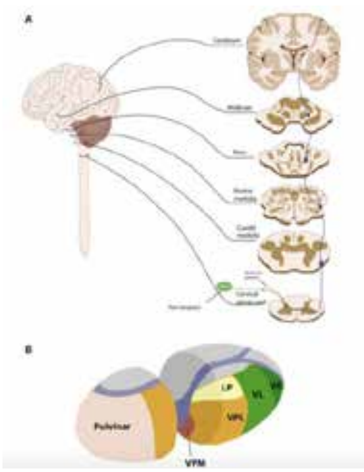

Figure 4. Central post-stroke pain neuroanatomy scheme

CONCLUSION

According to the literature analysis above, there is a lot of research on managing hemiplegic shoulder discomfort. The options for post-stroke therapy range from conservative rehabilitation to interventional therapy. Several innovative experimental rehabilitation treatment approaches have been studied. However the findings do not outperform conventional treatment for rehabilitation. It is provided that by understanding the numerous therapeutic options for post-stroke pain, neurologists would be able to carry out post-stroke pain management thoroughly, with the ultimate objective of pain-free patients. The achievement of pain-free patients can increase the patient's quality of life. Furthermore, the disability rate of post-stroke patients will not rise. Patients recovering from a stroke are expected to be able to resume their regular activities without experiencing pain or a deterioration in quality of life.

REFERENCES

Andersen, L. T. (1985). Shoulder Pain in Hemiplegia . *The American Journal of Occupational Therapy*, *39*(1), 11–19.

Aprile, I., Germanotta, M., Cruciani, A., Pecchioli, C., Loreti, S., Papadopoulou, D., Montesano, A., Galeri, S., Diverio, M., Falsini, C., Speranza, G., Langone, E., Carrozza, M. C., & Cecchi, F. (2021). Poststroke shoulder pain in subacute patients and its correlation with upper limb recovery after robotic or conventional treatment: A secondary analysis of a multicenter randomized controlled trial. *International Journal of Stroke*, *16*(4), 396–405. https://doi.org/10.1177/1747493020937192

Aras, B., Alanbay, E., Kesikburun, S., Kizilirmak, S., Yasar, E., & Tan, A. K. (n.d.). *Effectiveness of Suprascapular Nerve Pulsed Radiofrequency Treatment for Hemiplegic Shoulder Pain: A Randomized-Controlled Trial*. www.painphysicianjournal.com

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JURNAL KEDOKTERAN FKUM SURABAYA
http://journal.um-surabaya.ac.id/index.php/qanunmedika

Boivie, J., Leijon, G., & Johansson, I. (1989). Central post-stroke pain-a study of the mechanisms through analyses of the sensory abnormalities. In *Pain* (Vol. 37).

Borboni, A., Villafañe, J. H., Mullè, C., Valdes, K., Faglia, R., Taveggia, G., & Negrini, S. (2017). Robot-Assisted Rehabilitation of Hand Paralysis After Stroke Reduces Wrist Edema and Pain: A Prospective Clinical Trial. *Journal of Manipulative and Physiological Therapeutics*, *40*(1), 21–30. https://doi.org/10.1016/j.jmpt.2016.10.003

Broussy, S., Saillour-Glenisson, F., García-Lorenzo, B., Rouanet, F., Lesaine, E., Maugeais, M., Aly, F., Glize, B., Salamon, R., & Sibon, I. (2019). Sequelae and quality of life in patients living at home 1 year after a stroke managed in stroke units. *Frontiers in Neurology*, *10*(AUG). https://doi.org/10.3389/fneur.2019.00907

Chuang, L. L., Chen, Y. L., Chen, C. C., Li, Y. C., Wong, A. M. K., Hsu, A. L., & Chang, Y. J. (2017). Effect of EMG-triggered neuromuscular electrical stimulation with bilateral arm training on hemiplegic shoulder pain and arm function after stroke: A randomized controlled trial. *Journal of NeuroEngineering and Rehabilitation*, *14*(1). https://doi.org/10.1186/s12984-017-0332-0

