

A Japanese Stretching Intervention Can Modify Lumbar Lordosis Curvature

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Study Design: Eighteen healthy male adults were assigned to either an intervention or control group.

Objectives: Isogai dynamic therapy (IDT) is one of Japanese stretching interventions and has been practiced for over 70 years. However, its scientific quantitative evidence remains unestablished. The objective of this study was to determine whether IDT could modify lumbar curvature in healthy young adults compared with stretching exercises used currently in clinical practice.

Summary of Background Data: None of previous studies have provided data that conventional stretching interventions could modify spinal curvatures. However, this study provides the first evidence that a specific form of a Japanese stretching intervention can acutely modify the spinal curvatures.

Methods: We compared the effects of IDT, a Japanese stretching intervention ($n = 9$ males), with a conventional stretching routine ($n = 9$ males) used widely in clinics to modify pelvic tilt and lumbar lordosis (LL) angle. We measured thoracic kyphosis (TK) and LL angles 3 times during erect standing using the Spinal Mouse before and after each intervention. IDT consisted of: (1) hip joint correction, (2) pelvic tilt correction, (3) lumbar alignment correction, and (4) squat exercise stretch. The control group performed hamstring stretches while (1) standing and (2) sitting.

Results: IDT increased LL angle to 25.1 degrees (± 5.9) from 21.2 degrees (± 6.9) ($P = 0.047$) without changing TK angle (pretest: 36.8 degrees [± 6.9]; posttest: 36.1 degrees [± 6.5]) ($P = 0.572$). The control group showed no changes in TK ($P = 0.819$) and LL angles ($P = 0.744$).

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Conclusions: IDT can thus be effective for increasing LL angle, hence anterior pelvic tilt. Such modifications could ameliorate low back pain and improve mobility in old adults with an unfavorable pelvic position.

Key Words: lumbar lordosis, stretching exercise, Isogai dynamic therapy

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Lumbar lordosis (LL) is 1 of the 3 curvatures forming the “S” shape of the spinal column. The “S” shape plays an important role in controlling the line of gravity. If the thoracic kyphosis (TK) becomes more round and LL flattens, the line of the gravity, projecting from the center of the mass toward the ground,¹ shifts anteriorly, which can interfere with balance.^{1–3}

One approach to correcting such a change in posture is to walk with greater knee flexion and project the gravity line behind the knee joints.^{1–3} However, such postural changes can excessively activate several leg muscles and cause fatigue in ankle and knee extensors, resulting in an energetically inefficient gait.^{3,4} In addition, muscle strength and body balance are associated with LL in old adults.^{3,5} Therefore, maintaining the natural curvatures of LL is important for the execution of activities of daily living at all ages.

Many young and old adults have an unbalanced posture due to inappropriate posterior pelvic tilt.² An unbalanced habitual posture can interfere with the coordination of muscle recruitment, resulting in muscle and ligament contractures and an abnormal pelvic tilt.^{6–8} Stretching could restore the original length of shortened muscles and ligaments, re-position the pelvis anteriorly, and normalize lumbar spine alignment. Although the stretching-mediated restoration of pelvic alignment is an attractive hypothesis, stretching of the abdominal and hamstring muscles has so far failed to modify lumbar spine alignment in healthy young adults.^{6–8}

Isogai dynamic therapy (IDT) is a traditional Japanese stretching-based manual intervention. Anecdotal and undocumented clinical evidence accumulating for over 70 years suggests that IDT can normalize misaligned spinal curvatures. Previous stretching interventions were designed to improve flexibility of muscles attaching to the pelvis.^{6–8} In contrast, IDT uses a unique stretching technique. First, it resolves contractures in muscles and ligaments that control

pelvic tilt in the sagittal direction. Second, through manipulation, it adjusts pelvic tilt and lumbar spine curvature. However, scientific quantitative evidence supporting IDT's effectiveness is lacking. Therefore, the purpose of this study was to determine whether IDT could modify lumbar curvature in healthy young adults compared with stretching exercises used currently in clinical practice.

