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Effect of Nordic Walking in Patients With Hip Osteoarthritis: A Preliminary Report From Japan

Sokichi MANIWA[1)], Yuko MICHIBATA[2)], Kohei KAWAMOTO[2)], Akihito NOGUCHI[2)], Taku TADENUMA[1)], Yasuo SAKAI[1)]

[1)] Department of Rehabilitation Medicine, Shimane University Faculty of Medicine

[2)] Division of Rehabilitation Medicine, Shimane University Hospital, 89-1 Enya-cho, Izumo, Shimane 693-8501, Japan

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Nordic walking（NW）is introduced as a feasible form of exercise that can be performed by anybody. The purpose of this study was to determine the effects of NW for 6 months in a small sample of the patients with hip osteoarthritis（OA）. Nine female patients with mild-to-severe hip OA were recruited from an outpatient clinic of a university hospital. Patients were encouraged to perform NW for 6 months. Outcomes, including Harris Hip Score（HHS）, 10 meter walking time, Timed Up & Go Test, and muscle strength were assessed at 3 and 6 months after intervention. Clinical evaluation and walking ability improved at 3 months and were maintained up to 6 months. Although hip abductor muscle strength did not improve significantly, knee extensor in involved side improved at 3 months significantly. NW improved walking ability and function of the joints in patients with hip OA.

Keywords: nordic walking, osteoarthritis, hip, fitness, walking poles

Corresponding author: Sokichi MANIWA, MD, PhD
Department of Rehabilitation Medicine, Faculty of Medicine, Shimane University, 89-1 Enya-cho, Izumo, Shimane 693-8501, Japan
Tel: +81-853-88-3047
Fax: +81-853-88-3076
Email: smaniwa@med.shimane-u.ac.jp

INTRODUCTION

Osteoarthritis（OA）of the hip is a progressive degenerative disease, and causes many complaints, such as pain, functional impairment, and limitation of activity of daily living（ADL）.

Exercise therapy is recommended as a first-line treatment in International Guidelines for OA［1, 2, 3, 4］. Pain-free movement is required for exercise therapy because excessive exercise causes pain and disability. Nordic walking（NW）is a style of walking that uses two specially designed poles and has been widely used as an option for physical therapy［5, 6, 7］.

Recently, the efficacy of NW in the patients with hip OA were reported［8, 9, 10］. NW is divided into European-style Nordic walking（ENW）and Japanese-style Nordic walking（JNW）by Japanese Nordic Walking League［11］. The difference between ENW and JNW includes the use of the poles: in JNW, the walker uses the pole vertically on the ground, like a cane; in contrast, in ENW, the walker thrusts each pole at a diagonal angle, producing active driving force［11］. Specifically, JNW method involves placement of the pole vertically near the heel of the forefoot. In contrast, ENW method involves placement of the pole diagonally near the heel of the forefoot. Of note, a significant increase in joint angular moments was found in gait analysis for ENW, suggesting a walking with longer-stride compared with walking without poles in normal subjects［11］. As this report suggested that ENW did not reduced the load on the knee joints, exer-

cise therapy is necessary to offer better joint protection for hip joints as well. With respect to muscle activities around the hip joint, Homma found significant decrease in JNW compared to ENW by the electromyographic studies [11]. Hence, JNW might be one of the recommended options for the patients with hip OA.

However, to the best of our knowledge, no clinical studies have specifically investigated the effectiveness of JNW in the patients with moderate to severe hip OA up to 6 months.

The purpose of this study was to evaluate the effects of JNW exercise on pain and hip function in patients with hip OA.

PATIENTS AND METHODS

Participants

Patients diagnosed with hip OA were recruited from an outpatient clinic for orthopedics in the university hospital. The inclusion criteria were as follows: (1) a diagnosis of primary hip OA or secondary hip OA due to acetabular dysplasia; and (2) the ability to walk without any assistive devices in daily life. The exclusion criteria were as follows: (1) a history of previous hip surgery (e.g., arthroplasty, osteotomy); (2) indication for hip replacement within one year; (3) severe metabolic, circulatory, or mental diseases that affect gait and activities of daily living; (4) necessity for daily use of anti-inflammatory analgesic; and (5) a history of physiotherapy in the past one year.

Nine female patients, who were interested in the exercise therapy using NW, were selected for this study. Those patients were classified according to Kellgren and Lawrence grade [12] using the X ray of the hip joint. In cases of bilateral OA, the most painful hip was chosen as the index joint.

Intervention

Prior to intervention, JNW was practiced according to the methods of the Japanese Nordic Walking League by a supervisor [11]. The pole length was body height (cm) × (0.64–0.67). The JNW method involves placement of the pole vertically near the heel of the fore foot. Patients were instructed to avoid the increased stride length to minimize the load upon the joints. Patients were guided to perform NW for at least 15 min, 3 times a week for 6 months and were also encouraged to keep diary to assess their continuation of exercise. The patients were asked to visit out-patient clinic at 3 months and 6 months for evaluation of the physical function and counseling for the exercise.

