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นิพนธ์ต้นฉบับ
ORIGINAL ARTICLE

การศึกษาเปรียบเทียบผลทันทีระหว่างการนวดไทยกับการยืดค้างกล้ามเนื้อแบบทำให้ต่อการเปลี่ยนแปลงอาการแข็งเกร็งของกล้ามเนื้อและความสามารถในการเดินในเด็กสมองพิการ

พิศมัย มะลิลา อาภาภรณ์ ห้าวหาญ จุรีภรณ์ แก้วจันดา พรรณี ปึงสุวรรณ

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วัตถุประสงค์; เพื่อเปรียบเทียบผลทันทีระหว่างการนวดไทยกับการยืดค้างกล้ามเนื้อแบบทำให้ต่อการเปลี่ยนแปลงอาการแข็งเกร็งของกล้ามเนื้อและระยะทางการเดิน 1 นาทีในเด็กสมองพิการ

วิธีการ; การทดลองแบบสุ่มและมีกลุ่มควบคุมอาสาสมัครที่ผ่านเกณฑ์การคัดเข้าจะถูกสุ่มจากเพศ ระบบจำแนกความสามารถด้านการเคลื่อนไหว (Gross Motor Function Classification System; GMFCS) และแบ่งเป็น 2 กลุ่ม คือ กลุ่มนวดไทย และกลุ่มยืดค้างกล้ามเนื้อแบบทำให้ วัดผลของระดับการแข็งเกร็งของกล้ามเนื้อโดยใช้ Modified Ashworth Scale (MAS) และวัดความสามารถในการเดินโดยใช้ one minute walk test (1MWT) ก่อนและหลังจากให้การรักษาทันที

ผลการศึกษา; อาสาสมัครเด็กสมองพิการ 13 คน ผ่านการสุ่มกลุ่มนวดไทย 7 คน และกลุ่มยืดค้างกล้ามเนื้อแบบทำให้ 6 คน มีคุณลักษณะพื้นฐานแตกต่างอย่างไม่มีนัยสำคัญทางสถิติ ($p>0.05$) หลังการรักษาพบว่ากลุ่มนวดไทยอาสาสมัคร 5 คน (ร้อยละ 71.43) มีระดับการแข็งเกร็งของกล้ามเนื้อ quadriceps ข้างซ้ายลดลงมากกว่ากลุ่มยืดค้างกล้ามเนื้อแบบทำให้ซึ่งลดลง 1 คน ร้อยละ 16.67 ($p = 0.0483$) ส่วนกล้ามเนื้ออื่นๆ ไม่พบการลดลง ($p>0.05$) โดยในกล้ามเนื้อ quadriceps ข้างขวา $p = 0.135$ กล้ามเนื้อ hamstrings ข้างซ้ายและข้างขวา $p = 0.42, 0.553$ ตามลำดับ ส่วนผลของ 1MWT ระยะทางการเดินหลังรับการรักษา แตกต่างอย่างไม่มีนัยสำคัญทางสถิติและไม่แตกต่างระหว่างกลุ่ม ($p = 0.659$)

สรุป; การนวดไทยให้ผลในการลดระดับการแข็งเกร็งของกล้ามเนื้อ quadriceps ข้างซ้าย ในเด็กสมองพิการ การนวดแผนไทยและการยืดค้างกล้ามเนื้อแบบทำให้มีผลเพิ่มระยะทางการเดินหลังการรักษาอย่างไม่มีนัยสำคัญทางสถิติ

คำสำคัญ; การนวดไทย, การยืดกล้ามเนื้อ, อาการแข็งเกร็ง, สมองพิการ, ความสามารถในการเดิน

1 สาขาวิชากายภาพบำบัด คณะเทคนิคการแพทย์ มหาวิทยาลัยขอนแก่น
2 กลุ่มวิจัยปวดหัว ปวดคอ และปวดหัวอื่น ๆ และสมรรถภาพของมนุษย์ (BNOJPH) คณะเทคนิคการแพทย์ มหาวิทยาลัยขอนแก่น