MATERIALS AND METHODS

Eighteen healthy male adults were recruited for this study. Human research ethics committee at Waseda University approved the protocol of this study. The subjects signed an informed consent that was in accordance with the Declaration of Helsinki and participated in this study. The subjects were assigned to 1 of 2 groups: (1) IDT group ($n = 9$; mean [\pm SD] age: 29.3 [8.1] y; height: 1.75 [0.06] m; mass: 70.0 [9.7] kg); (2) control group ($n = 9$; age: 28.2 [10.0] y; height: 1.73 [0.06] m; mass: 69.8 [9.7] kg). For the postural measurement, subjects assumed an erect standing position and a technician measured the TK and LL angles, each 3 times, using the Spinal Mouse (v. 3.32, Idiag AG, Fehrlitorf, Pfäffikon, Switzerland) (Fig. 1).

A certified Isogai dynamic therapist, with 12.5 years of IDT experience, administered IDT. Figure 2 shows the 4 exercises: (1) hip joint correction; (2) pelvic tilt correction; (3) lumbar alignment correction; (4) squat exercise stretch.^{9,10} Hip joint correction: subjects were supine with 1 knee and hip flexed on one side and the other leg extended. The therapist applied pressure to the lateral aspect of the flexed knee to the direction of the straight leg and the floor for 5 seconds with 3 repetitions for each leg, stretching the tensor fascia lata and iliobibial band. This

maneuver also helped resolve the tightness in the gluteus minimus, medius, and maximus and piriformis and adjust the alignments of the hip joints. Pelvic tilt correction: subjects sat on the heels. With the knees strapped, subjects reclined on a cushion adjusted to an individual height and held this position for 10 minutes, stretching the quadriceps, abdominals, serratus anterior, intercostal, and pectoralis major and minor (Fig. 2B). This stretch intends to tilt the pelvis anteriorly. Lumbar alignment correction: subjects were supine with a ceramic pillow under the third lumbar vertebra with straps around the ankle and above and below the knees (Fig. 2C). The 10-minute-long exercise stretches muscles, ligaments, and tissues around the lumbar spine and increases the LL angle. Therefore, the pelvic tilt and lumbar alignment corrections targeted the same muscles but in a different way. Squat exercise stretch: subjects faced the wall with knees flexed 90 degrees, elbows flexed 40–45 degrees, strapped behind the back (Fig. 2D). The exercise lasted 10 minutes and stretched the hip flexors and abductors.

Because the purpose of the study was to show the effectiveness of IDT compared with a method currently used in clinical practice, the control group performed 2 types of hamstring stretching exercises to manipulate lumbar curvature: (1) sitting and (2) standing stretches.⁶ Subjects performed two, 30-second-long trials for each stretch, with 30 seconds of rest between trials. For the sitting stretch, subjects sat on an examination table with knees flexed and feet on the floor slowly extending one knee and leaving the other foot in contact with the floor (Fig. 3A). The knee extension progressed until the subject sensed a tolerable but somewhat uncomfortable tightness in the hamstrings of the straightened leg.

In the standing stretch, subjects assumed a tandem position with one foot 10 cm in front of the other (Fig. 3B). One knee was extended and the other knee was slightly flexed. Subjects slowly leaned forward with the back straight and hands on the thigh of the front leg. Subjects continued the trunk flexion until a tolerable but somewhat uncomfortable tightness appeared in the hamstrings.

After the IDT and the control interventions, the same technician re-tested the spinal curvatures 3 times using the Spinal Mouse. The average of the 3 trials was used in the analysis.

We compared the pretest TK and LL angles between the 2 groups using an independent sample *t*-test for each comparison at $P < 0.05$ (SPSS, v 21.0; IBM, Armonk, NY). The main analysis consisted of a group (IDT, control groups) by location (TK, LL), and time (pretest, posttest) analysis of variance (ANOVA) with repeated measures on the last 2 factors followed by a Tukey posthoc contrast at $P < 0.05$.