Outcome measure

This study evaluated numerous rating scale (NRS) of hip pain, Harris Hip Score (HHS) [13] for clinical evaluation, Timed Up & Go (TUG) test [14], ten-meter walking time for evaluation of walking ability, and muscle power of knee extensor and hip abductor using a handheld dynamometer (MicroFET® 2, Hoggan scientific, Salt Lake City, UT, USA), for functional evaluation. Each evaluation was repeated two times and the average values were used for comparison.

Evaluation for NRS of hip pain, HHS, TUG test, ten-meter walking time, and muscle power measurement were evaluated before intervention and after intervention at 3 and 6 months.

The adherence to NW exercise (number of exercise days / total number of days × 100) was calculated based on the training diaries by the patients during the 6-month intervention period.

Statistical analysis

Statistical analysis was performed using Wilcoxon signed-rank test in BellCurve for Excel® ver.2.0 (SSRI Co., Ltd. Tokyo, Japan) for the comparison of clinical evaluation scores, and statistical significance was accepted for values of $p < 0.05$.

RESULTS

There were 9 female participants, with a mean age of 63.9 ± 2.3 years, height 155.6 ± 4.0 cm, body weight 60.0 ± 7.8 kg, body mass index 24.9 ± 3.7.

Those patients were classified according to Kellgren and Lawrence grade (grade 2: 2 hips, grade 3: 3 hips, grade 4: 5 hips). Seven patients exhibited unilateral hip OA and 2 patients involved bilateral hip OA.

NRS of hip pain decreased from 4.0 ± 2.2 to 3.6 ± 2.3 at 3 months ($p = 0.72$) and 3.6 ± 1.2

at 6 months (p = 0.58) (Table 1). HHS improved from 67.9 ± 13.0 points to 77.0 ± 5.5 points at 3 months (p = 0.043) and 80.1 ± 11.4 points at 6 months (p = 0.04) (Table 2). Ten-meter walking time improved from 8.4 ± 1.3 sec to 7.4 ± 1.3 sec at 3 months (p = 0.046) and to 6.9 ± 0.9 sec at 6 months (p = 0.03) (Table 3). TUG improved from 9.5 ± 2.0 sec to 7.1 ± 1.1 sec at 3 months (p = 0.046) and 7.3 ± 1.1 sec at 6 months (p = 0.03) (Table 4). Hip abductor muscle strength in involved side slightly increased from 0.20 ± 0.11 (kg / body weight kg) to 0.22 ± 0.11 at 3 months (p = 0.46) and 0.24 ± 0.11 at 6 months (p = 0.50), and that of control side changed from 0.22 ± 0.10 to 0.26 ± 0.09 at 3 months (p = 0.12) and 0.29 ± 0.08 at 6 months (p = 0.11) (Table 5). Knee extensor in the involved side improved from 0.23 ± 0.08 to 0.33 ± 0.13 at 3 months (p = 0.02) and 0.33 ± 0.10 at 6 months (p = 0.02), and that of control side changed from 0.30 ± 0.11 to 0.35 ± 0.15 (p = 0.09) and 0.41 ± 0.11 (p = 0.02) (Table 6).

The adherence rate to NW was 46.8 ± 21.7% (5.6–73.6) according to the diaries. One unilateral hip OA patient with Kellgren and Lawrence stage 3 quitted NW due to discomfort around the hip joint at 3 months and remaining 8 patients completed NW for 6 months without aggravation of the symptoms. For the patient who dropped out at 3 months, her symptom disappeared soon after quitting NW exercise without medication.

Table 1. Numerous rating scale of pain.

Baseline	3 months	*P* Value (Baseline-3m)	6 months	*P* Value (Baseline-6m)
4.0 ± 2.2	3.6 ± 2.3	0.72	3.6 ± 1.2	0.58

NRS of hip pain decreased over time, but did not reach the significant difference.

Table 2. Harris Hip Score.

Baseline (Points)	3 months	*P* Value (Baseline-3m)	6 months	*P* Value (Baseline-6m)
67.9 ± 13.0	77.0 ± 5.5	0.04	80.1 ± 11.4	0.04

HHS improved at 3 months (p = 0.043) and at 6 months (p = 0.04).

Table 3. Ten-meter walking time.

Baseline (Seconds)	3 months	*P* Value (Baseline-3m)	6 months	*P* Value (Baseline-6m)
8.4 ± 1.3	7.4 ± 1.3	0.046	6.9 ± 0.9	0.03

Ten-meter walking time improved at 3 months (p = 0.046) and at 6 months (p = 0.03).

Table 4. Timed Up & Go Test.

Baseline (Seconds)	3 months	*P* Value (Baseline-3m)	6 months	*P* Value (Baseline-6m)
9.5 ± 2.0	7.1 ± 1.1	0.046	7.3 ± 1.1	0.03

TUG improved at 3 months (p = 0.046) and at 6 months (p = 0.03).

Table 5. Hip abductor muscle strength.