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ORIGINAL ARTICLE

A comparison of immediate effect between traditional Thai massage and passive static stretching on alteration of spasticity and walking ability in children with cerebral palsy

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Objective: To compare the immediate effects between traditional Thai massage and passive static stretching on alteration of spasticity and walking distance in children with cerebral palsy

Materials and Methods: The study was randomized controlled trial participants who met the inclusion criteria were randomly allocated to the traditional Thai massage (TTM) or passive static stretching (PSS). The stratified (manual matching) randomized allocation was performed using gender (male and female) and Gross Motor Function Classification System (GMFCs) (level I-III). The level of muscle spasticity was measured using Modified Ashworth Scale (MAS) and walking ability using one minute walk test (1MWT) before and after immediate treatment of TTM and PSS.

Results: Thirteen children with cerebral palsy (CP) were recruited. After randomization, 7 and 6 of them were allocated into TTM group and the other group were PSS, respectively. All characteristics were similar in both group with no statistical different (p>0.05). After treatment, 5 participants (71.43 %) in the TTM group had reduced the MAS of left quadriceps greater than in the PSS group which reduced only 1 child (16.67 %, p = 0.0483). However, the other muscles did not show any statistically significant change (p > 0.05) in right quadriceps p = 0.135, right and left hamstrings p = 0.42 and 0.553 respectively. After treatment, the 1MWT did not show significant change in each group and no difference between groups as well (p = 0.659).

Conclusion: This present study showed that the TTM was the effective in left quadriceps muscles for reduction of spasticity in children with CP. No significant increasing walking distance after treatment both the TTM and PSS.

Keywords: Traditional Thai Massage, Passive Static Stretching, Spasticity, Cerebral palsy, Modified Ashworth Scale, Walking ability

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Introduction

Cerebral palsy (CP) is a group of movement disorders and postural limitation[1]. It causes body structure and functional problems such as spasticity, limited range of motion, joint stiffness and muscle weakness lead to decrease mobility and activities for daily living[2]. Spasticity cause secondary problem include muscle and soft tissue contracture and deformities[3]. There are many basic physical therapy treatment techniques in relieving the signs and symptoms of spasticity such as Neuro Developmental Treatment (NDT), passive muscle stretching, positioning, massage, whole body vibration and others in children and adult with CP spasticity[4-5].

Muscle stretching is commonly used in the treatment and management of children with CP. Prolong passive muscle stretching is commonly used in the treatment for CP. Sustained passive muscle stretching for a long period improves the range of movements and reduces muscle spasticity. Passive muscle stretching activates Golgi tendon organ and inhibits the excitability of alpha motor neurons[4]. Prolong stretching with long term manual static stretching provides the normalization of muscle mechanical properties in CP[6]. Passive static stretching (PSS) with manual static stretching is performed by another person continually and the child does not actively take part and relax as possible. This technique has done with the child in comfortable and safe position such as prone, lying and long sitting. Parents may engage and participate passive stretching with children[7]. The previous study supports manual static stretching of the ankle plantar flexors in CP has been shown to improve acute lengthening of the medial gastrocnemious belly and Achilles tendon in one session[6]

TTM is a deep massage with prolonged pressure along the '*Sen Sib'*. The Sen Sib line originating from the center point (underneath the abdominal surface (umbilicus), 2 fingers width deep), and throughout the body via invisible pathways[8]. The idea is that if these lines are unblocked, then energy can flow through the body in a balanced feature, increase awareness, vitality, etc[9]. TTM is an alternative treatment that has been used to promote health as well as therapy for body and mind. Its effects are well known for enhancing muscle relaxation, reducing muscle tension, and improving joint flexibility[10]. In addition, the previous study has shown that TTM could be an alternative treatment to reduce spasticity in cerebral palsy temporarity[2]. The study suggests that spasticity in cerebral palsy involves impairments and functional limitation, measurement such as walking ability should be further investigated [2]. Nowadays, there is no comparative study between TTM and PSS to improve the muscle spasticity. Therefore, our study aims to compare the immediate effects between traditional Thai massage and passive static stretching on alteration of spasticity and walking ability in people with cerebral palsy.

