# Effect of McConnell Patelar Taping on Joint Position Sense and Threshold to Detection Passive Motion in Sub acute Stroke Patient

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**Abstract**

The purpose of this study is to analyse the effect of McConnell patellar taping on joint position sense and threshold to detection passive motion in sub acute stroke patient. This is an pre-post test analysis experimental study (n=8). The McConnell patelar taping placed on knee joint in paresis side for 30 minute with McConnell technique and measured by isokinetic dynamometer (Cybex). This research placed in Physical Medicine and Rehabilitation outpatient clinic Dr Soetomo General Hospital. Eight sub acute stroke patient in this study had average age 46.38 ± 11.01 years old and onset of stroke 3,87 ± 1,13 months. The result of McConnell patelar taping application showed significant increase of knee joint position sense in $15^0$ (from 10,78 ± 3,5 to 12,22 ± 3,64 degree) , $30^0$ (from 23,17 ± 3,54 to 24,27 ± 3,50 degree) and improve threshold to detection passive motion (from 13,09 ± 3,49 to 12,09 ± 3,51 second ). Result of this study, conclude that application of McConnell patellar taping can increase joint position sense and improve threshold to detection passive motion and useful for improvement on proprioception in sub acute stroke patient.

*Keywords:* McConnell patellar taping, sub acute stroke, joint position sense, threshold to detection passive motion

## 1. Introduction

Stroke is the leading cause of disability in the world. Proprioceptive impairment in stroke patients is reported to occur in about 50% of patients. This disorder is often associated with postural instability, impaired motor healing, level of patient safety, length of stay in hospital, and decreased independency (Kenzie et al., 2014). Somatosensory disturbances (proprioceptive and tactile somatosensory) are more commonly affected in the lower extremities than the upper extremities in stroke patients, where this will increase in frequency with increasing level of weakness and stroke severity. Somatosensory disturbances in the lower extremities are a third important factor, which reduces walking speed in stroke patients. The incidence of falls in stroke is higher in people with somatosensory disorders compared to those without the disorder (Chia et al., 2019).

Patellar taping is a simple and efficient technique that is usually used to reduce symptoms in anterior knee pain and patelofemoral pain syndrome (PFPS). Patellar taping can improve proprioception of the knee (Mokhtarinia et al., 2008). Similar results were obtained in a study conducted by Callaghan and colleagues, patellar taping on PFPS increased proprioception (as assessed by JPS, both actively and passively), but this increase in proprioception only occurred in subjects who had impaired proprioception from the start (Callaghan et al., 2005). However, there are few studies on the addition of patellar taping as an adjunct therapy for proprioceptive function. Therefore, the researcher believes that it is necessary to conduct a study to assess the improvement of proprioceptive function in subacute stroke patients with the addition of McConnell patellar taping.

## 2. Materials and Methods

This study is pre post test experimental study. Data collection was carried out from March to October 2020 in Physical Medicine and Rehabilitation outpatient clinic and Gait Analysis Laboratory of Physical Medicine and Rehabilitation Installation at RSUD Dr. Soetomo Surabaya. The inclusion criteria for patients were : first or recurrent stroke, subacute stroke (more than 2 weeks and less than 6 months), , spasticity of the ankle plantar flexor based on the Modified Asworth Scale ≤ 2, can understand and follow simple verbal instructions, and signed a written informed consent prior to participation. The exclusion criteria were : Cognitive deficit (MMSE score < 24), neurological disorders other than stroke, heart problems, uncontrolled hypertension or severe pain, apraxia, range of motion limitation on ankle and knee joints, taping hypersensitivity

McConnell patellar taping is a rigid taping (Strappal, BSN) by the method performed (Shin., et al, 2014) by affixing to the knee joint that has been positioned and pulled medially (from the lateral kneecap to covering the medial end of the semitendinosus muscle), and used for 30 minutes.

Joint Position Sense (JPS) of the knee is the ability to sense the position of the knee joint, at angles of $15^0$, $30^0$ and $60^0$ flexion, measured using an isokinetic dynamometer (Cybex NORM TM). Calculated the difference between the target angle and the angle of joint reposition (absolute error), in degrees (absolute error normal value: $2.5^0$).

The knee threshold to detect passive movement (TTDPM) is the time it takes for the subject to detect any movement of the knee joint generated by the isokinetic dynamometer (Cybex NORM$^{TM}$), with a speed of $1^0$ per second, in seconds (normal value for TTDPM: 2.5–4 seconds ).

