

Title: Dramatic effects of a new home exercise to improve hip function for patients with osteoarthritis

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Purpose: An exercise program was developed to prevent or postpone surgery for patients with osteoarthritis (OA) of the hip. Worsening OA of the hip results in adduction contracture of the hip and the pelvis tilting forward. A closed kinetic chain (CKC) exercise involving the abductors was developed to prevent pelvic tilt in the coronal plane due to adduction contracture(Fig.1). Pelvic realignment exercise(Fig.2) and a back-and-forth figure 8 exercise(Fig.3) were developed to halt worsening OA of the hip. The pelvic realignment exercise and the back-and-forth figure 8 exercise were performed prior to a CKC exercise involving the hip abductors as part of a new exercise program to improve hip function for patients with OA.



Fig. 1 CKC exercise involving the hip abductors

An open kinetic chain (OKC) exercise to strengthen the hip abductors involves raising and lowering the leg on the affected side. During this exercise, tilting of the pelvis was noted in the coronal plane. The abductors may not be active during this exercise, so a closed kinetic chain (CKC) exercise involving the abductors was developed to prevent pelvic tilt in the coronal plane due to adduction contracture.

The patient assumes a lateral position with the leg on her affected side on top. She raises the foot of her top leg to the height of her hip. She then moves the foot forward 5–10° and rests it on the pillow. She then sticks her heel out and holds that position for 15 seconds. This exercise is performed 20 times a day.

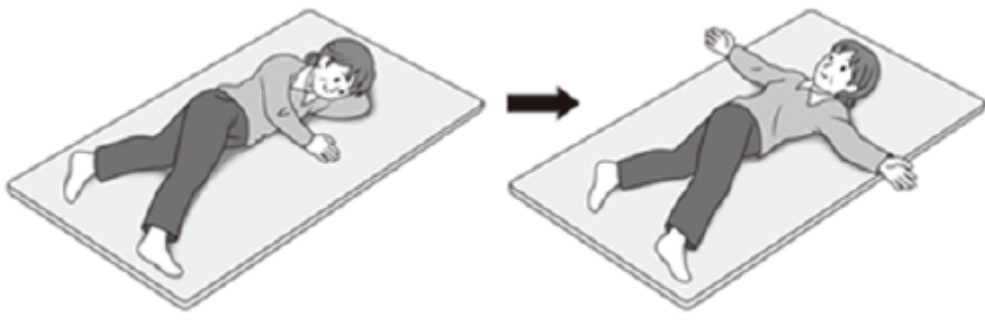


Fig. 2 Pelvic realignment exercise

When the pelvis is tilted forward, the paths that muscles follow may differ from their anatomical paths. Failure to correct pelvic malalignment before a strengthening exercise may exacerbate OA of the hip, so a pelvic realignment exercise was developed to do so. This exercise corrects apparent differences in leg lengths. The patient assumes a lateral position with her shorter leg on top. She then moves her top leg forward 30–45° and rests her front foot on the floor. She moves her top shoulder back without lifting her leg up and she maintains this position for 120 seconds.

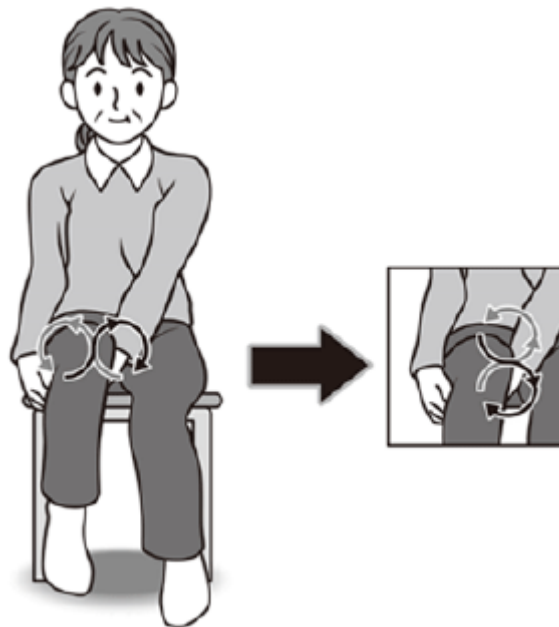


Fig. 3 Back-and-forth figure 8 exercise

A back-and-forth figure 8 exercise was developed to increase the restricted range of motion (ROM) of affected hip joints to more closely approximate the physiological ROM. This exercise better distributes the local load to more closely approximate its physiological distribution.