Materials and Methods

Study design

The study was a randomized controlled trial (real control)[11]. Participants who met the inclusion criteria were randomly allocated into the TTM or PSS. The stratified (manual matching)[12] was randomized allocation[13] by three researchers who were investigator, generated the random allocation sequence and enrolled participants. It was performed using gender (male and female)

and Gross Motor Function Classification System (GMFCs level I-III) as a stratified variable. This study was conducted in Srisungwan School in Khon Kaen Province. All participants and their parents signed a consent form prior to entering into the study. The protocol was approved by the ethics committee of Khon Kaen University (HE542188).

Participants

The spastic diplegia patients aged 10-15 years old and who met the inclusion criteria were recruited: such as 1) spastic diplegia, 2) GMFCS level I to III, 3) Modified Ashworth Scale (MAS) level 1-4, and 4) normal tactile sensation. Participants with any of the following criteria were also excluded: 1) skin abrasion, 2) skin infections, and 3) fracture and unable to verbally communicated.

Treatment protocol:

TTM group, a certified Thai massager applied thumb pressure, by gently and gradually increasing the pressure, with no pain among the participants for each point along the *Sen Sib*. *Sen Sib* are imaginary lines along postural muscles of the body; these muscle were proved to be tightened and exhibited myofacial pain syndrome[14]. For each point, thumb pressure was applied until the participants reported feeling comfortable. Pressure was maintained for 5–10 seconds before it was released and applied to the next point along the lines on anterior and posterior legs and feet[2,15]. This protocol on both legs was repeated twice for each line. At the end of massage on each body segment and overall, the massage session took 30 minutes[2,14,16].

PSS group, each participant received prolong stretching static muscle both the right and left legs. Stretches were maintained for 20 sec on muscle group, 15 minute per leg and overall stretching session was for 30 minutes applied in a comfortable and safe position for a period of time [17]. When stretching was applied continually until the end point, there was no pain[18] at gastrocnemius, tibialis anterior, quadriceps and hamstrings muscles[2].

Assessment

Participant's demographic characteristics (age, sex) and GMFCS were recorded. The definitions of GMFCS are described; level I, children can walk indoors and outdoors and climb stairs without using hands for support, can perform usual activities such as running and jumping, and have decreased speed, balance and coordination; level II, children have the ability to walk indoors and outdoors and climb stairs with a railing, have difficulty with uneven surfaces, inclines or in crowds, and have only minimal ability to run or jump; level III, children can walk with assisting mobility devices indoors and outdoors on level surfaces, may be able to climb stairs using a railing, may propel a manual wheelchair, and may require assistance for long distances or uneven surfaces [19].

Severity of spasticity, quadriceps femoris and hamstrings muscle were tested using Modified Ashworth Scale (MAS), the participants laid on their left side or supine while an assessor tested resistance to passive movement about the hip and knee joint (with varying speeds of movement, then recorded the category indicating resistance

according to The MAS classification described as follow. A score of 0 revealed no increase in muscle tone while a score of 1 showed slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of the range of motion when the affected part(s) was moved in flexion or extension. A score of 1+ indicated slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the reminder (less than half) of the ROM (range of movement). A score of 2 revealed more marked increase in muscle tone through most of the ROM, but the affected part(s) could be moved easily. A score of 3 showed considerable increase in passive muscle tone, movement difficult and a score of 4 indicated the affected part(s) to be rigid in flexion or extension[2,20,21].