The statistic in this study was performed using IBM SPSS program version 24, a statistical software. Compare before after application using taping using paired T-test. Significant if $p < 0,05$

Figure 1. McConnell Patellar Taping

## 3. Results and Discussion

Total subjects were 8 patient. The mean onset of stroke was 3.87 ± 1.13 months (onset range 2-6 months). The mean age of subjects was 46.38 ± 11.01 years (with an age range of 30-57 years). The average body weight of the subjects was 60.12 ± 9.91 kg (with a range of 48-78 kg). The average height is 158.75 ± 6.90 cm (with a height range of 150-170 cm). The mean body mass index of research subjects was 23.65 ± 2.84 kg/m2 (with a body mass index range of 20.2-28.8 kg/m2). The number of subjects who had non hemorrhagic stroke was 6 people (75%), while the other 2 people had a hemorrhagic stroke (25%). All subjects in this study

were first attack stroke patients (100%). Weakness on the right side of the body were 3 people (37.5%), left side 5 people (62.5%).

**Table 1. Subject Characteristic**

| Characteristic | N | Min | Max | Rerata ± SD |
|---|---|---|---|---|
| Total Subject | 8 | | | |
| Age (year) | | 30 | 57 | 46.38 ± 11.01 |
| Gender | | | | |
| Men | 4 (50%) | | | |
| Women | 4 (50%) | | | |
| Stroke Onset (months) | | 2 | 6 | 3.87 ± 1.13 |
| Weight (kg) | | 48 | 78 | 60.12 ± 9.91 |
| Height (m) | | 150 | 170 | 158.75 ± 6.90 |
| BMI (kg/m2) | | 20,2 | 28,8 | 23.65 ± 2.84 |

**Table 2. Stroke Characteristic**

| | Frequency | Percentage |
|---|---|---|
| Stroke type | | |
| Non Hemorrhagic | 6 | 75 |
| Hemorrhagic | 2 | 25 |
| Paresis side | | |
| Right | 3 | 37,5 |
| Left | 5 | 62,5 |
| Stroke attack | | |
| 1st attack | 8 | 100 |

Table 3 shows average JPS of all subjects before and 30 minutes after taping. It was found that the increase in paresis side JPS at $15^0$ was statistically significant (p=0.016) between before taping (10.78 ± 3.5) after being taped for 30 minutes (12.22 ± 3.64). At $30^0$, there was also an increase and was statistically significant (p = 0.050) between before taping (23.17 ± 3.54) and after taping for 30 minutes (24.27 ± 3.50), while for JPS at $60^0$ no statistically significant results were obtained (p=0.622).

Table 4 shows the mean TTDPM before and 30 minutes after taping. There was a decrease in TTDPM and statistically significant (p = 0.001) between TTDPM before (13.09 ± 3.49) and TTDPM after taping (12.09 ± 3.51). The average TTDPM is 1 ± 0.55 seconds

**Table 3. Average knee joint position sense (JPS) of the paresis side, before and after taping**

| | Before Taping (degree) | 30 minutes after Taping (degree) | Δ Mean ± SD | p value |
|---|---|---|---|---|
| JPS 15 | 10,78 ± 3,5 | 12,22 ± 3,64 | 1,45 ± 1,29 | 0,016* |
| JPS 30 | 23,17 ± 3,54 | 24,27 ± 3,50 | 1,1 ± 1,3 | 0,050* |
| JPS 60 | 53,3 ± 4,09 | 52,2 ± 7,39 | 1,15 ± 6,3 | 0,622 |

*Significant if p value < 0,05

**Table 4. Average knee threshold to detection passive motion (TTDPM) of the paresis side, before and after taping**

| | Before Taping (second) | 30 minutes after Taping (second) | Δ Mean ± SD | p value |
|---|---|---|---|---|
| TTDPM | 13,09 ± 3,49 | 12,09 ± 3,51 | 1 ±0,55 | 0,001* |

* Significant if p value < 0,05

The results of the Joint Positional Sense (JPS) measurement of the knee at $15^0$ and $30^0$ increased when compared to the baseline and were statistically significant. Research by Mokhtarinia and colleagues, found the results of increased joint positional sense in patients with PFPS after being given patellar taping. Afferent receptors are present in the skin, ligaments, muscles and joint capsule and provide proprioceptive input to the knee joint. Although position sense receptors in joint capsules and ligaments are located deeper in the soft tissues and may be less affected by external support, patellar taping provides greater stimulation of skin and subcutaneous structures and increases pressure on underlying tissues. Receptors that also play a role are free nerve endings which react strongly to new stimuli and adapt quickly. Afferent signals from cutaneous receptors provide proprioceptive information and facilitate proprioception and muscular control by increasing the sensitivity and excitability of motor neurons. Another mechanism that may contribute to the increase in proprioception is the effect on the initial activity of the VMO muscle and changes in its recruitment threshold (Mokhtarinia et al., 2008).