The patient sits in a chair. She places both hands at the rear of the thigh on the affected side (the side with poor hip abduction). She supports her thigh with both hands and moves her thigh in 4 directions (to one side, to the other side, up, and down) inwards and outwards to form a figure 8 pattern. The thigh is put through each loop of the figure 8 (one loop inwards, 1 loop outwards) 15 times for each direction as a cycle. 1–3 cycles a day.

Methods: This new exercise program was undertaken by 1,077 patients with OA of the hip who visited this Hospital from April 2011 to January 2014. Subjects had hip pain for longer than 3 months based on the Japanese Orthopaedic Association guidelines for osteoarthritis of the hip and the American College of Rheumatology classification criteria for the classification and reporting of osteoarthritis of the hip. Criteria for exclusion were any previous surgeries in the lower limbs, taking analgesics (if even one time), have received chiropractic treatment or other hip therapy, or having previously undertaken this exercise program. Patients were guided by a physical therapist and supervised while exercising once every 2 weeks. They were instructed to perform the exercises as a daily routine at home. After 12 weeks, patients were instructed to perform the exercises daily at home.

Two hundred and eighty-six subjects were divided into 2 groups, one with unilateral OA of the hip (Group I) and another with bilateral OA of the hip (Group II). In Group II, the more painful hip joint was analyzed. The sex, age, and Kellgren-Lawrence grade of joint arthritis of patients are shown in Table 1. Groups I and II were compared in terms of the Harris Hip Score (HHS), HHS pain score, pain on a numerical rating scale (NRS), range of motion (ROM), the hip open angle in Patrick's test, and the maximum strength of hip abductors at the baseline and at the 3-month follow-up. The HHS and HHS pain score were compared at the 1-year follow-up. None of the subjects received analgesics. Data were collected from electronic medical charts and analyzed by the Clinical Research Support Center Kyushu.

A paired t-test was used for statistical analysis. Stata ver. 13 (StataCorp., College Station, Texas) was used. $P < 0.05$ was significant.

Table 1 Baseline Characteristics of the patients studied

	No. females(%)	age(years)	K/L grade(N)			
			K/L 1	K/L 2	K/L 3	K/L 4
Group I (N=154)	133(86.4)	56.5±14.3	57	33	42	22
Group II (N=132)	124(93.9)	54.3±12.9	51	29	34	18

Group I : Group with unilateral OA of the hip (no pain in the opposite hip)

Group II : Group with bilateral OA of the hip (pain in the opposite hip)

★Patients with KL grade 1 arthritis had a Center-Edge angle smaller than 20°

Results:

Significant differences in the HHS, HHS pain score, pain on an NRS, the hip open angle in Patrick's test, and maximum muscle strength of the hip abductors at the baseline and at the 3-month follow-up were noted (Table 2). Group I had significant differences in abduction, adduction, external rotation, and internal rotation while Group II had significant differences in flexion, abduction, and internal rotation (Table 3). Significant differences in the HHS were noted for KL grades 1-3 at the baseline and at the 3-month follow-up but not for KL grade 4 (Table 4). Significant differences were noted among patients in Group II with a hip open angle smaller than 30° in Patrick's test but were not noted among patients in Group I. Significant differences were noted for patients in Groups I and II who had a hip

open angle larger than 30° (Table 5).

Significant differences in the HHS and HHS pain score of patients in Groups I and II were noted at the baseline and at the 1-year follow-up (Table 2).

