

# Effects of Kinesio-Taping Versus Effects of Scapular Proprioceptive Neuromuscular Facilitation on Post Stroke Shoulder Pain in Stroke Patients

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## ABSTRACT

**Background:** According to WHO, stroke is defined as an accident to the brain with rapidly developing Clinical signs of focal or global disturbance to cerebral function with symptoms lasting 24 hours or longer, Or leading to death, with no apparent cause other than intracerebral haemorrhage and subarachnoid Haemorrhage. Post stroke shoulder pain is one of the most prevalent impairments. The incidence of hemiplegic shoulder pain is reported to be approximately 17% - 72%. Scapular PNF has Positive impact on post stroke shoulder pain and upper extremity function kinesiology taping has proven To activate the neuromuscular function and produce mechanical support to the shoulder and reducing pain For post stroke shoulder pain.

**Objective:** To compare the effects of kinesiology taping and scapular proprioceptive neuromuscular Facilitation on hemiplegic shoulder pain and upper extremity function on post Stroke patients

**Methodology:** The research study was conducted at Dr. B.R. Ambedkar Medical College and Hospital, in the Department of Physiotherapy, involving community-dwelling participants. Twenty-seven participants were randomly selected based on inclusion and exclusion criteria. Informed consent was obtained from each participant before the study began, providing detailed information about the procedures and their rights. Participants were assigned to either Group A, which received the kinesiology taping technique, or Group B, which received the Scapular Proprioceptive Neuromuscular Facilitation technique, to reduce pain and improve upper extremity function. Both groups also received conservative treatment. The intervention consisted of four sessions per week for four consecutive weeks. The study aimed to evaluate the effects of each intervention and determine the more efficient technique using outcomes such as the Numerical Pain Rating Scale (NPRS) and the Fugl-Meyer Upper Extremity Function score. The results were then statistically analysed and interpreted.

**Result:** Individually, both K-Taping & PNF techniques were effective in managing pain and improving upper extremity function in post-stroke patients, with K-Taping showing greater effects in relieving Hemiplegic shoulder pain However, regarding upper extremity function, no significant difference was Observed between the two techniques, as neither was found to be superior to the other, despite both yielding notable improvements.

**Conclusion:** Individually, Both PNF and K-Taping techniques proved effective in alleviating pain and enhancing upper extremity function in post-stroke patients. However, findings indicated that K-Taping was more effective for relieving hemiplegic shoulder pain compared to PNF.

- In terms of pain relief, participants in the K-Taping group reported a significantly greater decrease in pain levels than those in the PNF group, as shown by the NPRS scores, which indicated a notable difference between them.
- In terms of upper extremity function, no significant difference was found between the groups according to the Fugl-Meyer scores. The average score for the PNF group was higher than that of the K-Taping group. While both techniques contributed positively to the improvement of upper extremity function, the degree of improvement was similar across both groups, with no significant differences noted.

**Keywords:** WHO: World Health Organisation, ROM: Range of Motion, HSP: Hemiplegic Shoulder Pain, NPRS: Numeric Pain Rating Scale, FMA-UE: Fugl-Meyer Assessment Scale - Upper Extremity; PNF: Proprioceptive Neuromuscular Facilitation; K-Taping: Kinesiology Taping.

## INTRODUCTION

According to WHO, stroke is defined as an accident to the brain with rapidly developing clinical signs of focal or global disturbance to cerebral function with symptoms lasting 24 hours or longer, or Leading to death, with no apparent cause other than of vascular origin and includes cerebral infarction, intracerebral haemorrhage and subarachnoid haemorrhage<sup>(1)</sup>

Post-stroke hemiplegia often results in significant impairment of upper extremity Movements due to abnormal muscle tone and a loss of voluntary control <sup>(2)</sup>Shoulder pain is frequently encountered following a stroke, with recent research suggesting an occurrence rate ranging from 10% to 22%. This pain manifests through three primary etiological Categories: central, involving central post-stroke pain (CPSP); regional, which encompasses chronic regional pain syndrome (CRPS) or reflex sympathetic dystrophy (RSD); and local mechanical Issues. The origins of hemiplegic shoulder pain (HSP) are diverse and often interconnected. The underlying mechanism involves flaccid paralysis during the initial and subsequent phases Of stroke, potentially leading to shoulder subluxation and/or disruptions in Shoulder joint control and soft tissue integrity. Consequently, these alterations can affect movement mechanics and heighten vulnerability to injury<sup>(2)</sup>

Dysfunction in the scapular muscles, characterized by both spasticity and weakness, further exacerbates upper extremity impairments. Kinesiology tape, functioning primarily through skin receptors, offers therapeutic benefits such as enhancing joint stability, reducing pain, correcting posture, and facilitating muscle activation when applied from muscle origin Insertion. Conversely, when applied in the opposite direction, from insertion to origin, it aids in inhibiting muscle activity<sup>(3)</sup>

To ensure smooth and coordinated movements and functions of the upper extremity, it is necessary to correct any imbalance in muscular forces. This correction is achieved through K-Taping, which primarily acts on the skin receptors and proprioceptors to influence muscles, fascia, ligaments, and nerves. K-Taping offers various benefits, including proprioceptive facilitation, reduced muscle fatigue, muscle facilitation/inhibition, improved joint position sense, reduced delayed-onset muscle soreness, pain inhibition, and enhanced healing, such as reducing oedema and improving lymphatic drainage and blood flow<sup>(4)</sup>

