Home Program of Physical Therapy: Effect on Disabilities of Patients With Total Hip Arthroplasty

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Objective: To study the effect of a home program of physical therapy.

Design: Nonrandomized control trial.

Setting: Home based.

Patients: Subjects had total hip arthroplasty (THA) for hip osteoarthritis (hip-OA) without THA failure, or cardiopulmonary, neurological, or cognitive problems. Twenty-three subjects (mean age 63.4 years; mean post-THA period 793 days, 6 to 48 months) were divided into 3 groups matching with age, gender, and postoperative periods.

Intervention: The 6-week home program included range of motion (ROM) exercises, and low resistance isometric and eccentric exercises of hip abductors. Physical therapists prescribed ROM and isometric exercises for group A, all programs for group B, and no programs for the control group. The programs were modified every 2 weeks as necessary.

Main Outcome Measure: Hip ROM, maximum isometric hip abduction torque measured by Cybex II, gait speed, and cadence were evaluated.

Results: The practice ratio of the program was about 70% for both groups. Maximum isometric torque improved in the THA side of group A (p < .01) and the control group (p < .05), and on both sides in group B (p < .01). Gait speed and cadence also improved significantly. No correlation coefficient existed between practice days and the improvement ratio of the maximum torque.

Conclusion: The home program was effective in long-term post-THA.

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PAtIENTS who have total hip arthroplasty (THA) for hip osteoarthritis (hip-OA) usually have mild or moderate long-term impairments and disabilities postoperatively. The extent of disabilities was about 80 points according to the hip score of the Japanese Orthopaedic Association (JOA hip score; fig 1), about 90 points with the Harris score,1 and about 5.0 to 6.0 according to pain, range of motion (ROM), and walking ability factors of the Charnley score.2-4 The disabilities included contracture of hip joint, muscle weakness of hip abductors, pain, gain disorders, and inability to perform certain activities of daily living (ADL), such as putting on and off socks.

A home program of physical therapy is necessary for these patients; the program should be one that patients can do easily and safely in their homes without supervision.

We have prescribed a home program of physical therapy (fig 2) for patients with THA for hip-OA. The home program consists of (1) ROM exercises of hip flexion by bending the body forward and other similar movements; (2) isometric muscle strengthening exercises of hip abductors, hip extensors, and knee extensors, under low resistance of 20% to 30% of the maximum isometric muscle torque; and (3) eccentric contractile muscle strengthening exercises of hip abductors in the standing position.

The purpose of this investigation was to study the effectiveness of both the program itself and the method of instructing patients in how to carry out the program.

METHODS

Procedure

Forty-one patients had a THA for hip-OA at our medical center from February 1989 through February 1992. We contacted the 41 patients by telephone and asked that they visit our physical therapy department, where they were informed about this study and gave their consent to participate. Patients with any acetabular and/or femoral failure of the THA were excluded, as were patients with cardiopulmonary, neurological, or cognitive problems. The final study sample included 3 men and 20 women, who were divided into 3 groups closely matched by age, gender, and time since the THA. The home program was prescribed for groups A and B on both sides of the hip. Group A (8 patients) was given the same exercises as group A, plus eccentric muscle contractile exercises of hip abductors in the standing position on one leg. The control group (7 patients) was not given any home programs.

In the initial and the final evaluation, physical therapists prescribed ROM and manual muscle testing (MMT) for hip flexors, hip extensors, knee extensors, and others. Maximum isometric torque of hip abductors at the neutral position in the supine position was evaluated with the Cybex II.5 The lever arm of the dynamometer was applied to the distal thigh, with the pelvis and the opposite thigh immobilized by manual and belt fixation by 2 PTs. Gait speed and cadence were evaluated. Physical therapists also assessed pain and ADL using the JOA hip score.

Physical therapists explained the evaluation results to the subject easily to be understood. For the subjects in groups A and B, a PT prescribed a 6-week home program of physical therapy on both sides of the hip. The subject was provided with an illustrated guide on how to perform the exercises (fig
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1. PAIN (40 possible points)
   A. None or ignore it. :40
   B. Mild pain:
      no effects on ordinary activity, occasional pain. :30
   C. Moderate pain:
      pain with gait, but vanished with rest of short time. :20
   D. Marked pain:
      marked pain with gait, diminished with rest, pain at resting occasionally. :10
   E. Severe pain:
      spontaneous continuous pain. :0

2. RANGE OF MOTION OF HIP
   (20 possible points)
   A. Flexion:
      over 90° :12
      60 - 89° : 9
      30 - 59° : 6
      10 - 29° : 3
      less than 10° or malposition : 0