Outcome measures:

Each participant was assessed the level of muscle spasticity and walking distance using MAS and 1MWT, respectively before and after receiving the TTM or PSS. The details of each outcome measure were described below:

1. MAS was a primary outcome. It was classified to a dichotomous variable as "reduction of spastic" meant at least a level of reduction, for example: from level 2 to 1^+, or the 1^+ to 0, etc (cut point reduced spastic in one level) and "no reduction or no change of spasticity levels". The detail of the assessment were explained: the participants laid on their side and supine while an assessor tested resistance to passive movement of the hip and knee joint (quadriceps femoris and hamstrings muscle; 3 times) with varying speed of movement, then recorded the category indicating resistance according to the MAS classification described as assessment part. The MAS has been reported to have good intra-rater reliability ($ICCs_{(3,1)}$ = 0.80-0.85) and moderate to good inter-rater reliability (ICCs = 0.58-0.81) for elbow flexor muscles [20,21]. All participants were assessed the MAS of quadriceps femoris and hamstrings muscle before and immediately after a 30-minute session of TTM and PSS.

2. One minute walk test (1MWT) was walking distance (metre) measure within 1 minute. The participants were asked to complete 1-min walks, two times using the following procedure: following a 5 min seated rest, children stood at a starting point inside the outline of 20 m. They were given the following instruction, walk as fast as possible around the track for 1 minute and not allowed to run. Distance was calculated to the nearest metre using markings on the track. A 10 minutes seated resting was given between tests. During the test children were allowed to wear their own comfortable shoes and used their walking aids. An assessor recorded the walked distance, and another assessor carefully followed participant to test walking[22]..

Data analysis

The continuous outcome measures were presented as mean ± standard deviation (SD) and median (min:max). The categorical outcomes were presented as the proportion or percentage (%). According to a small sample size, therefore, the non-parametric was performed. To compare the proportion of participants with decreasing of muscle spasticity (using a score of posttest - pretest) in both quadriceps and hamstring between two groups were analyzed by the Chi-square test (x^2). For 1MWT, the within group

(pre vs post test in each group) the Wilcoxon Signed-rank test was used. The Mann-Whitney test (mean ± SD or median and min:max) was used to compare between two groups. To achieve statistical significance, an overall two-sided 5% significance were used. The data were analyzed using a STATA version 10.1 (StataCorp, 4905 Lakeway Drive College Station, Texas 77845, USA) with the license for Khon Kaen University.

Results

Thirteen children with cerebral palsy were recruited. After randomization, 7 and 6 of them were allocated into the TTM group and the others were in the PSS group, respectively. Table 1 shows the baseline characteristics. All characteristics were similar in both groups (p>0.05).

Table 2 shows the mean and SD of TTM group; MAS at pre intervention on Lt. quadriceps is 1.71 (S.D.= 0.39), while post is 1.29 (S.D.=0.39). Rt. Quadriceps at pre and post intervention are 1.71 (S.D.= 0.27) and 1.36 (S.D.=0.38) respectively. On the other hand, pre intervention Lt. hamstrings is 1.64 (S.D.= 0.38) when post intervention is 1.57 (S.D.=0.45). Rt. Hamstrings is 1.57 (S.D.= 0.35) for pre intervention; 1.5 (S.D.= 0.41) for post intervention. For, PSS group Lt. quadriceps pre intervention is 1.5 (S.D.= 0.29); post intervention 1.42 (S.D.= 0.19). While Rt. Quadriceps pre intervention is 1.58 (S.D.= 0.19); post intervention 1.5 (S.D.=0.29). Lt. hamstrings pre intervention is 1.83 (S.D.=0.62) whereas post intervention 1.42 (S.D.=0.45). Lastly, Rt. Hamstrings pre and intervention is 1.83 (S.D.= 0.62) and 1.5 (S.D.=0.29) respectively.

According to Table 3, after treatment, 5 participants (71.43 %) in TTM group had significantly reduced left quadriceps spastic greater than in PSS group, which reduced only 1 child or 16.67 % (p = 0.0483). The other muscle did not show statistically significant changes (p > 0.05); however, the MAS results were not change. The number (%) of CP children shows the reduction of leg spasticity (using MAS) after treatment. MAS was classified to a dichotomous variable that reduction of spastic as described in outcome measures[23].