RESULTS

The pretest TK ($P = 0.296$) and LL ($P = 0.315$) angles were similar in the 2 groups. There was a 3-way group, location, and time interaction ($P = 0.01$). IDT

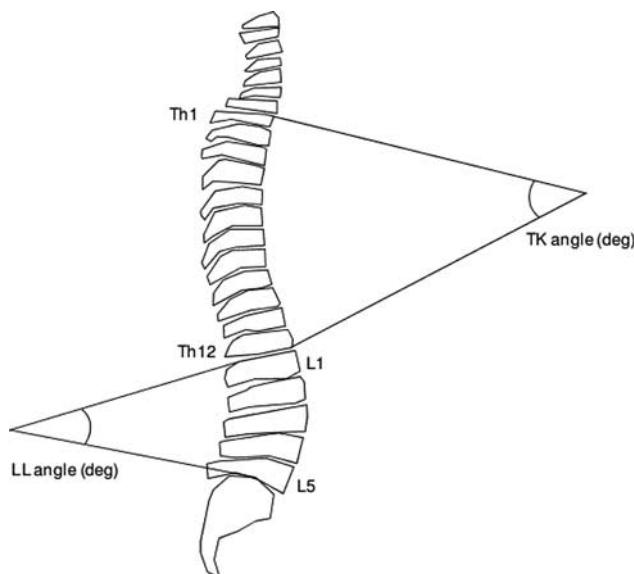


FIGURE 1. Definition of spinal curvatures: thoracic kyphosis (TK) and lumbar lordosis (LL). The TK angle is a cumulative angle of Th1 through Th12. The LL angle is a cumulative angle of L1 through L5.

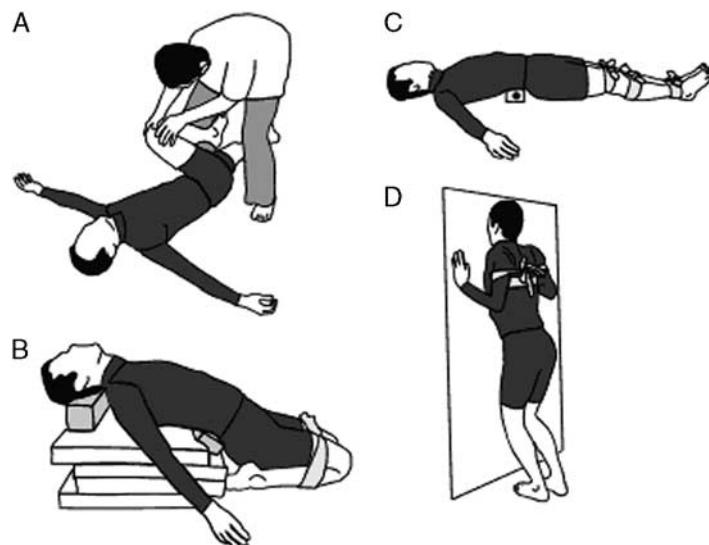


FIGURE 2. Exercises used in Isogai dynamic therapy: (A) hip joint correction, (B) pelvic tilt correction, (C) lumbar alignment correction, and (D) squat exercise stretch.

increased LL angle by 18.4% to 25.1 degrees (± 5.9) from 21.2 degrees (± 6.9) ($P = 0.047$). The LL angle increased in 8 out of 9 subjects (range, 1–13 degrees). IDT did not affect the TK angle (pretest: 36.8 degrees [± 6.9]; posttest: 36.1 degrees [± 6.5]) ($P = 0.572$).

In contrast, hamstring stretching exercises did not modify TK and LL angles. The control group showed no changes in the TK (pretest: 40.0 degrees [± 5.7]; posttest: 39.8 degrees [± 5.7]) and LL (pretest: 24.4 degrees [± 6.3]; posttest: 24.0 degrees [± 8.0]) angles (TK: $P = 0.819$; LL: $P = 0.744$).