3. GAIT (20 possible points)
   A. Almost normal pattern and tolerance. :20
   B. Mild limping (possible 2km or 30min gait).
      no cane, almost no limitation of ordinary activity. :15
   C. Severe limping (possible 500m or 10-15min gait).
      with cane most of time. :10
   D. Severe limitation of gait, possible indoor activity, difficult for ordinary activity (two canes or crutches). :5
   E. Almost impossible of gait. :0

4. ACTIVITIES of DAILY LIVING
   (20 possible points)
   B. Abduction: over 30° : 8
      20 - 29° : 6
      10 - 19° : 4
      less than 10° : 2
      ankylosis or malposition. : 0
      With ease : 2
      Difficult : 1
      Impossible : 0

2). Subjects were usually instructed to perform the exercises twice a day for 15 to 20 minutes per session, and asked to keep a daily record of how often they did the exercises. Although subjects were not permitted to visit the physical therapy department during the 6 weeks, the PT contacted them every 2 weeks by telephone and modified the program as necessary.

The final evaluation was done at the end of the 6-week home program for the subject of groups A and B, and at 6 weeks after the first evaluation for the control group.

Fig 1. The hip score of the Japanese Orthopaedic Association (JOA hip score).

Fig 2. The prescription chart of the home program for patients of THA for hip osteoarthritis.
Table 1: Characteristics of Subjects

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th>Group B</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>THA side</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rt</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Lt</td>
<td>5</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td><strong>Revision</strong></td>
<td>5</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td><strong>Re-revision</strong></td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
| **(Bone graft)**     | 1       | 0       | 0       | $x^2 = 2.6660^*$
| **Opposite side**    |         |         |         |
| Normal               | 4       | 2       | 2       |
| OA (Ope -)           | 0       | 3       | 3       |
| OA (Ope +)           | 2       | 0       | 0       |
| THA                  | 2       | 3       | 2       | $x^2 = 10.388^*$
| **Age at THA, yr (SD)** | 63.8 (8.06) | 62.8 (9.78) | 63.7 (5.28) | $F = .0241^*$
| **Months after THA (SD)** | 26.1 (7.58) | 23.9 (14.90) | 29.6 (7.93) | $F = .4529^*$
| **Body Weight, kg (SD)** | 53.8 (7.21) | 58.4 (8.85) | 51.0 (2.90) | $F = 1.9385^*$
| **JOA hip score* (SD)** | 77.9 (7.4) | 83.5 (9.5) | 69.9 (16.1) | $F = 2.3416^*$
| **Home program period, days (SD)** | 43.8 (2.22) | 45.8 (7.19) | 39.4 (3.58) | $F = 2.8356^*$

Abbreviations: THA, Total hip arthroplasty; OA, osteoarthritis; Ope, operation such as osteotomy except THA; SD, standard deviation.
* The hip score of the Japanese Orthopaedic Association.
† Days from the initial evaluation to the final evaluation.
‡ Not significant.

Statistical Methods

For statistical analysis, we used paired t test, chi-square analysis, one-way and two-way analysis of variance (ANOVA), and Spearman correlation coefficient.

Subjects

There were no significant differences between the 3 groups regarding age, gender, period after THA, types of hip prosthesis, body weight, height, etc (table 1). Mean age was 63.4 years, and the mean period after THA was 26.4 months (range, 6 to 48 months). On the THA side, 17 subjects had first THA, 5 subjects had revision of THA, and 1 subject had re-revision of THA. Cementless prostheses were used on the THA side of all subjects—16 of Porous Coated Anatomic (PCA), 5 of Biological Ingrowth Anatomical Stem (BIAS), and others. On the opposite side, X-ray findings showed osteoarthritic changes of the hip joint on 8 subjects, previous THA surgery on 7 subjects, and no abnormal changes on 8 subjects.

RESULTS

We defined the practice ratio (%) of the home program as the percentage of the practice days to the total days of the home program period. The practice ratio was 70.1% for group A and 71.2% for group B (table 2). Many subjects in group B complained that the eccentric muscle contractile exercises were difficult to perform because of their unstable balance in the one-leg standing position caused by their weak hip abductor power. One subject each in group A and B complained of increased pain in the hip; consequently, the number of repetitions or resistance per exercise were reduced to half, and subjects completed the program.

The maximum isometric hip abduction torques of both sides were low on all three groups at the beginning of the program (fig 3), but improved significantly in the THA side from 13.4 to 16.6ft·lb in group A ($p < .01$), from 12.5 to 21.0ft·lb in group B ($p < .01$), and from 9.1 to 13.6ft·lb in the control group ($p < .05$). In group B, the maximum isometric hip abduction torque in the opposite side also improved significantly from 15.1 to 23.3ft·lb ($p < .01$). Group B was prescribed much more eccentric muscle contractile exercises, and the improvement in group B was greater than that in group A. The control group also gained improvement of the torque in the THA side, because subjects in this group seemed to be motivated for training as a result of their very weak hip abductor power at the initial evaluation. Range of motion of hip flexion did not improve in groups A and B (fig 4).