Creamer, M., Cloud, G., Kossmehl, P., Yochelson, M., Francisco, G. E., Ward, A. B., Wissel, J., Zampolini, M., Abouihia, A., Calabrese, A., & Saltuari, L. (2018). Effect of intrathecal baclofen on pain and quality of life in poststroke spasticity: A Randomized Trial (SISTERS). *Stroke*, *49*(9), 2129–2137. https://doi.org/10.1161/STROKEAHA.118.022255

Feigin, V. L., Brainin, M., Norrving, B., Martins, S., Sacco, R. L., Hacke, W., Fisher, M., Pandian, J., & Lindsay, P. (2022). World Stroke Organization (WSO): Global Stroke Fact Sheet 2022. *International Journal of Stroke*, *17*(1), 18–29. https://doi.org/10.1177/17474930211065917

Galhardoni, R., Da Silva, V. A., García-Larrea, L., Dale, C., Baptista, A. F., Barbosa, L. M., Bahia Menezes, L. M., De Siqueira, S. R. D. T., Valério, F., Rosi, J., De Lima Rodrigues, A. L., Mendes Fernandes, D. T. R., Lorencini Selingardi, P. M., Marcolin, M. A., De Souza Duran, F. L., Ono, C. R., Lucato, L. T., Fernandes, A. M. B. L., Da Silva, F. E. F., … De Andrade, D. C. (2019). Insular and anterior cingulate cortex deep stimulation for central neuropathic pain disassembling the percept of pain. *Neurology*, *92*(18), E2165–E2175. https://doi.org/10.1212/WNL.0000000000007396

Garland, M. (1985). Practical Management of Stroke. *Postgraduate Medical Journal*, *61*(721), 1026–1026. https://doi.org/10.1136/pgmj.61.721.1026

Griffin, J. W. (1986). Hemiplegic Shoulder Pain. *Physical Therapy*, *66*(12), 1884–1893. https://doi.org/10.1093/ptj/66.12.1884

Hernandez-Ort, A. R., Ponce-Luceño, R., Saez-S anchez, C., Garcıa-Sanchez, O., Fernandez-De-las-Pe ñas, C., & de-La-Llave-Rincon, A. I. (2020). Changes in Muscle Tone, Function, and Pain in the Chronic Hemiparetic Shoulder after Dry Needling within or Outside Trigger Points in Stroke Patients: A Crossover Randomized Clinical Trial. *Pain Medicine (United States)*, *21*(11), 2939–2947. https://doi.org/10.1093/PM/PNAA132

Hochsprung, A., Domínguez-Matito, A.,

QANUN MEDIKA
JURNAL KEDOKTERAN FKUM SURABAYA
http://journal.um-surabaya.ac.id/index.php/qanunmedika

López-Hervás, A., Herrera-Monge, P., Moron-Martin, S., Ariza-Martínez, C., Granja-Dominguez, A., & Heredia-Rizo, A. M. (2017). Short- and medium-term effect of kinesio taping or electrical stimulation in hemiplegic shoulder pain prevention: A randomized controlled pilot trial. *NeuroRehabilitation*, *41*(4), 801–810. https://doi.org/10.3233/NRE-172190

Hosomi, K., Kishima, H., Oshino, S., Hirata, M., Tani, N., Maruo, T., Yorifuji, S., Yoshimine, T., & Saitoh, Y. (2013). Cortical excitability changes after high-frequency repetitive transcranial magnetic stimulation for central poststroke pain. *Pain*, *154*(8), 1352–1357. https://doi.org/10.1016/j.pain.2013.04.017

Huang, Y. C., Chang, K. H., Liou, T. H., Cheng, C. W., Lin, L. F., & Huang, S. W. (2017). Effects of kinesio taping for stroke patients with hemiplegic shoulder pain: A double-blind, randomized, placebo-controlled study. *Journal of Rehabilitation Medicine*, *49*(3), 208–215. https://doi.org/10.2340/16501977-2197

Jan, F., Naeem, A., Malik, A. N., Amjad, I., & Malik, T. (2017). Comparison of low level laser therapy and interferential current on post stroke shoulder pain. *JPMA. The Journal of the Pakistan Medical Association*, *67*(5), 788–789.