	Baseline (kg f / body weight kg)	3 months	*P* Value (Baseline-3m)	6 months	*P* Value (Baseline-6m)
Involved side	0.20 ± 0.11	0.22 ± 0.11	0.46	0.24 ± 0.11	0.5
Control side	0.22 ± 0.10	0.26 ± 0.09	0.12	0.29 ± 0.08	0.11

Hip abductor muscle strength in involved side slightly increased at 3 months (p = 0.46) and at 6 months (p = 0.50), and that of control side changed likewise.

Table 6. Knee extensor muscle strength.

	Baseline (kg f / body weight kg)	3 months	*P* Value (Baseline-3m)	6 months	*P* Value (Baseline-6m)
Involved side	0.23 ± 0.08	0.33 ± 0.13	0.02	0.33 ± 0.10	0.02
Control side	0.30 ± 0.11	0.35 ± 0.15	0.09	0.41 ± 0.11	0.02

Knee extensor in the involved side improved at 3 months ($p = 0.02$) and at 6 months ($p = 0.02$), and that of control side improved at 6 months ($p = 0.02$).

DISCUSSION

The present study demonstrated that JNW exercise for 6 months was tolerable for hip OA patients even with the advanced stage (e.g., Kellgren and Lawrence grade 3 or 4) and improved hip function, walking speed, and muscle strength of knee extensor significantly.

Bieler et al. [8] reported NW was superior to both strengthening exercise and home-based exercise for improving hip function in the patients with hip OA by observer-blinded, randomized controlled trial. In their study, the participants were not awaiting hip replacement and NW was performed 1 hour three times weekly with the intensity of 12–14 on the Borg scale for 4 months. Based on intention-to-treat-analyses, improvements in the number of chair stand test after intervention were greater in the NW group than in the strengthening exercise group at 12 months. Improvements in functional performance were also observed in NW group. Likewise, we obtained the similar results in functional performance as well as improvement in knee extensor muscle strength by Nordic walking exercise that had lighter burden than that of Bieler's study. Bieler et al. [8] reported that continuation rates of Nordic walking exercise at 2 months, 4 months, and 12 months were 72%, 70%, and 58%, respectively. On the other hand, continuation rate of exercise at 6 months in our study was 88.9% and was proved to be higher than those of Bieler's study. It is important for physiatrists to prescribe an appropriate, moderate exercise for OA patients with impaired walking capacity in order to raise exercise adherence and to maximize the effect. The findings of this study may allow physiatrists to choose JNW as one of the promising options for an effective land-based exercise.

Hansen et al. [15] reported that NW did not reduce the loading of the knee joint compared with walking without poles. They used three-dimensional gait analysis and showed that no reduction in the compressive loads and shear forces of the knee joint during walking with the use of poles was found. In their study, the subjects were all healthy experienced instructors of NW and a small but significant increase in joint angular movements was observed for NW, suggesting a more "bouncing" and wide-stride walk compared with normal walking. They thought that this may cause the increased ankle plantar flexor moment and the increased stride length during NW. They also mentioned that the hip range of motion was significantly increased during NW compared with walking without poles.

Hence, it is suggested that ENW should be used with caution as a physical training method for people with hip joint diseases as well.

Homma et al. [11] indicated the biomechanical and physiological advantages in JNW compared with ENW. They observed that the pelvic rotation angle was significantly larger in ENW than in JNW. They also found that hip abductor muscle activity was significantly decreased in JNW compared to ENW in the stance phase, and rectus abdominis muscle activity was significantly increased in both JNW and ENW and lumbar erector spinae muscle activity was significantly increased in JNW than in ENW in the stance phase. Hence, JNW reduced compensatory pelvic rotation and protected the hip joint by decreasing the muscle activity of the hip abductors.

Homma et al. [11] considered that pole placement in JNW elicited a reduced ground reaction force, which complements the activity of hip abductors, thereby reducing hip abductor muscle activity [16].

Study limitations

This study had several limitations. First, the present

study was a case-series and demonstrated the short-term effect of NW up to 6 months. We need a randomized control study to reveal the effectiveness of JNW compared to that of ENW. Second, the number of patients was small and the patients exhibited various stages of OA. We need enough participants with homogeneous stages of the disease to compare the efficacy of JNW in each stage of OA. Third, the adherence to NW in each patient was uneven. We should use special elaboration (e.g., making a telephone call to facilitate motivation) to keep exercise adherence.

CONCLUSIONS

JNW for 6 months improved walking ability, function of the hip joints, and bilateral knee extensor muscle strength in patients with hip OA. JNW may contribute to delay the progression of osteoarthritis and may protract the timing of total hip arthroplasty.

Ethical approval

This study was conducted in accordance with the principles of the Declaration of Helsinki and the Good Clinical Practice Guidelines. This study protocol was approved by the Shimane University Certified Review Board (approved number 20140116-1 (1489)). All participants provided written informed consent.

Conflict of interest

Authors had no conflict of interest.

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