PNF, a method in therapeutic exercise, blends diagonal movement patterns with techniques for neuromuscular facilitation to stimulate motor responses, thus enhancing neuromuscular control and function. The primary goal of PNF exercises is to improve functional movement by aiding muscle groups through facilitation, inhibition, strengthening, and relaxation. This approach is characterized by its utilization of diagonal patterns and the incorporation of sensory cues like proprioceptive, cutaneous, visual, and auditory stimuli to enhance or provoke motor responses. Scapular PNF techniques involve two diagonal patterns targeting the scapular muscles: anterior elevation-posterior depression and posterior elevation-anterior depression. These exercises are adaptable and can be done with the patient lying down, sitting, or standing either on a treatment table or a mat. They utilize functional or diagonal movement patterns to selectively stretch or strengthen muscles.<sup>(5)</sup>

The gate control mechanism has been shown to induce analgesic effects through proprioceptive neuromuscular facilitation (PNF) techniques. This mechanism operates when there is competition between pain and pressure stimuli. It is understood that nociceptors transmit pain signals via unmyelinated C fibres or small myelinated A-delta fibres, and both pain and pressure stimuli converge at the spinal level. The application of pressure and proprioceptive inputs through PNF techniques inhibits the entry and transmission of pain signals at the spinal level. Scapula plays a vital role in effective shoulder activities<sup>(5)</sup>

## NEED OF THE STUDY

Both methods have demonstrated efficacy independently, but their relative effects Remains unclear. Thus, conducting a study to determine the superior approach for treating post-stroke Shoulder pain and improving upper extremity function is crucial, providing physical therapists with evidence based guidance for selecting the most effective treatment option in treatment settings.

## HYPOTHESIS

- **NULL HYPOTHESIS:**

There is no significant difference between the effects of K-Taping and scapular PNF in Improving upper extremity function and shoulder pain in post-stroke patients

- **ALTERNATIVE HYPOTHESIS:**

There is a significant difference between the effects of K-Taping and scapular PNF in Improving upper extremity function and shoulder pain in post-stroke patients

## METHODOLOGY

**Study design:** Comparative study

**Sampling Method:** Convenient sampling

**Sample Size:** 27

**Study setting:**

1. Dr. B.R. Ambedkar Medical College and Hospital, Department of Physiotherapy
2. Community-Dwelling.

**Outcome measure:**

1. Fugl-meyer upper extremity scale
2. NPRS

**Criteria for GROUP A ( K-TAPING )****Inclusion Criteria:**

- Period after stroke : >1month and <6 month ,Age between 35-60 years, Having HSP, Restricted Shoulder ROM

**Exclusion criteria:**

- History of cancer, Skin problems ,Allergy to tape, History of shoulder fracture

**Criteria for GROUP B ( PNF )****Inclusion Criteria**

- Period after stroke : >1month and <6 month ,Age between 35-60 years, Having HSP , Restricted Shoulder ROM

**Exclusion criteria**

- Acute stroke(flaccid), Inability to follow commands, Other neurological disorder, Any other diagnosed causes

**PROCEDURE**

The research study was conducted at Dr. B.R. Ambedkar Medical College and Hospital, in the Department of Physiotherapy, involving community-dwelling participants. Twenty-seven participants were randomly selected Based on strict inclusion and exclusion criteria. Informed consent was obtained from each participant before the Study began, providing detailed information about the procedures and their rights. Participants were assigned to Either Group A, which received the Kinesiology Taping technique, or Group B, which received the Scapular

Proprioceptive Neuromuscular Facilitation technique, to reduce pain and improve upper extremity function. Both groups also received conservative treatment. The intervention consisted of four sessions per week for four Consecutive weeks. The study aimed to evaluate the effects of each intervention and determine the more Efficient technique using outcomes such as the Numerical Pain Rating Scale (NPRS) and the Fugl-Meyer Upper Extremity Function score. The results were then statistically analysed and interpreted.

- **GROUP A ( K-TAPING):** The treatment for Group A included kinesiology taping, electrical therapy, and exercise. Electrical therapy was applied first, followed by taping and exercise. Taping aimed to activate neuromuscular function and support the shoulder. Patients were taped using 5 cm wide strips. The shoulder was positioned in 30 degrees of abduction, with slight flexion and internal rotation. The first 4 cm of tape was applied without tension to the supraspinatus origin. The remaining tape was applied with 25–50% tension toward the greater tubercle of the humerus For the deltoid muscle, the first 4 cm of tape was applied to the acromion process without stretch, and the rest was stretched with 20–30% tension toward the deltoid tuberosity.
- **GROUP B (PNF):** The treatment for Group B involved a combination of conventional treatment and PNF hold-relax techniques. The session began with 30 minutes of conventional treatment, which included passive range of motion (ROM) exercises, passive stretching, and transcutaneous electrical nerve stimulation (TENS) at 100 Hz Applied to the painful area to help alleviate discomfort. During the PNF hold-relax technique, the therapists first lengthened the tight muscle and guided the patient to Perform an isometric contraction for 5 to 10 seconds. Once the patient relaxed, the therapists further Lengthened the muscle and held the stretch at the new end range of motion (end-ROM).