Jeon, S., Kim, Y., Jung, K., & Chung, Y. (2017). The effects of electromyography-triggered electrical stimulation on shoulder subluxation, muscle activation, pain, and function in persons with stroke: A pilot study. *NeuroRehabilitation*, *40*(1), 69–75. https://doi.org/10.3233/NRE-161391

Karaahmet, O. Z., Gurcay, E., Unal, Z. K., Cankurtaran, D., & Cakci, A. (2019). Effects of functional electrical stimulation-cycling on shoulder pain and subluxation in patients with acute-subacute stroke: A pilot study. *International Journal of Rehabilitation Research*, *42*(1), 36–40. https://doi.org/10.1097/MRR.0000000000000319

Kasapoğlu-Aksoy, M., Aykurt-Karlıbel, İ., & Altan, L. (2020). Comparison of the efficacy of intramuscular botulinum toxin type-A injection into the pectoralis major and the teres major muscles and suprascapular nerve block for hemiplegic shoulder pain: a prospective, double-blind, randomized, controlled trial. *Neurological Sciences*, *41*(8), 2225–2230. https://doi.org/10.1007/s10072-020-04334-4

Kim, M. S., Kim, S. H., Noh, S. E., Bang, H. J., & Lee, K. M. (2019). Robotic-Assisted Shoulder Rehabilitation Therapy Effectively Improved Poststroke Hemiplegic Shoulder Pain: A Randomized Controlled Trial. *Archives of Physical Medicine and Rehabilitation*, *100*(6), 1015–1022. https://doi.org/10.1016/j.apmr.2019.02.003

Klit, H., Finnerup, N. B., & Jensen, T. S. (2009). Central post-stroke pain: clinical characteristics, pathophysiology, and management. In *The Lancet Neurology* (Vol. 8, Issue 9, pp. 857–868). https://doi.org/10.1016/S1474-4422(09)70176-0

Korkmaz, N., Gurcay, E., Demir, Y., Tezen, Ö., Korkmaz, İ., Atar, M. Ö., & Yaşar, E. (2022). The effectiveness of high-intensity laser therapy in the treatment of post-stroke patients with hemiplegic shoulder pain: a prospective randomized controlled study. *Lasers in Medical Science*, *37*(1), 645–653. https://doi.org/10.1007/s10103-021-03316-y

QANUN MEDIKA
JURNAL KEDOKTERAN FKUM SURABAYA
http://journal.um-surabaya.ac.id/index.php/qanunmedika

Lannin, N. A., Ada, L., English, C., Ratcliffe, J., Faux, S., Palit, M., Gonzalez, S., Olver, J., Schneider, E., Crotty, M., & Cameron, I. D. (2022). Long-term effect of additional rehabilitation following botulinum toxin-A on upper limb activity in chronic stroke: the InTENSE randomised trial. *BMC Neurology*, *22*(1). https://doi.org/10.1186/s12883-022-02672-8

Lempka, S. F., Malone, D. A., Hu, B., Baker, K. B., Wyant, A., Ozinga, J. G., Plow, E. B., Pandya, M., Kubu, C. S., Ford, P. J., & Machado, A. G. (2017). Randomized clinical trial of deep brain stimulation for poststroke pain. *Annals of Neurology*, *81*(5), 653–663. https://doi.org/10.1002/ana.24927

Lindgren, I., Jönsson, A. C., Norrving, B., & Lindgren, A. (2007). Shoulder pain after stroke: A prospective population-based study. *Stroke*, *38*(2), 343–348. https://doi.org/10.1161/01.STR.0000254598.16739.4e

