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# อิทธิพลการคลาย sacrotuberous ligament ด้วยการทดสอบ Faber ในคนสุขภาพดี

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**บทคัดย่อ**

**วัตถุประสงค์:** เปรียบเทียบระยะห่างระหว่าง head of fibula ถึงเตียงที่ใช้ทดสอบด้วย Faber ก่อน และ หลังการคลาย sacrotuberous ligament (ST ligament).

**วิธีการ :** ผู้เข้าร่วมวิจัยสุขภาพดี 30 คน (เพศชาย 8 คน และ เพศหญิง 22 คน) ได้รับการทดสอบ Faber โดยนักกายภาพบำบัด พบความตึงของ ST ligament แตกต่างกัน ดังนี้ ข้างขวา, ซ้าย เท่ากับ 12 และ 18 ข้าง ตามลำดับ โดยทำการวัดระยะห่างระหว่าง head of fibula ถึงเตียง ก่อน และ หลังการคลาย ST ligament โดยนักกายภาพบำบัดอีกท่าน

**ผลการดำเนินการ :** ค่าเฉลี่ยของระยะห่างระหว่าง head of fibula ถึงเตียง ก่อน และ หลังการคลาย ST ligament เท่ากับ 12.42 ± 4.30 เซนติเมตร และ 9.00 ± 4.71 เซนติเมตร ตามลำดับ และ มีความแตกต่างกันอย่างมีนัยสำคัญที่ $p$ <0.001.

**สรุป :** การคลาย ST ligament สามารถลดระยะห่างระหว่าง head of fibula ถึงเตียง ในการทดสอบด้วย Faber ในคนสุขภาพดี

**คำย่อ :** ST ligament = sacrotuberous ligament, QL = quadratus lumborum, SIJ = sacroiliac joint, KLIMB = Kinematic linkage muscle imbalance

**คำสำคัญ:** Sacrotuberous ligament, Sacroiliac joint, Muscle linkage, Faber test, Sign of 4

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# Influence of releasing sacrotuberous ligament to Faber test in healthy individuals

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**Abstract**

**Objectives:** To compare perpendicular distances from the head of fibula to the examining table on the Faber test before and after releasing sacrotuberous ligament (ST ligament).

**Method :** Thirty healthy people participated in this study (8 males and 22 females) volunteered. A physical therapist (PT) performed the Faber test to identify whose leg was tighter; 12 right and 18 left sides. A PT measured the distance between head of fibula to the table surface during the Faber test before and after the ST ligament was released by another PT.

**Results :** Mean distance between head of fibula to table before releasing ST ligament was 12.42 ± 4.30 centimeters, while after release the distance STL was 9.00 ± 4.71 centimeters a significant difference ($p < 0.001$).

**Conclusion :** The effect of released ST ligament could decrease the distance between head of fibula and table surface in the Faber test

**Abbreviation :** ST ligament = sacrotuberous ligament, QL = quadratus lumborum, SIJ = sacroiliac joint, KLIMB = Kinematic linkage muscle imbalance

**Keywords:** Sacrotuberous ligament, Sacroiliac joint, Muscle linkage, Faber test, Sign of 4

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## Introduction

Mobility of the sacroiliac joint (SIJ) is mainly passive structure, occurs in three planes with a few degrees of movement. This motion is only 0.5-1.6 mm for translation and up to 4 degrees for rotation according to X-ray analysis[1]. The main movement of SIJ is rotation of the sacrum relatively to the iliac bone. Although no muscle moves the SIJ directly, the movements of this joint depend on the rectus femoris, adductor muscles of hip joint, sartorius, iliacus[2], gluteus maximus[4] and hamstrings[4,5] (especially bicep femoris[3]) muscle.

Besides these muscles, there are some ligaments so-called "self-bracing the pelvis"[6]. The important ligaments which have an influence on the SIJ such as sacrotuberlous (ST) ligament (connecting the sacrum to ischial tuberosity[3]), long dorsal sacroiliac ligament (connecting the sacrum to posterior superior iliac spine) and sacrospinous ligament[7] (connecting the ischial spine to the sacrum-coccyx).