## STATISTICAL ANALYSIS

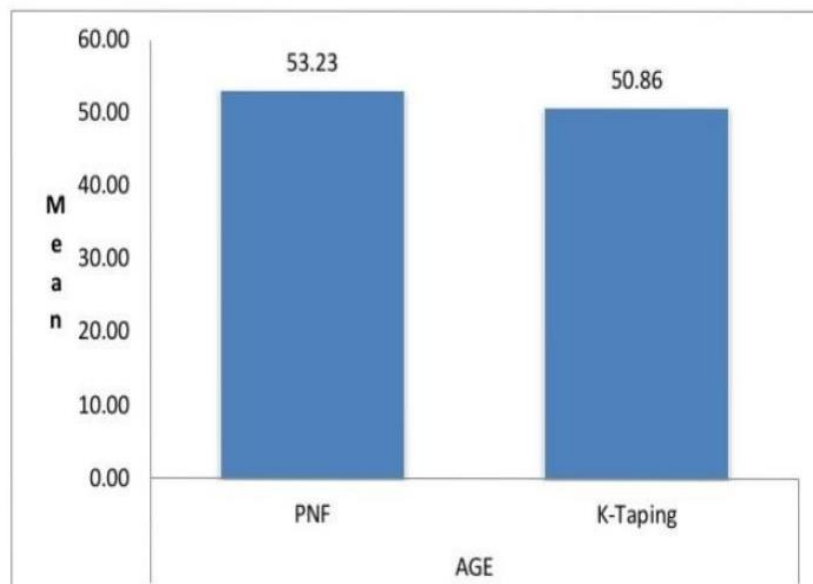
Statistical analysis of the data was performed using SPSS 20.0. The Categorical variables were presented as frequency and percentage. The continuous variables were presented as mean  $\pm$  SD. Pre post comparison was done using paired t test and between group comparisons was done using unpaired t test. A p value  $<0.05$  was considered statistically significant.

Table 1: Showing mean and standard deviation of age in years in PNF and K-Taping group

	GROUP	N	Mean	Std. Deviation	t value	p value
AGE	PNF	13	53.23	8.57	0.59	0.563 ( $p>0.05$ )
	K-Taping	14	50.86	12.03		

The above table shows the average age for the PNF group was  $53.23 \pm 8.57$  years, while the average age for the K-Taping group was  $50.86 \pm 12.03$  years with t-value 0.59 and the p-value 0.563 ( $p > 0.05$ ). This analysis indicates that there is no significant difference in age between the PNF and K-Taping groups.

Figure 1: Representation of age in years in PNF and K-Taping group





## Data analysis

Table 2: Showing distribution of Gender in PNF and K-Taping group

		GROUP		Total	Chi Square	p value
		PNF	K-Taping			
GENDER	FEMALE	5 38.5%	4 28.6%	9 33.3%	0.297	0.586 ( $p > 0.05$ )
	MALE	8 61.5%	10 71.4%	18 66.7%		
Total		13 100.0%	14 100.0%	27 100.0%		

In Group PNF there were 5 females (38.5%) and 8 males (61.5%), while in Group K-Taping there were 4 females (28.6%) and 10 males (71.4%). The total number of participants was 13 in the PNF group and 14 in the K-Taping group. The chi-square value was 0.297, with a p-value of 0.586 ( $p > 0.05$ ). This analysis indicates that there is no significant difference in gender distribution between the PNF and K-Taping groups.

Figure 2: Representation of gender distribution in PNF and K-Taping group

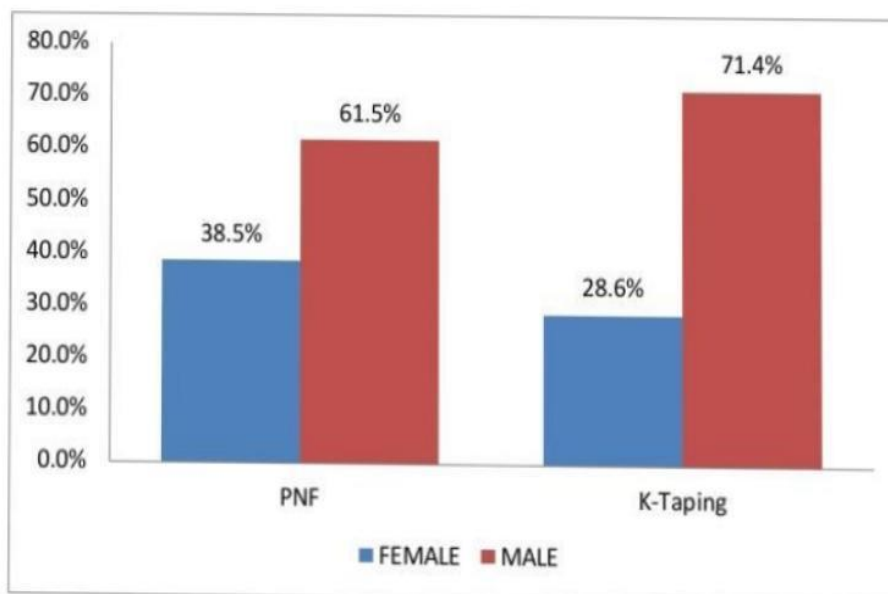


Table 3: Showing comparison of Side affected for PNF and K-Taping group

		GROUP		Total	Chi Square	p value
Side affected		PNF	K-Taping			
	Left	4 30.8%	6 42.9%	10 37.0%	0.422	0.516 (p>0.05)
	Right	9 69.2%	8 57.1%	17 63.0%		
Total		13 100.0%	14 100.0%	27 100.0%		

In the comparison of the affected side between the PNF and K-Taping groups, Group PNF had 4 participants with the left side affected (30.8%) and 9 participants with the right side affected (69.2%), while Group K-Taping had 6 participants with the left side affected (42.9%) and 8 participants with the right side affected (57.1%). The chi-square value was 0.422, with a p-value of 0.516 ( $p > 0.05$ ).

This analysis indicates that there is no significant difference in the distribution of the affected side between the PNF and K-Taping groups.