Table 4 shows that TTM group trended to have greater walking distance than those in PSS. Both groups showed significant increased walk-distance after treatment (p<0.05). In comparing the difference (post-pre), the TTM show slightly better result than the PSS; however, this was not statistically significant (p= 0.659).

Table 1. Baseline characteristics

Characteristics	TTM (N=7) Number (%)	PSS (N=6) Number (%)
Age (years)	12.71 ± 1.80	12.50 ± 1.87
Sex		
Male	2(28.57)	2(33.33)
Female	5(71.43)	4(66.67)
GMFCS		
I	0(0)	0(0)
II	5(71.43)	4(66.67)
III	2(28.57)	2(33.33)

TTM ; Traditional Thai Massage, PSS; passive static stretching, GMFCS; Gross Motor Function Classification System

Table 2. MAS at pre – post intervention

MAS		TTM				PSS			
		pre		post		pre		post	
		mean	S.D.	mean	S.D.	mean	S.D.	mean	S.D.
Quadriceps	Lt.	1.71	0.39	1.29	0.39	1.5	0.29	1.42	0.19
Quadriceps	Rt.	1.71	0.27	1.36	0.38	1.58	0.19	1.5	0.29
Hamstrings	Lt.	1.64	0.38	1.57	0.45	1.83	0.62	1.42	0.45
Hamstrings	Rt.	1.57	0.35	1.5	0.41	1.83	0.62	1.5	0.29

Modified Ashworth Scale (MAS), TTM ; Traditional Thai Massage, PSS; passive static stretching, Lt; Left, Rt. ; Right

Table 3. The number (%) of MAS after treatment

Muscle	TTM (N=7)	PSS (N=6)	*p*-value
Lt. Quadriceps n (%)	5 (71.43)	1 (16.67)	0.04*
Rt. Quadriceps n (%)	4 (57.14)	1 (16.67)	0.13
Lt. Hamstrings n (%)	1 (14.29)	4 (66.67)	0.05
Rt. Hamstrings n (%)	1 (14.29)	3 (33.37)	0.41

TTM ; Traditional Thai Massage, PSS; passive static stretching, Lt; Left, Rt.; Right

* statistic significant is p<0.05 in comparing between 2 groups using Chi-Square test

Table 4. Pre - post data of walking distance in both TTM and PSS

1 MWT / metre	TTM (N=7) $\overline{x}$ ± SD, median (max: min)	PSS (N=6) $\overline{x}$ ± SD, median (max: min)	*p*-value[$]
Pre-test	31.29 ± 9.20	40.50 ± 7.32	0.477
	34 (14 : 41)	37 (23 : 70)	
Post-test	33.86 ± 9.75*	42.67 ± 18.82*	0.568
	35 (16 : 44)	39 (24 : 72)	
Mean Different (post-pre-test)	2.57 ± 1.13	2.17 ± 1.94	0.659
	2 (1 : 4)	1.5 (0 : 5)	

* statistic significant (p<0.05) when comparing with pre test...

$ The p-value when comparing between 2 group using Mann-Whitney test

1MWT; One minute walk test, TTM ; Traditional Thai Massage, PSS; passive static stretching, SD; standard deviation, $\overline{x}$; mean

Discussion

The study found the immediate effect of TTM after treatment was reduced left quadriceps spasticity in the TTM group was greater than in the PSS group. The result showed that TTM group had decreased quadriceps spasticity than PSS and PPS had reduced spasticity of hamstrings than TTM. Table 2 showed the baseline MAS of quadriceps in TTM group and MAS of PSS in hamstring muscles tended to high level, however this was not statistically significant. The results shown that TTM group tended to have higher walking distance than those in PSS, the baseline 1 MWT of PSS group were higher than TTM. There were some

factors such as the difference data base between both groups that MAS level of hamstrings muscle tended to higher in PSS than TTM. According to the results of TTM and PSS, the effects were not different. It tended to cause positive consequence for decreasing spasticity in different muscles, and it increased walking ability. Thus, TTM and PSS both affect the mentioned muscles as Malila P et al (2015) states that TTM might reduce spasticity[2] and Lorenzo TM et al (2017) found that manual static stretching shown to improve acute lengthening of muscles[6].