The ST ligament is one of important structures of the SIJ attached from the lower lumbar spine to posterior portion of the iliac crest. This ligament plays 2 roles: 1) to stabilize the SIJ while this joint is moving and 2) to control the range of movement of the SIJ[2,3]. Hammer N. et al 2013 found that if ST ligament has the tension, it decreases of nutation. If the long dorsal sacroiliac ligament has the tension, sacrum is happened the counternutation[1]. Sprains of the SIJ might also result from imbalance forces acting on ilium.

The relationship between SIJ to the part of the lower limb has been previously shown. The study of Van Wingerden et al found that there was a part of the long head of biceps femoris which was attached to the ST ligament[8]. Thus it was presented that the role of ST ligament could affect to the movement of the lower limb.

Common problem of the pelvic girdle pain[1] comes from low back pain[7] however, the SIJ was another cause of pain at pelvic girdle, also. Fortin JD. et al located of pain in SIJ by injected in healthy subjects. Pain from SIJ spread approximate caudally 10 cm. and 3 cm. laterally from posterior superior iliac spine[9]. The clinical test for SIJ are many test such as Gillet, Gaenslen's, Spring, Distraction /compression, Patrick's or sign of four or Faber test.[10]

The Faber test is one of the mobility test for SIJ combining ipsilateral hip flexion, abduction and external rotation positioning the heel on the contralateral knee in supine. The specificity, sensitivity of Faber's test is 81-100%, 50-77%, respectively, is reviewed by Stuber KJ[11]. Meanwhile this test is positive if the patient felt pain at the pelvic girdle area. If there are only the tension, and the distance between knee and the table was higher than the other side. This distance showed that it may be tightened from the adductor muscle of hip joint or tension from ST ligament.

Releasing the ST ligament would decrease nutation has been anecdotal but the evidence to support this notation is still lacking. Seemingly the ST ligament has been overlooked. There was no other study previously investigating this ligament. Therefore, this study aimed to investigate the immediate effect of releasing the ST ligament on as measured by the distance between head of the fibula to the table in Faber's test.

**Material and Methods:**

**Participants** :

Thirty asymptomatic male and female volunteers, 19-26 years of age, were recruited. This protocol was approved by the Institutional Review Board, Mahidol University (MU-CIRB 2015/073.1405) and was registered at the Thai Clinical Trail Registry (TCTR) as an identification number TCTR 20170412002. The amount of volunteers was calculated the sample sized with drop out 20%. Participants were excluded due to have past history of musculoskeletal symptoms (e.g. scoliosis, fibromyalgia, pain at any regions, and instability of lower extremities caused by ligamentous injury, injury or trauma to lower extremities), endocrine disease, rheumatoid arthritis, pregnancy and had menstruation on the data collection day.

**Instrumentation :** A tape measure, a disappear ink pen (see the ink when use the ultraviolet light), Standard goniometers


A B

**Figure 1** Instruments A = Tape measure, B = disappear ink pen

**Procedure :**

Prior to participate in this study, the researchers explained details of data collection to the participants and the latter signed inform consent.

Each participant initially received a battery of tests for physical assessment from two experienced physical therapists (more than 5 years). The inter-reliability of the distance between head of fibula and the table in Faber test of the first (PT1) and second physical therapists (PT2) were 0.867. So, PT2 who was chosen for measure the distance, the intra-reliability of the PT2 was 0.947. This physical assessment was aimed to investigate which the participant's side had more ST ligament tightness by Faber test, compared to the other side. This particular side was chosen to receive ligament release.

Faber test ; we did the test both side to compare which side have tension

The first physical therapist (PT1) set the Faber test position (the side of test leg is flexed, abducted, and external rotation of hip joint, the heel on the other side of knee in supine lying) and placed one hand onto the anterior superior iliac spine (ASIS) of the opposite leg, the other hand on the top of knee joint of the test leg. Then lowered the test leg until the ASIS in opposite side lifting up. The PT1 decided which leg was more tighten. Then the second physical therapist (PT2) measured the distance between the head of fibula of the test leg and the table using a tape measure. (**Figure 2**)