Figure 3: Representation of Side affected for PNF and K-Taping group

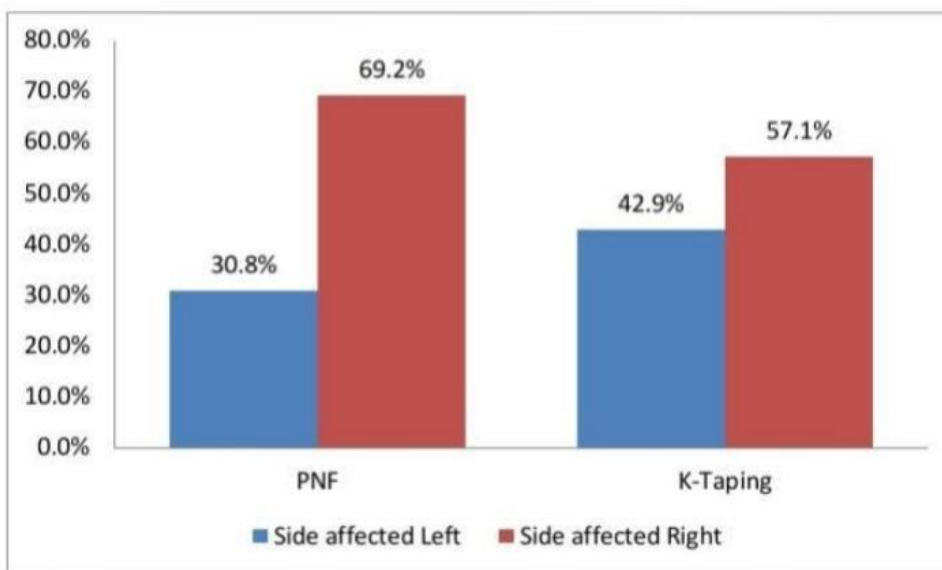


Table 4: Showing comparison of Dominant side for PNF and K-Taping group

		GROUP		Total	Chi Square	p value
Dominant side		PNF	K-Taping			
	Left	3 23.1%	4 28.6%	7 25.9%	0.106	0.745 ( $p > 0.05$ )
	Right	10 76.9%	10 71.4%	20 74.1%		
Total		13 100.0%	14 100.0%	27 100.0%		

In the comparison of dominant side between the PNF and K-Taping groups, PNF had 3 participants with the left dominant side (23.1%) and 10 with the right (76.9%). K-Taping had 4 with the left dominant side (28.6%) and 10 with the right (71.4%). The chi-square value was 0.106, with a p-value of 0.745 ( $p > 0.05$ ). This indicates no significant difference in dominant side distribution between the groups.

Figure 4: Representation of Dominant side for PNF and K-Taping group

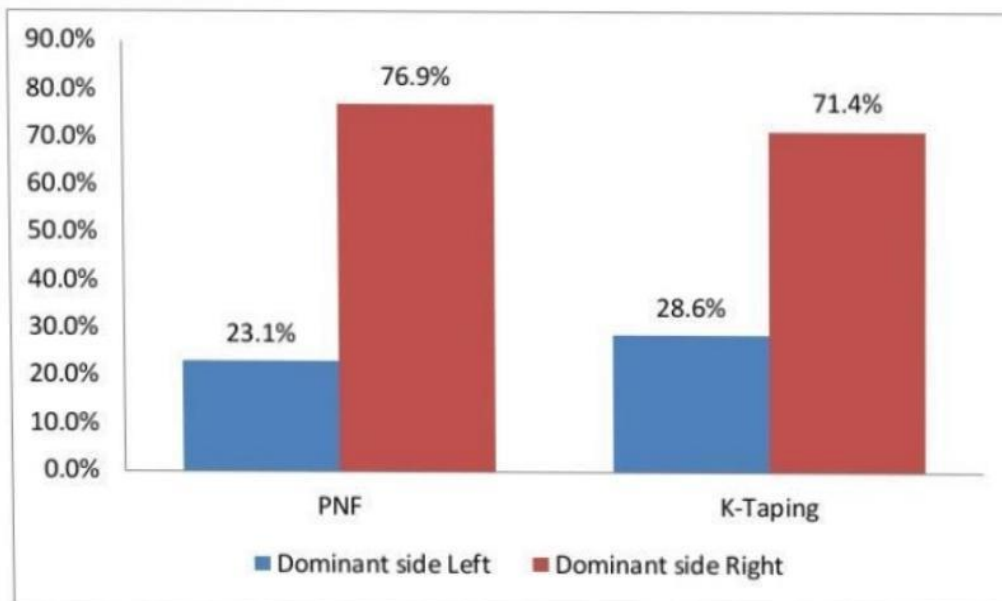




Table 5: Showing pre-post comparison of NPRS in PNF Group

PNF		Mean	Std. Deviation	Mean difference	t value	p value
NPRS	Pre	7.69	1.03	5.00	22.08	0.000 (p<0.001)
	Post	2.69	0.75			

In the PNF group, the average pre-NPRS score was  $7.69 \pm 1.03$ , which decreased to  $2.69 \pm 0.75$  post-intervention with decrement of 5.00 and t-value of 22.08. The analysis shows there is a significant difference in NPRS with  $p < 0.001$