Marinus, J., Moseley, G. L., Birklein, F., Baron, R., Maihöfner, C., Kingery, W. S., & van Hilten, J. J. (2011). Clinical features and pathophysiology of complex regional pain syndrome. In *The Lancet Neurology* (Vol. 10, Issue 7, pp. 637–648). https://doi.org/10.1016/S1474-4422(11)70106-5

Mendigutía-Gómez, A., Quintana-García, M. T., Martín-Sevilla, M., de Lorenzo-Barrientos, D., Rodríguez-Jiménez, J., Fernández-de-las-Peñas, C., & Arias-Buría, J. L. (2020). Post-needling soreness and trigger point dry needling for hemiplegic shoulder pain following stroke. *Acupuncture in Medicine*, *38*(3), 150–157. https://doi.org/10.1177/0964528419882941

Moriarty, O., McGuire, B. E., & Finn, D. P. (2011). The effect of pain on cognitive function: A review of clinical and preclinical research. *Progress in Neurobiology*, *93*(3), 385–404. https://doi.org/10.1016/j.pneurobio.2011.01.002

Pain, L. A. M., Baker, R., Sohail, Q. Z., Hebert, D., Zabjek, K., Richardson, D., & Agur, A. M. R. (2020). The three-dimensional shoulder pain alignment (3D-SPA) mobilization improves pain-free shoulder range, functional reach and sleep following stroke: a pilot randomized control trial. *Disability and Rehabilitation*, *42*(21), 3072–3083. https://doi.org/10.1080/09638288.2019.1585487

Pan, R., Zhou, M., Cai, H., Guo, Y., Zhan, L., Li, M., Yang, Z., Zhu, L., Zhan, J., & Chen, H. (2018). A randomized controlled trial of a modified wheelchair arm-support to reduce shoulder pain in stroke patients. *Clinical Rehabilitation*, *32*(1), 37–47. https://doi.org/10.1177/0269215517714830

Paolucci, S., Iosa, M., Toni, D., Barbanti, P., Bovi, P., Cavallini, A., Candeloro, E., Mancini, A., Mancuso, M., Monaco, S., Pieroni, A., Recchia, S., Sessa, M., Strambo, D., Tinazzi, M., Cruccu, G., & Truini, A. (2016). Prevalence and time course of post-stroke pain: A multicenter prospective hospital-based study. *Pain Medicine (United States)*, *17*(5), 924–930. https://doi.org/10.1093/pm/pnv019

Payton, H., & Soundy, A. (2020). The experience of post-stroke pain and the impact on quality of life: An integrative review. In *Behavioral Sciences* (Vol. 10, Issue 8). MDPI AG. https://doi.org/10.3390/BS10080128

Pérez-De la Cruz, S. (2020). Influence of an aquatic therapy program on perceived pain,

QANUN MEDIKA
JURNAL KEDOKTERAN FKUM SURABAYA
http://journal.um-surabaya.ac.id/index.php/qanunmedika

stress, and quality of life in chronic stroke patients: A randomized trial. *International Journal of Environmental Research and Public Health*, *17*(13), 1–12. https://doi.org/10.3390/ijerph17134796

Rahmatian, A., Karbasfrushan, A., & Modara, F. (2023). Relationship Between Pain and Disability Among Stroke Patients. *Anesthesiology and Pain Medicine*, *13*(3). https://doi.org/10.5812/aapm-136330

Ralph, S. J., Weissenberger, A., Bonev, V., King, L. D., Bonham, M. D., Ferguson, S., Smith, A. D., Goodman-Jones, A. A., & Espinet, A. J. (2020). Phase I/II parallel double-blind randomized controlled clinical trial of perispinal etanercept for chronic stroke: improved mobility and pain alleviation. *Expert Opinion on Investigational Drugs*, *29*(3), 311–326. https://doi.org/10.1080/13543784.2020.1709822

Roy, C. W., Sands, M. R., & Hill, L. D. (n.d.). *The effect of shoulder pain on outcome of acute hemiplegia*.