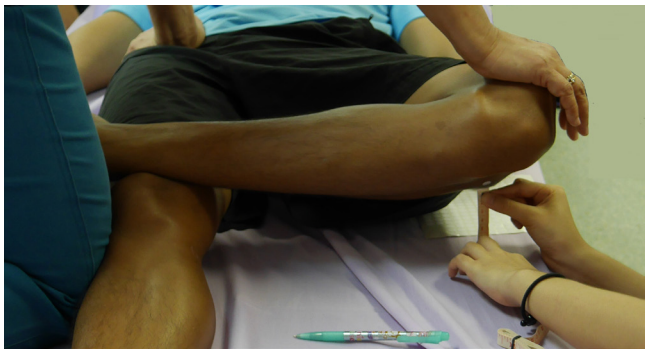

**Figure 2** The second physical therapy measured the distance between the head of fibula of the test leg and the examining table

Palpation of ST ligament

The position of the participants were side lying, flexion hip and knee 90° of the ST ligament tension side. The lower leg extended the knee. The PT1 palpated the ST ligament by tracking imaginary line which was perpendicular to the midpoint between ischial tuberosity and sacrum 1 inch. (**Figure 3**)

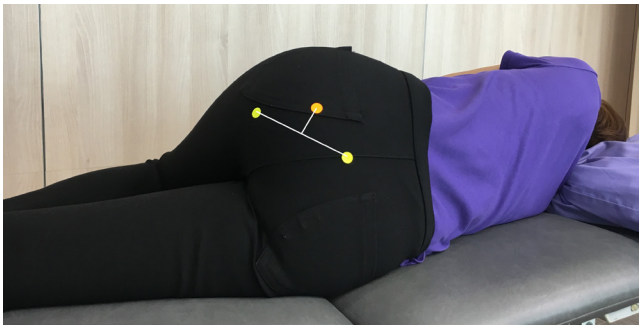

**Figure 3** The ST ligament (A) which showed the tracking imaginary line from the midpoint of ischial tuberosity to sacrum 1 inch.

In our pilot study, we investigated an agreement of ST ligament in ten subjects by palpation between PT1 and PT2. These two physical therapists marked ST ligament twice for each person (by a disappear ink pen). The agreement of palpation of the ST ligament by marked 2 times of the PT1 was 100% (PT2 was 80% of the agreement). If two marked were more than 50% of overlapped point, it mean that 100% coincide.

PT1 placed both thumbs on the ST ligament and slightly release pressure from the shoulder of the upper thumb (the dominant thumb was on the another thumb) (**Figure 4**)

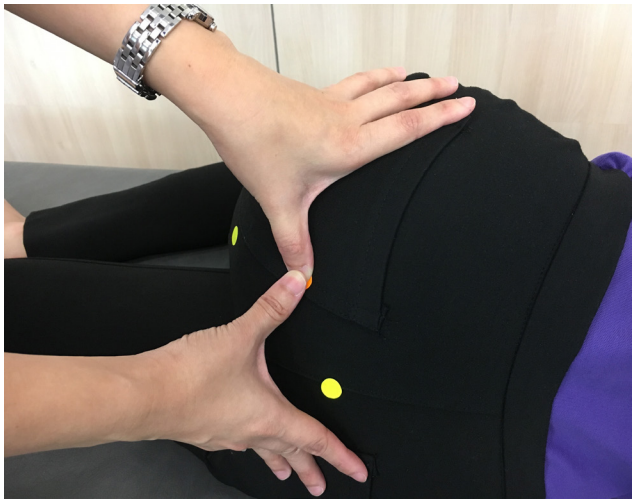

**Figure 4** Release ST ligament by place the dominant side on the PT's upper thumb

**Data analysis**

The data were normally distribution by Kolmogorov Smirnov test. We performed statistical analysis using SPSS (version 19). Comparison of distance from head of fibula to examining table between pre and post releasing ST ligament was performed using paired t test.