Figure 5: Representation of pre-post comparison of NPRS in PNF Group

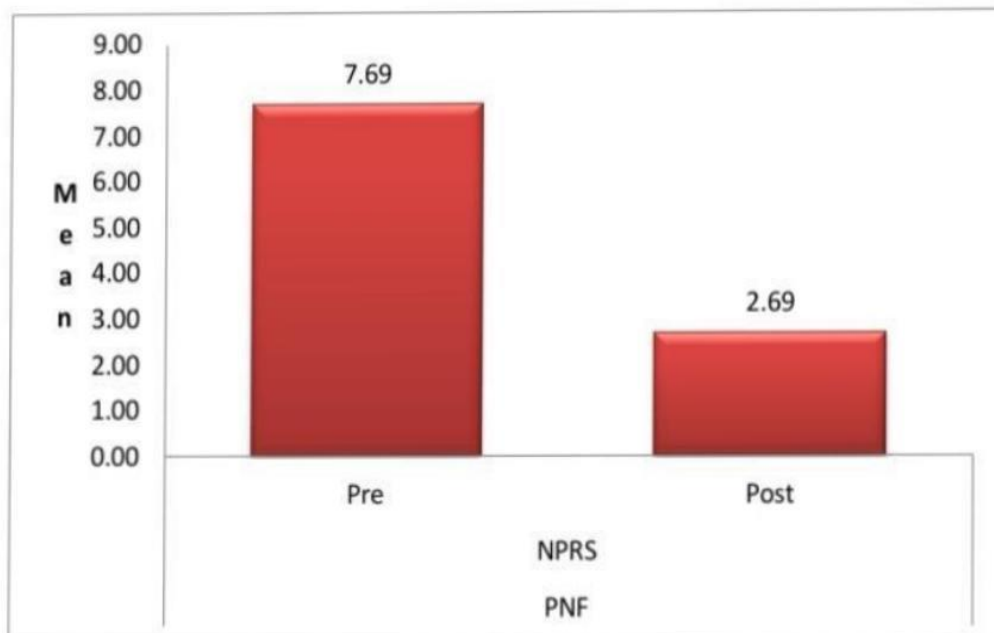


Table 6: Showing pre-post comparison of NPRS in K-Taping Group

K-Taping		Mean	Std. Deviation	Mean difference	t value	p value
NPRS	Pre	7.93	1.07	4.14	12.59	0.000 (p<0.001)
	Post	3.79	1.37			

In the K-Taping group, the average pre-NPRS score was  $7.93 \pm 1.07$ , which decreased to  $3.79 \pm 1.37$  post-intervention with decrement of 4.14 and t-value of 12.59. The analysis shows there is a significant difference in NPRS with  $p < 0.001$ .

Figure 6: Representation of pre-post comparison of NPRS in K-Taping Group

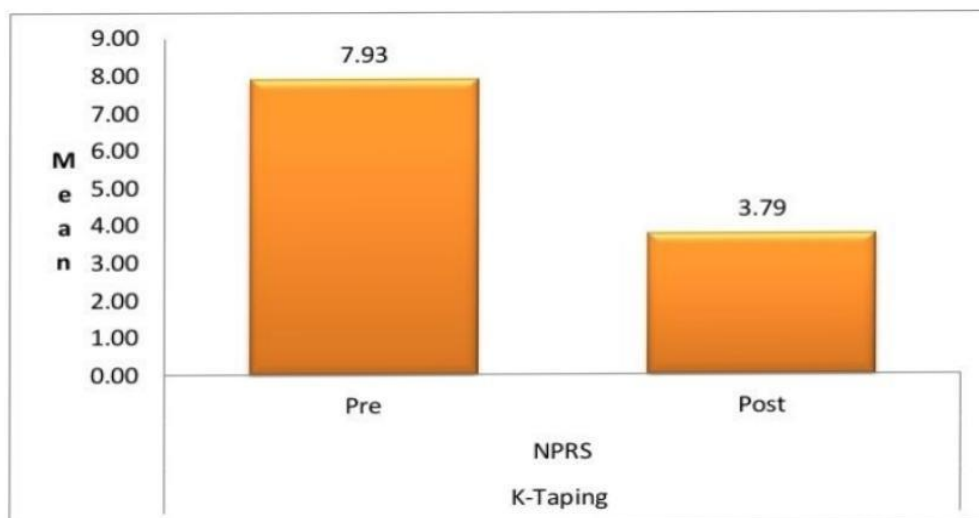


Table 7: Showing pre-post comparison of FM in PNF Group

PNF		Mean	Std. Deviation	Mean difference	t value	p value
FM	Pre	29.38	3.28	24.54	16.99	0.000 (p<0.001)
	Post	53.92	5.56			

In the PNF group, the average pre-FM score was  $29.38 \pm 3.28$ , which increased to  $53.92 \pm 5.56$  post-intervention with improvement of 24.54, with a t-value of 16.99. The analysis shows there is a significant difference in FM with  $p < 0.001$