Saha, S., Sur, M., Ray Chaudhuri, G., & Agarwal, S. (2021). Effects of mirror therapy on oedema, pain and functional activities in patients with poststroke shoulder-hand syndrome: A randomized controlled trial. *Physiotherapy Research International*, *26*(3). https://doi.org/10.1002/pri.1902

Serrezuela, R. R., Quezada, M. T., Zayas, M. H., Pedrón, A. M., Hermosilla, D. M., & Zamora, R. S. (2020). Robotic therapy for the hemiplegic shoulder pain: A pilot study. *Journal of NeuroEngineering and Rehabilitation*, *17*(1). https://doi.org/10.1186/s12984-020-00674-6

Sezgin Ozcan, D., Tatli, H. U., Polat, C. S., Oken, O., & Koseoglu, B. F. (2019). The Effectiveness of Fluidotherapy in Poststroke Complex Regional Pain Syndrome: A Randomized Controlled Study. *Journal of Stroke and Cerebrovascular Diseases*, *28*(6), 1578–1585. https://doi.org/10.1016/j.jstrokecerebrovasdis.2019.03.002

Shin, S., Yang, S. P., Yu, A., Yoo, J., Lim, S. M., & Lee, E. (2019). Effectiveness and safety of electroacupuncture for poststroke patients with shoulder pain: Study protocol for a double-center, randomized, patient- and assessor-blinded, sham-controlled, parallel, clinical trial. *BMC Complementary and Alternative Medicine*, *19*(1). https://doi.org/10.1186/s12906-019-2468-x

Tan, B., & Jia, L. (2021). Ultrasound-guided BoNT-A (botulinum toxin A) injection into the subscapularis for hemiplegic shoulder pain: A randomized, double-blind, placebo-controlled trial. *Stroke*, *52*(12), 3759–3767. https://doi.org/10.1161/STROKEAHA.121.034049

Terlemez, R., Çiftçi, S., Topaloglu, M., Dogu, B., Yilmaz, F., & Kuran, B. (2020). Suprascapular nerve block in hemiplegic shoulder pain: comparison of the effectiveness of placebo, local anesthetic, and corticosteroid injections—a randomized controlled study. *Neurological Sciences*, *41*(11), 3243–3247. https://doi.org/10.1007/s10072-020-04362-0

Treister, A. K., Hatch, M. N., Cramer, S. C., & Chang, E. Y. (2017). Demystifying Poststroke Pain: From Etiology to Treatment. In *PM and R* (Vol. 9, Issue 1, pp. 63–75). Elsevier Inc. https://doi.org/10.1016/j.pmrj.2016.05.015

Uzdu, A., Kirazlı, Y., Karapolat, H., Unlu, B., Tanıgör, G., & Çalış, F. A. (2021). Efficacy of platelet-rich plasma in the treatment of

QANUN MEDIKA
JURNAL KEDOKTERAN FKUM SURABAYA
http://journal.um-surabaya.ac.id/index.php/qanunmedika

hemiplegic shoulder pain. *Neurological Sciences*, *42*(5), 1977–1986. https://doi.org/10.1007/s10072-020-04710-0

Wasner, G., Lee, B. B., Engel, S., & McLachlan, E. (2008). Residual spinothalamic tract pathways predict development of central pain after spinal cord injury. *Brain*, *131*(9), 2387–2400. https://doi.org/10.1093/brain/awn169

Westerlind, E., Singh, R., Persson, H. C., & Sunnerhagen, K. S. (2020). Experienced pain after stroke: A cross-sectional 5-year follow-up study. *BMC Neurology*, *20*(1). https://doi.org/10.1186/s12883-019-1584-z

Zhou, M., Li, F., Lu, W., Wu, J., & Pei, S. (2018). Efficiency of Neuromuscular Electrical Stimulation and Transcutaneous Nerve Stimulation on Hemiplegic Shoulder Pain: A Randomized Controlled Trial. *Archives of Physical Medicine and Rehabilitation*, *99*(9), 1730–1739. https://doi.org/10.1016/j.apmr.2018.04.020