**Results**

Thirty participants (8 males and 22 females). Twelve persons had more ST ligament tension on the right, while the rest had more tension on the left. Descriptive data of their characteristics were displayed in **Table 1**

**Table 1** Participants' characteristics (n=30)

| Characteristics | Mean ± SD |
|---|---|
| Age (years) | 20.40 ± 1.10 |
| Weight (kilograms) | 54.65 ± 9.62 |
| Height (centimeters) | 162.42 ± 7.72 |
| BMI (kilogram/meter$^2$) | 20.65 ±2.90 |
| Leg-dominant (right/left) | 12/18 |

The mean of distance between the head of fibula to the table surface before releasing ST ligament was 12.42 ± 4.30 centimeters, while that after releasing such ligament was 9.00 ± 4.71 centimeters. (Table 2) The means of such distance between pre- and post-releasing the ST ligament were significantly different ($t_{df=29}$ = 5.26, $p$ > 0.00). (**Table 3**) The perpendicular distance between the femoral condyle and the table in Faber test of the post-test after release ST ligament was less than that of the pre-test.

**Table 2.** Mean, Standard deviation and standard error mean of the distance between head of fibula to couch surface before and after releasing ST ligament in 30 healthy subjects

| position | Mean (cm.) | SD | Std. Error Mean |
|---|---|---|---|
| Faber before | 12.42 | 4.30 | .78 |
| Faber after | 9.00 | 4.71 | .86 |

**Discussion and Conclusion**

The present study was to evaluate the effect of releasing ST ligament on the distance of head of fibula measured in the Faber test position. Mean and standard deviation between head of fibula to table surface before and after releasing ST ligament were 12.42, 9.00, respectively. This result of this present study demonstrate that releasing ST ligament significantly increased position of hip in Faber test, by ($p$<0.0001). Our participants were healthy subjects who were not pain during the Faber test position. However, they showed the different tension of legs by the distance from head of fibula to the table.

Function of the SIJ is to transfer loads between the spine and legs[8], allow shock and shear absorption and minimize energy for gait. Changing from quadrupeds to bipeds for allowing activities in humans (e.g. standing, sitting, walking) adaptation of pelvis (e.g. ilium, pubis, ischium, ligaments and muscle are increased stability of pelvic girdle[12]. For stability, 1993 Snijders CJ**.** et al. [6] suggested a self-bracing effect or phenomenon which protects the SIJ against shear loading. The model included a large numbers of muscles and ligaments such as the gluteus maximus, piriformis muscle, ST, sacrospinal, and long dorsal and interosseous sacroiliac ligaments, which can be tested with the Faber's test[6].

The Faber test or sign of four is the standard special test for assessment of sacroiliac joint[13,14]. Its position of knee is flexed, ankle is placed on the opposite of thigh, the hip in flexion, abduction and external rotation. Dreyfuss 1996, Broadhurst, 1998, Broadhurst, 1998 found that the sensitivity were 69%, 77%, 50%, respectively, and the specificity were 16%, 100%, 100%, respectively[11]. If the distance of the knee from the table was high, the limitation of SIJ may be the secondary problem of low back pain. Decreased tension of the ST ligament should increase sacrum nutation[7] and LBP region related to this ligament[15]. This research was conducted to released the ST ligament in 30 healthy subjects at the affected side which had ST ligament more tighten than the other side. The mean and standard deviation of the distance from head of fibula to the examining table in Faber's test before-after releasing ST ligament were 12.42±4.3, 9.0±4.71 cm, respectively.

**Table 3** Paired T test between before and after releasing ST ligament in 30 healthy subjects.

| | Paired Differences | | | | | *t* | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Std. Error Mean | 95% Confidence Interval of the Difference | | | |
| | | | | Lower | Upper | | |
| Faber before-after | 3.42 | 3.56 | .65 | 2.09 | 4.74 | 5.26 | .0001 |

The ST ligament which attached sacrum, ilium and coccyx to ischial tuberosity, has close anatomical relations with erector spinae/ multifidus gluteus maximus, biceps femoris muscle, contralateral of thoracolumbar fascia and latissimus dorsi[13]. The main movements in the SIJ are forward-backward rotation of sacrum relative to the iliac bones or nutation-counternutation. Nutation is the movement for prepare the pelvis for increased loading by slackened of ST ligament.

This study demonstrated that releasing the ST ligament could be increased the action of Faber's test. If low back pain patients who were suspected of counter-nutation of sacrum, releasing ST ligament may decreased pain.

**Acknowledgement :** The concept of this study follows the Kinematic Linkage Muscle Imbalance which is originated from Ass. Prof. Preecha Danvarjor.

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