Figure 7: Representation of pre-post comparison of FM in PNF Group

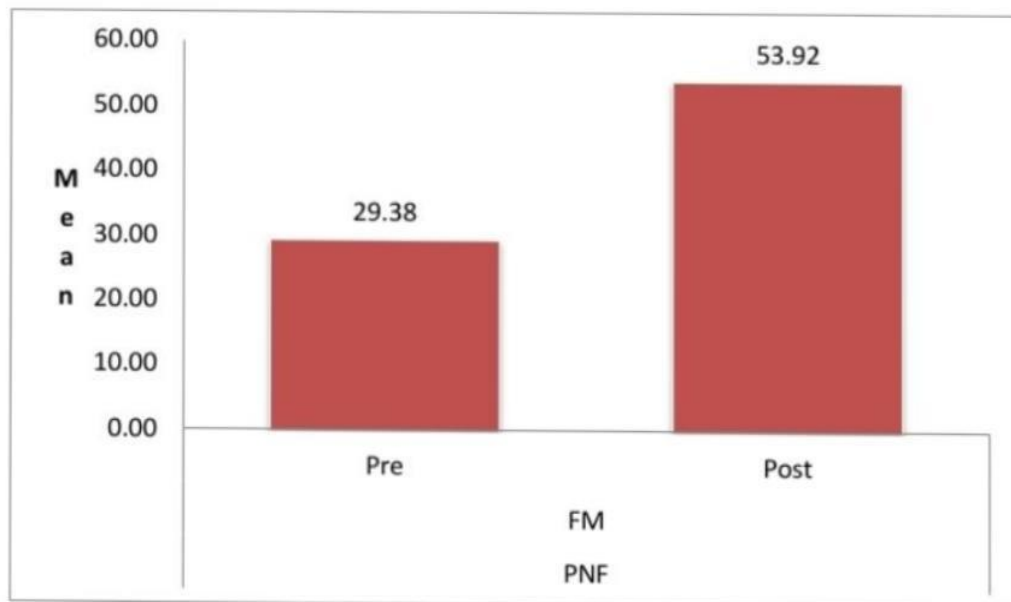


Table 8: Showing pre-post comparison of FM in K-Taping Group

K-Taping		Mean	Std. Deviation	Mean difference	t value	p value
FM	Pre	29.43	4.43	22.00	15.86	0.000 ( $p < 0.001$ )
	Post	51.43	5.12			

In the K-Taping group, the average pre-FM score was  $29.43 \pm 4.43$ , which increased to  $51.43 \pm 5.12$  post-intervention with improvement of 22.00, with a t-value of 15.86. The analysis shows there is a significant difference in FM with  $p < 0.001$

Figure 8: Representation of pre-post comparison of FM in K-Taping Group

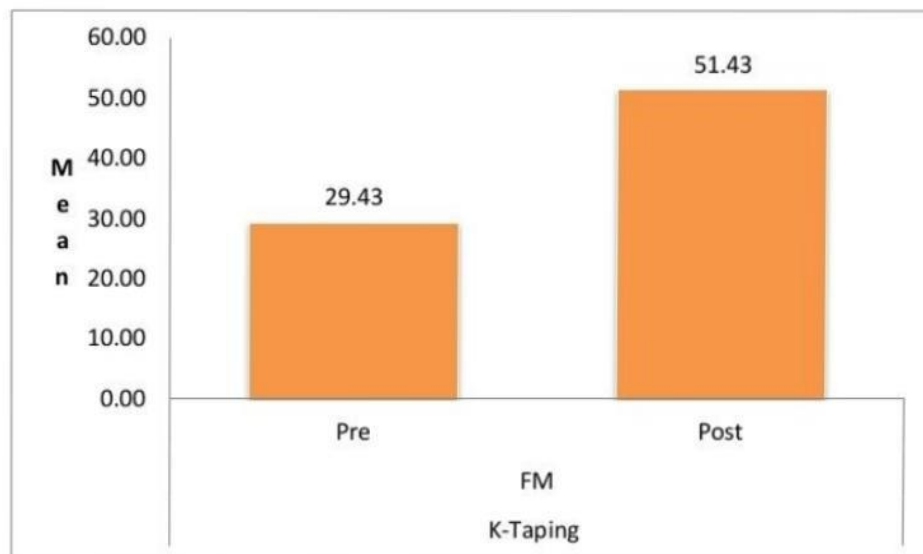


Table 9: Comparison of NPRS between PNF and K-Taping Group

GROUP		Mean	Std. Deviation	t value	p value
NPRS	PNF	5.00	0.82	2.44	0.043 (p<0.05)
	K-Taping	4.14	1.23		

In the comparison of NPRS scores between the PNF and K-Taping groups, the average score for the PNF group was  $5.00 \pm 0.82$ , while for the K-Taping group it was  $4.14 \pm 1.23$ . The t-value was 2.44, and the p-value was 0.043. This analysis indicates NPRS improvement is significantly high in K-Taping group  $p < 0.05$