McConnell patellar taping improves patella tracking in the patellofemoral groove by making the patella medial and this will cause patellar realignment (Shin et al., 2014). Realignment of the patella will change the leverage of the patella, maximizing the mechanical advantage of the quadriceps muscle. (Herrington, 2001). Shift or realignment of the patella to the medial direction can maintain the quadriceps muscle lever arm to be longer and ultimately cause an increase in the knee extensor moment and also increase the ability of the vastus

medialis muscle to produce a greater knee extensor force (Crossley et al., 2000). Facilitation on muscle performance will increase proprioception through correction of afferent input from muscle receptors (Mokhtarinia et al., 2008).

Different results were obtained by Callaghan et al., where the use of patellar taping on the knee of PFPS patients, did not improve knee joint proprioception. However, after the study subjects were divided into normal proprioceptive groups (≤ 5 degrees from the target angle) and proprioceptive disorders (> 5 degrees from the target angle), proprioceptive improvements were found in patients with proprioceptive disorders after using patellar taping (Callagahan et al., 2002). In this study, the joint position sense increased only at $15^0$ and $30^0$ angles, while not at $60^0$ angles. This may be due to the anterior cruciate ligament. The ACL acts as a barrier to anterior movement of the tibia and exerts the greatest force at an angle of $15^0$ flexion and decreases to $90^0$ degrees of knee flexion (Dargel et al., 2007). When the ACL is stretched, there will be changes in the length and stretch of the ligament which will cause the capsuloligament mechanoreceptors contained in the ligament to provide and receive proprioceptive feedback (Nagai et al., 2011). It is this greater strain on the ACL at $15^0$ and $30^0$ flexion angles that may cause an increase in proprioception when compared to the $60^0$ angle.

The increase in joint position sense at $15^0$ and $30^0$ angles can also be explained by tension in the patellar tendon. Tension in this tendon is seen from the P/Q ratio (patellar tendon/quadriceps tendon force), which shows the force of the patellar tendon against the tibia. (Cleather et al., 2014). This P/Q ratio changes based on the knee flexion angle. At an angle < $45^0$, the ratio will be > 1, while < 1 if the knee angle is > $45^0$ (Dan et al., 2018). At an angle of $90^0$ and $60^0$ flexion is the optimal angle of contact of the patella to the femur, while at an angle of $20^0$-$30^0$ at the end of extension, the patella loses mechanical contact with the intercondylar groove (Neumann, 2010). Loss of patellar contact with the intercondylar groove of the femur may also contribute to the increased proprioception of the knee joint after patellar taping. McConnell patellar taping improves patella tracking in the patellofemoral groove. (Shin et al., 2014). The angle of $60^0$ is the optimal angle of contact of the patella to the femur, therefore there is no increase in proprioceptive after McConnnell patellar taping.

The results of the TTDPM measurement showed an improvement in the TTDPM of the knee joint after the use of patellar taping. There was a decrease in TTDPM and was statistically significant, from 13.09 ± 3.49 seconds to 12.09 ± 3.51 seconds. This result is different from the study conducted by Mokhtarinia and colleagues, where in PFPS patients who were given patellar taping, there was no improvement in the results of the knee joint TTDPM. Improvement was only found in the reproduction of an active angle of 20 degrees of the knee joint. (Mokhtarinia et al., 2012). The use of patellar taping can change the response of the brain. Research on the effect of patellar taping on brain activity during a knee joint proprioceptive test was carried out using fMRI (Functional Magnetic Resonance Imaging). The use of fMRI was carried out to measure BOLD (Blood Oxygenation Level-Dependent) which reflects the loss of oxygen from hemoglobin which causes iron to be paramagnetic. When a movement is carried out there will be neuronal activity and will increase oxygen consumption. Patellar taping increased the BOLD response in several areas (primary sensorimotor cortex and primary sensory cortex) compared to the knee joint without taping. This response shows that the effectiveness of using patellar taping not only provides mechanical support to the patella and changes in the biomechanics of the lower limbs, but also affects the brain (Callaghan, 2012).

## 4. Conclusion

Application of McConnell patellar taping on the paresis side of the knee in sub acute stroke patient for 30 minutes, increased joint position sense in $15^0$, $30^0$ and improve threshold to detection passive motion. This application thought be useful for sub acute stroke patient for improvement on knee proprioception. Further research is needed to evaluate long term effect of McConnell patellar taping in stroke patient

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