DISCUSSION

Conventional stretching protocols have been mostly unsuccessful for modifying spinal curvatures. The present study provides the first evidence that a specific form of stretching technique can acutely adjust postural alignment in healthy young adults by increasing the LL angle 18.4% or 4 degrees. Consistent with previous data, IDT had a focal effect on LL without affecting TK.⁵ IDT targets muscles and ligaments that are known to pull the pelvis anteriorly or posteriorly. In addition to the dynamic stretching element, the pelvic tilt and lumbar alignment corrections probably also influence the pelvis and LL through a static positioning effect. It is therefore likely that a combination of these 2 effects increased the LL angle and tilted the pelvis anteriorly. A lack of change in the TK angle suggests a lower or no sensitivity of this structure to a manipulation focusing on anterior pelvic tilt.⁵

We used the Spinal Mouse to measure the spinal curvatures in healthy young male adults. The LL and TK values of the pretest in IDT group were similar to those (LL: 17.4 degrees [± 10.3]; TK: 38.3 degrees [± 7.2]) reported in a previous study¹¹ using the same methodology in healthy young subjects. However, the LL angle after

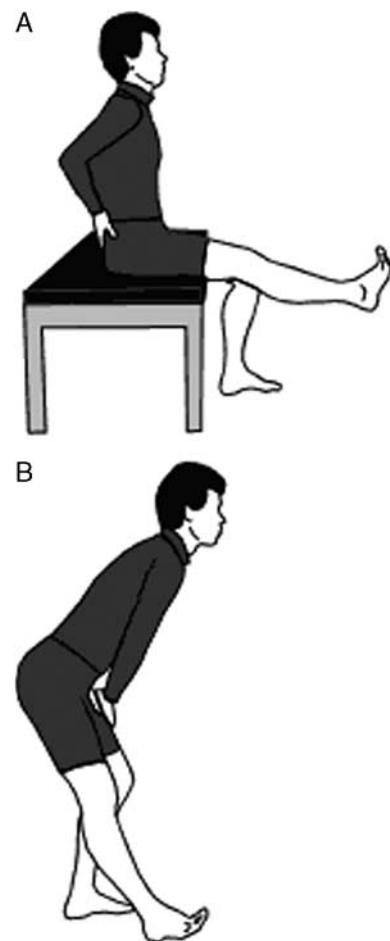


FIGURE 3. Hamstring stretching exercises used in the control group: (A) sitting stretch and (B) standing stretch.

the therapies was larger than reported by Hakuta and Sato¹¹ (25.1 vs. 17.4 degrees), suggesting that the increase in the LL angle was most likely the result of IDT. In contrast to the IDT effects but in agreement with a previous study,⁶ we observed no changes in the TK and LL angles following the control intervention consisting of hamstring stretching exercises recommended for the lengthening of shortened hamstrings and for realigning the lumbar spine posture.

One limitation of the present study is that it did not examine the mechanism of how IDT increased 4 degrees of the LL angle. We did not directly measure the actual magnitude of change in anterior pelvic tilt. However, we found an increase in LL angle after IDT, and suggest that such increases are associated with pelvic tilt, as demonstrated by several studies.^{5,12,13} Imagama and colleagues reported that a tilting of the pelvis in the sagittal plane can modify the LL curvature. Theoretically, forces generated by muscles and ligaments attaching to the pelvis can control pelvic tilt. Activation of the quadriceps femoris and intrinsic back extensors tends to tilt the pelvis anteriorly. In contrast, activation of the abdominal muscles tends to tilt the pelvis posteriorly.^{14,15} Eventually, anterior pelvic tilt can increase and posterior pelvic tilt can decrease LL curvature.^{5,16} In the present study, the hip joint correction exercise first resolved contractures from muscles and ligaments involved in setting sagittal pelvic position. The subsequent pelvic tilt and the lumbar alignment correction exercises in particular, acted through the stress-relaxation phenomenon and mobilized the lumbar motion segments. Compared with stretching exercises used previously, IDT emphasizes the mobilization of the lumbar motion segments, a key element of IDT to modify the LL angle.

CONCLUSIONS

The clinical relevance of the present results is at least 2 fold: prevention and treatment of low back pain and aging. It is known that a flatter LL is associated with low back pain.^{17,18} Thus, we suggest that IDT can be an effective therapeutic approach to preventing and reducing low back pain. In addition, although in this study we examined healthy young adults, the findings have relevance for old adults. Abnormal LL angle can affect old adults' ability to walk and maintain balance.³ It is conceivable that IDT could help some old adults' mobility by adjusting an unfavorable pelvic position. Future studies

will also examine the time course of adaptations to multiple sessions of IDT and will determine how long the IDT-induced postural changes last after the treatment.

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