Figure 9: Representation of Comparison of NPRS between PNF and K-Taping Group

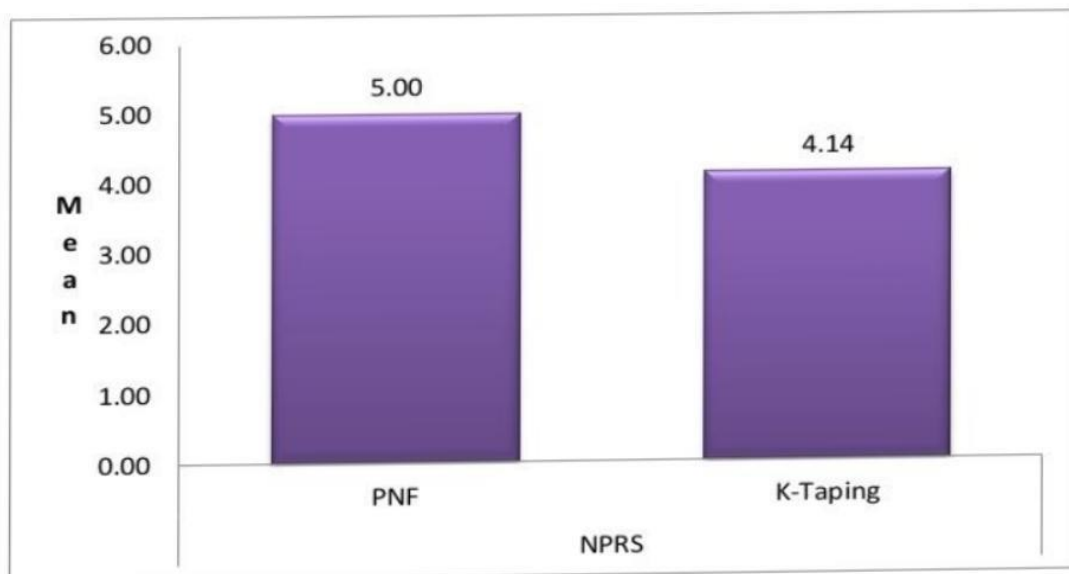


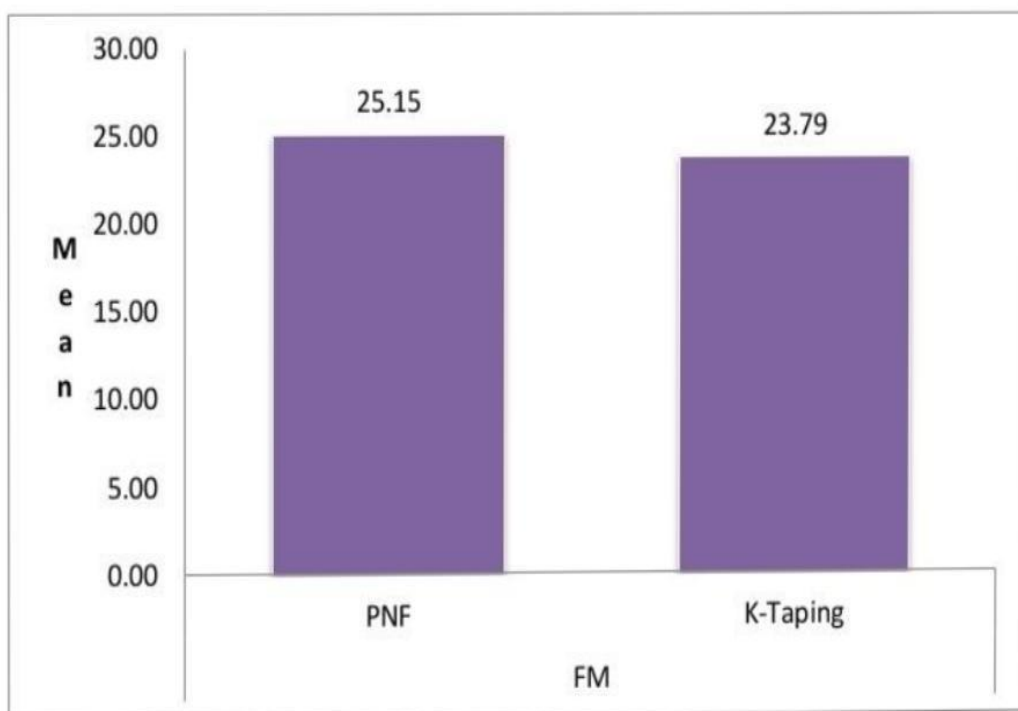


Table 10: Comparison of FM between PNF and K-Taping Group

GROUP		Mean	Std. Deviation	t value	p value
FM	PNF	25.15	6.94	0.38	0.710 ( $p > 0.05$ )
	K-Taping	23.79	11.29		

In the comparison of FM scores between the PNF and K-Taping groups, the average score for the PNF group was  $25.15 \pm 6.94$ , while for the K-Taping group it was  $23.79 \pm 11.29$ . The t-value was 0.38, and the p-value was 0.710. This indicates that there is no significant difference in FM between the PNF and K-Taping groups with  $p > 0.05$ .

Figure 10: Representation of Comparison of FM between PNF and K-Taping Group



## RESULT

In the present study, the results show the ages of stroke patients in both groups were Analysed. The mean age for Group A (k-taping) was  $50.86 \pm 12.03$  years, while Group B (pnf) Had a mean age of  $53.23 \pm 8.57$

years. This analysis indicates that there is no significant Difference in age between the PNF and K-Taping groups' participants.

In this present study, the overall gender outcome indicates that there are 9 females (32.1%) And 18 males (64.3%). This suggests that there is higher incidence of stroke in males than In females.

In the present study, the pre-treatment NPRS score of the Group A (K-Taping) was  $7.93 \pm 1.07$ . The post treatment NPRS score decreased to  $3.79 \pm 1.37$ , Indicating a significant Reduction in post stroke shoulder pain In the present study, the pre-treatment Fugl-Meyer upper extremity assessment score of the Group A (K-Taping) was  $29.43 \pm 4.43$ . The Post-treatment score increased to  $51.43 \pm 5.12$ . This significant increase shows that Kinesiology taping effectively improves upper extremity function in post-stroke patients.

In the present study, for assessment of pain, the pre-treatment NPRS score of the Group B( PNF ) had a mean and standard deviation of  $7.69 \pm 1.03$ . Post-treatment NPRS Score of the PNF group decreased to a mean of  $2.69 \pm 0.75$ , showing a significant reduction in pain

In the present study, for upper extremity function, the pre-treatment Fugl-Meyer Upper Extremity Assessment (FMA) score of the Group B (PNF) had a mean and standard Deviation of  $29.38 \pm 3.28$ . Post-treatment, the FMA score significantly increased to a mean Of  $53.92 \pm 5.56$ , demonstrating a substantial improvement in upper extremity function.