Gait speed improved significantly from 60.1 to 63.6m/min in group A ($p < .05$), and from 64.4 to 69.0m/min in group B ($p < .05$; fig 5). Cadence also improved significantly from 120.0 to 126.8steps/min in group A ($p < .05$), and from 121.5 to 131.3steps/min in group B ($p < .01$; fig 6). These improvements were considered to result from increase of hip abductor power and hip stability during stance phase of gait.

Table 2: Practice of the Home Program

<table>
<thead>
<tr>
<th>Practice ratio of the home program</th>
<th>Group A</th>
<th>Group B</th>
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<tbody>
<tr>
<td>49%</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>50%-69%</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>70%-79%</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>
| 80%-89%                           | 3       | 1       | $x^2 = 10.043 (p < .05)$
| 90%                               | 2       | 1       |
| **Average of practice ratio (SD)** | 70.1% (24.7) | 71.2% (18.1) |

Practice ratio of the home program: percentage of the practice days to the total days of the home program period.
Abbreviation: SD, standard deviation.

Fig 3. Change of the maximum isometric torque of hip abductors during the home program period: Mean values (ft·lbs) ± SD in each group are presented. ANOVA: THA side: $F_{1,6} = 11.229 (p < .01)$, $F_{1,6} = 3.832 (p < .06)$, $F_{1,6} = .995$ (NS); Opposite side: $F_{1,6} = 6.493 (p < .05)$, $F_{1,6} = 1.987$ (NS), $F_{1,6} = 4.61$ (NS) (factor A, period; factor B, group).
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The improvement ratio (%) of the hip abduction torque was defined as the percentage of the maximum isometric hip abduction torque at the final evaluation to that of the initial evaluation. There was no significant correlation coefficient between the practice days of the home program and the improvement ratio of the hip abduction torque of the THA side in groups A and B (table 3).

DISCUSSION

The concept of the home program was to provide practical methods to enable handicapped persons to maintain daily living activities. Also, the home exercise was a part of the medical rehabilitation program designed to improve impairments and disabilities. The concept of the home program of this study was the latter. The home program should be practiced safely, easily, accurately, and continuously by patients in their homes without any other help. Accordingly, we prescribed the home program to THA patients for hip-OA to be performed easily using the illustrated prescription, which consisted of ROM exercises by motions in daily activities such as sitting on a chair and bending body forward, isometric and eccentric contractile exercises of hip abductors, etc. Further, the PT contacted the patient by telephone every 2 weeks. Consequently, the practice ratio of the home program was satisfactory, about 70%, and we inferred that compliance for the home program by the subjects in groups A and B was fairly good.

There were almost no complaints and problems during the 6-week home program. The eccentric muscle contractile exercises in the standing position, however, were difficult to perform because of insecure standing balance. It seemed inadequate for the prescription for THA patients to include no other programs but the eccentric muscle contractile exercise.

For hip-OA patients, it is very important to reduce the stress
The absence of an effect on ROM of hip flexion could be explained by the possibility that the intensity of ROM exercises by bending body forward and other similar movements had not been great enough to improve ROM of the hip. Also, subjects already had good ROM of hip flexion, about 90° in long-term post-THA.

The correlation coefficient between the improvement of the hip abductor torque and the practice days of the home program was not significant. This could be explained by the possibility that the isometric exercises were done with relatively low resistance of 20% to 30% of the maximum isometric torque, and the muscle power reached the plateau of the improvement during the early phase of the home program. Therefore, it was necessary to revise the home program by gradually increasing the resistant load as the isometric muscle power progressed.

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References


Supplier

a. Lumex, Inc., 2100 Smithtown Avenue, Ronkonkoma, NY 11779.

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Table 3: Correlation Coefficient Between the Practice Days of the Home Program and the Improvement Ratio of the Maximum Isometric Hip Abduction Torque

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average practice days</td>
<td>30.8 (11.1)</td>
<td>32.1 (9.2)</td>
</tr>
<tr>
<td>of the home program (SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average improvement</td>
<td>144.1 (54.1)</td>
<td>174.2 (34.2)</td>
</tr>
<tr>
<td>ratio (%) of the</td>
<td>195.9 (162.9)</td>
<td>165.2 (40.2)</td>
</tr>
<tr>
<td>maximum isometric</td>
<td></td>
<td></td>
</tr>
<tr>
<td>hip abduction torque</td>
<td></td>
<td></td>
</tr>
<tr>
<td>THA side</td>
<td>-3.651*</td>
<td>-3.764*</td>
</tr>
<tr>
<td>Opposite side</td>
<td>-1.1592*</td>
<td>-1.1231*</td>
</tr>
</tbody>
</table>

* Not significant.

Abbreviation: SD, standard deviation.