The previous study showed massage therapy led to a reduction in muscle tension and increased muscle relaxation. Massage, stimulating pressure receptors, may have contributed to increased relaxation, greater range of motion, greater reduction in pain, decreased muscle tension and less anxiety. Muscle tension was decreased for the hand massage. The massage therapy group experienced a greater reduction in pain and greater improvement in balance and walking [6,10,16]. The previous study showed that TTM had positively impacted and might reduce spasticity in CP[2]. The decreased spasticity resulting from TTM may be explained by the relaxation effect of touch applying thumb pressure, sustained muscle stretching that activation of Golgi tendon organ [2,15]. The results of this study showed trend of reducing spasticity that was not statistically significant; it may cause of complex problems and factors such as number of treatment repetitions[7], severity of spaticity, muscle contracture and soft-tissue extensibility[24].

Both groups showed increasing walking distance after treatment and having a tendency reduced spasticity. The acute or transient changes in muscle length in response to stretching, might be from the mechanism of Golgi tendon organs supporting the effect of stretching leading to relaxation and pacinian corpuscles that serve as pressure sensors leading to change. Repeated stretching also shows reduction in tension and allows elongation through small changes in muscle[17]. Stretching can preserve increased muscle extensibility and joint range of motion for functional movement and task that may delay or prevent surgical intervention for muscle contractures. Therapists use stretching interventions for children with CP, the stretching program will not only maintain range of joint motion, but positively impact the functional abilities of the child. Many therapists also use stretching to prevent or delay the development of secondary complications. From this perspective, the emphasis on flexibility and joint range of motion changes to a focus on encouraging movement opportunities that enable children with CP to experience a repertoire of movement and participate in enjoyable activities while enhancing their physical activity and fitness[7].

In addition, the participants in this study have GMFCS level II – III during the test of 1MWT the child can wear their own comfortable shoes and used their aids, these may support their walking ability in positive results. However, the MAS and walking distance in both groups is inclined, this should be concerned the level of spasticity severity of each muscle to be small or large muscles. So that, many factors for instance loss of selective motor control, functional abilities and weakness that may has affected on the change of spasticity[25].

It is important to recognize the limitations of this study, the small sample size may limit its effectiveness as a study as the results may not be transferrable to a larger sample of testing. The sample group was difficult to assess as all children have different levels of disabilities and abilities and to have two equal groups for sampling is problematic. The treatment history and background for each child may have an impact on the study as different children may respond to treatment if different ways[18]. Nonetheless, the child in this study takes only standard Physical Therapy. As Lesley W et al (2008) suggest that therapists may want to consider activities such as horseback riding, aquatic programs and yoga that allow children to stretch and move within a functional environment for further study[7].

TTM and PSS techniques were safe with short-term effect in CP[2,7]. Increasing muscle tone and poor selective motor control affect many children with CP. If children have easier movements, they might be encouraged to be more physically active, so this would benefit their overall health and physical condition. Their quality of life could be improved and this may benefit future to participate in community[7]. This study contributes to the knowledge of physical therapy with CP and future studies could entail studying the effectiveness of TTM in other situations and the use of stretching exercises in other physical impairments.

CONCLUSION

This study is a valuable contribution to therapists and parents because it shows that TTM and PSS this would be helpful in the future treatment of children with this particular disability. If TTM or massage therapy could be routinely included in treatment for children, it would lead to better outcomes for children with muscular or contractual disabilities. This present study shows that TTM was the effective in some muscles for reduction of spasticity in children with CP. No significant increasing walking distance after TTM and PSS treatment. Both techniques are safe for CP children.

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