In comparing NPRS scores, Group A (K-Taping) had an average score of  $4.14 \pm 1.23$ , while Group B (PNF) had an average score of  $5.00 \pm 0.82$ . The t-value was 2.44, with a p-value of 0.043 ( $p < 0.05$ ). This result shows that the reduction in NPRS scores was greater in Group A (K-Taping) compared to Group B (PNF), proving K taping has more efficiency than Scapular PNF in reducing hemiplegic shoulder pain .

In comparing FM upper extremity scores between the groups, the PNF group (Group B) had An average score of  $25.15 \pm 6.94$ , while the K-Taping group (Group A) had an average score Of  $23.79 \pm 11.29$ . The t-value was 0.38, and the p-value was 0.710 ( $p > 0.05$ ). This shows That there is no significant difference in FM scores between the PNF and K-Taping groups, Thereby proving both the techniques are almost equally efficient in improving upper Extremity function in post-stroke patients.

## DISCUSSION

This study aims to investigate the effects of kinesiology taping versus scapular proprioceptive neuromuscular facilitation (PNF) on shoulder pain and upper extremity function in post-stroke patients. Both techniques focus on alleviating pain and enhancing function, but they operate in distinct ways. The goal is to determine Which method is more effective for rehabilitation.

In the present study, the results show the ages of stroke patients in both groups were analysed. The mean age For Group A (k-taping) was  $50.86 \pm 12.03$  years, while Group B(pnf) had a mean age of  $53.23 \pm 8.57$  years. These findings are consistent with the study done by Carlos M.Meclon. et.al show similar result<sup>(13)</sup>. Yet another study done by Black Schaffer RM et al. show similar results<sup>(14)</sup>

In this present study, the overall gender outcome indicates that there are 9 females (32.1%) and 18 males (64.3%). This suggests that males are affected more than females. A study done by Turtzo LC et al. also Yields similar results stating that the prevalence of stroke is predominantly in males as per the result<sup>(15)</sup> Yet another study done by Pandian JD et al. also shows the similar Results as the present study stating that the prevalence of stroke is same Predominantly in males as per the results<sup>(16)</sup> Yet another study done by Bharati B et al. also yields the same results stating that shows that stroke is more prevalent in males than females<sup>(17)</sup>

In this present study, the overall distribution of the affected side reveals that 10 participants (36.4%) have

the left side affected, while 17 participants (63.6%) have the right side affected. These findings are similar with the study done by Park, Kwang-Yeol, et al<sup>(18)</sup>

In this present study, the overall distribution of the dominant side shows that 7 participants have a left Dominant side (25.0%), while 20 participants have a right dominant side (75.0%). These findings are similar with the study done by Park, Kwang-Yeol, et al<sup>(18)</sup>

In the present study, the pre-treatment NPRS score of the Group A (K-Taping) was  $7.93 \pm 1.07$ . The post treatment NPRS score decreased to  $3.79 \pm 1.37$ , indicating a significant reduction in post stroke shoulder pain. A study done by Huang, Yen-Chang, et al. also yields similar results<sup>(3)</sup>

Yet another study done by Wang Y, Li X, et al also have findings that suggest significant improvements in motor function and pain reduction<sup>(19)</sup>

In the present study, the pre-treatment Fugl-Meyer score of the Group A (K-Taping) was  $29.43 \pm 4.43$ . The Post-treatment score increased to  $51.43 \pm 5.12$ . This significant increase shows that kinesiology taping effectively improves upper extremity function in post-stroke patients. Another study done by Gong, Wei, et al Found that kinesiology taping can alleviate the pain and improve the upper limb function and shoulder motion function after stroke<sup>(20)</sup>

In the present study, the pre-treatment NPRS score of the Group B( PNF ) had a mean and standard deviation Of  $7.69 \pm 1.03$ . Post-treatment NPRS score of the PNF group decreased to a mean of  $2.69 \pm 0.75$ , showing a Significant reduction in pain. A study conducted by Rahman, Rafia Abdul, et al. yielded similar results, Indicating that PNF techniques effectively reduce shoulder pain and improve upper extremity function in Stroke patients<sup>(21)</sup> Another study by Joshi D, Chitra J. et al also supports these findings, showing that PNF Improves scapular function and reduces pain in hemiplegic patients<sup>(5)</sup>

In the present study, the pre-treatment Fugl-Meyer Assessment (FMA) score of the Group B (PNF) had a Mean and standard deviation of  $29.38 \pm 3.28$ . Post-treatment, the FMA score significantly increased to a mean Of  $53.92 \pm 5.56$ , demonstrating a substantial improvement in upper extremity function. A study by Chaturvedi, Poonam, et al found that PNF exercises significantly improved upper extremity motor function in Stroke patients, with increases in FM scores post-intervention<sup>(22)</sup>

## CONCLUSION

- Individually, Both PNF and K-Taping techniques proved effective in alleviating pain and enhancing upper extremity function in post-stroke patients. However, findings indicated that K-Taping was more effective for relieving hemiplegic shoulder pain compared to PNF.
- In terms of pain relief, participants in the K-Taping group reported a significantly greater decrease in Pain levels than those in the PNF group, as shown by the NPRS scores, which indicated a notable Difference between them.
- In terms of upper extremity function, no significant difference was found between the groups According to the Fugl-Meyer scores. The average score for the PNF group was higher than that of the K-Taping group. While both techniques contributed positively to the improvement of upper extremity Function, the degree of improvement was similar across both groups, with no significant differences Noted.

## LIMITATIONS

- The study sample size was small and included only 27 patients.
- This study does not include acute stroke patients.

- The age criteria was not limited

## RECOMMENDATIONS

- Population can be limited age specific in the future study.
- Studies with a larger sample size can be undertaken in the future to achieve better results as this was conducted with a small sample size.

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