Table 2 Difference in HHS, HHS pain score, pain on an NRS, angle in Patrick's test, and muscle strength at the baseline and follow-up at 3 months and 1 year

		Baseline	3 months	P value	1 year	P value
HHS	Group I	74.29 ± 17.76	81.20 ± 14.95(N=154)	<0.0001	87.08 ± 15.73(N=38)	0.003
	Group II	65.52 ± 17.32	76.80 ± 18.65(N=132)	<0.0001	82.06 ± 16.39(N=33)	<0.0001
HHS pain score	Group I	26.10 ± 14.43	31.70 ± 11.41(N=154)	<0.0001	36.26 ± 10.92(N=38)	0.004
	Group II	19.62 ± 13.03	28.79 ± 13.295(N=132)	<0.0001	31.70 ± 12.86(N=33)	<0.0001
NRS	Group I	4.32 ± 2.22	3.21 ± 2.22(N=150)	<0.0001		
	Group II	4.88 ± 1.98	3.61 ± 2.17(N=130)	<0.0001		
Angle in Patrick's test	Group I	51.44 ± 17.51	57.30 ± 17.82(N=111)	<0.0001		
	Group II	51.67 ± 17.80	57.75 ± 15.26(N=102)	<0.0001		
Muscle strength(Nm)	Group I	41.70 ± 18.05	48.16 ± 20.46(N=132)	<0.001		
	Group II	40.56 ± 16.82	47.36 ± 19.87(N=118)	<0.0001		

★Angle in Patrick's test: the hip open angle in Patrick's test

★Hand Held Dynamometer was used for evaluation of muscle strength

Table 3 Difference in ROM at baseline and follow-up at 3 months

		Baseline	3 months	P value
flexion	Group I	109.38±18.61	110.49±18.16(N=154)	0.16
	Group II	107.50±18.60	110.65±19.65(N=132)	<0.001
extension	Group I	10.93±7.45	11.69±6.85(N=154)	0.12
	Group II	10.46±7.25	11.38±7.29(N=132)	0.14
abduction	Group I	26.99±10.38	28.64±9.78(N=154)	0.009
	Group II	25.08±10.44	27.77±11.22(N=132)	0.001

adduction	Group I	10.20±4.95	11.15±4.97(N=154)	0.04
	Group II	9.92±4.90	10.73±4.41(N=132)	0.1
external rotation	Group I	34.41±11.83	36.45±12.65(N=154)	0.006
	Group II	35.86±12.15	37.30±12.29(N=132)	0.07
internal rotation	Group I	28.78±16.21	30.46±17.02(N=154)	0.04
	Group II	28.57±16.16	32.09±16.16(N=132)	<0.0001

Table 4 HHS evaluation according to the K/L grade

		Baseline	3 months	P value
K/L grade 1	Group I	81.58±17.47	87.93±11.086(N=57)	0.003
	Group II	71.73±15.37	84.22±14.34(N=51)	<0.0001
K/L grade 2	Group I	75.28±17.19	84.97±12.21(N=33)	0.004
	Group II	64.59±17.54	80.52±15.37(N=29)	<0.0001
K/L grade 3	Group I	67.64±15.31	74.05±14.45(N=42)	0.03
	Group II	60.13±17.21	69.50±17.90(N=34)	0.002
K/L grade 4	Group I	66.60±16.50	69.15±17.47(N=22)	0.26
	Group II	55.25±17.11	58.25±21.62(N=18)	0.6

★No change in the KL grade at the baseline and at the 1-year follow-up were noted.

Table 5 HHS evaluation according to angle of the hip in Patrick's test

		Baseline	3 months	P value
angle in Patrick's test <30°	Group I	76.67±18.97	82.67±12.72(N=15)	0.18
	Group II	67.13±17.32	74.40±20.74(N=15)	0.008
Angle in Patrick's test 30°-<50°	Group I	67.19±18.13	73.11±17.52(N=37)	0.04
	Group II	56.81±18.85	70.06±18.36(N=31)	0.003
Angle in Patrick's test <50°	Group I	76.17±17.29	84.55±13.77(N=58)	<0.001
	Group II	70.85±14.43	81.95±14.55(N=55)	<0.0001

★Angle in Patrick's test: the hip open angle in Patrick's test

Conclusions: This retrospective study revealed that this new home exercise program may improve hip function for patients with OA of the hip. Plans are to conduct a prospective controlled study to confirm the effectiveness of this program.