Relationship Between Functional Tests and Knee Muscular Isokinetic Parameters in Patients with Patellofemoral Pain Syndrome

Sh. Goharpey, M.J. Shaterzadeh, A. Emrani and V. Khalesi

To measure quadriceps and hamstring muscle strength with Isokinetic dynamometer in patients with patellofemoral pain syndrome (PFPS) and also to examine the relationship between muscle strength and functional test scores and subjective assessment. In this case-control study a total of 30 subjects (15 healthy and 15 patients with diagnosed PFPS) completed Kujala questionnaire concerning subjective functional knee assessment. Then muscle strength was measured with Isokinetic dynamometer in sitting position during 10 to 90 degree of knee flexion in 60 and 120 degree per sec speeds. Finally two kinds of functional tests (step down and semi-squat) were performed by each subject. There was no relationship between functional test scores and Isokinetic strength assessment. There was a poor relationship between functional test scores and Kujala questionnaire score ($r = 0.47$ for semi-squat test and $0.37$ for step down test). The overall mean scores of quadriceps Isokinetic parameter in 60 degree per sec speed, functional test scores and Kujala subjective knee assessment scores was less in patients with PFPS. This study showed that both Isokinetic dynamometry and functional tests must be done individually in patients with PFPS.

Key words: Functional tests, Isokinetic dynamometry, Patellofemoral pain syndrome

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INTRODUCTION

PFPS is the most common knee injuries in patients referred to orthopedic and sport clinics (Loudon et al., 2002; Alaca et al., 2002; Frederesson et al., 1995).

The traditional treatment method for these patients was quadriceps muscle isometric or isotonic exercise in open and closed chains (Pincivero et al., 1997; Alaca et al., 2002; Keays et al., 2003). Recently, Isokinetic dynamometry and functional tests was performed to determine the extent of knee muscles weakness before treatment (Negrete and Erophy, 2000; Petschenig et al., 1998; Andersson et al., 2003).

The most important parameter in Isokinetic test is Hamstring/Quadriceps ratio (H/Q), which is about 1 (Aaggard et al., 1995; Ostenberg and Roos, 1998). In PFPS this ratio will be less than 1 means that there is a neuro-muscular deficit in agonist-antagonist contraction (Alaca et al., 2002; Loudon et al., 2002). As Tsiokanos et al. (2002) described, there is a significant relationship between knee extensor Isokinetic strength and functional tests.

Keays et al. (2003), Petschenig et al. (1998), Mattacola et al. (2002) and Juris et al. (1997) in their researches with Biodex system noticed that there is a positive relationship between quadriceps muscle strength (in different speeds) and functional tests after ACL reconstruction.

The aim of this study was to determine the Quadriceps/Hamstring, Isokinetic strength and its relationship with functional tests and Kujala subjective assessment in patients with PFPS.

MATERIALS AND METHODS

This case-control study was performed in 2005-2006 at Department of Biomechanics, Iran rehabilitation school. 30 non-athletic subjects (15 healthy and 15 patients with PFPS) aged between 20-30 years old participated. As we selected patients according to inclusion criteria and because Isokinetic tests was very difficult and aggravating pain, thus only 15 patients was selected among 43 who referred to clinic.

Inclusion criteria: Positive Clark test (Magee, 2005), periodic giving way, patella crepation, patellar medial and lateral border tenderness, retro patellar pain (especially after exercise), quadriceps muscle atrophy and patellofemoral joint pain within previous 6 weeks.

Exclusion criteria: Any inter-articular derangement, malunion after lower limb fracture, acute joint pain, treatment for major knee problems within the previous 6 month such as ligament reconstruction or meniscal tearing.

Patient selection: The patients diagnosed with PFPS, who met the inclusion criteria were given more information about the purpose of the study and were asked to participate. The personal consent was also taken for those who enrolled.

Data collection

Phase 1: Warm-up phase; This phase contained, 5 min stationary bicycling and muscle stretching (Quadriceps, Hamstring, Gastrocnemius and Iliotibial band), each muscle 3 times and each time 10 sec.

Phase 2: In this phase functional tests were performed. The sequence of tests was also altered to avoid fatigue induced by muscle activity. These tests were as follows:

A: Step down test: This test was done 20.5 cm step for 30 sec. The number of up-down steps was counted and recorded.

B: Bilateral squat: In this test, each patient flex the knee up to 90 degree and return to starting position (upright standing). The number of performance was recorded for 30 sec

Phase 3: In this phase, Isokinetic strength of knee muscles was assessed by Biodex dynamometer system in sitting position, during 10 to 90 degree of knee flexion (Pincivero et al., 1997; Mattacola et al., 2002; Petschenig et al., 1998; Keays et al., 2003) within two different speeds; 60 and 120 degree per sec (Petschenig, 1998; Keays et al., 2003). Three maximum eccentric and concentric contractions were given from quadriceps and hamstring muscles in both speeds randomly.

Phase 4: Each subject performed 5 min stationary bicycling as cool down phase.

Finally Kujala questionnaire scale was completed by patients as subjective knee assessment.

RESULTS

The most previous researches was done on small sample groups (n = 12 or 15), so we compared present results with the same other valuable researches.

Table 1 showed mean and standard deviation of physical characteristics of subjects.
Table 1: Physical properties of normal subjects and patients with PPFS

<table>
<thead>
<tr>
<th>Variables</th>
<th>Normal</th>
<th>Patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>23±0.4±1.98</td>
<td>23±4±2.35</td>
</tr>
<tr>
<td>Height</td>
<td>170±45×8.06</td>
<td>169±43±6.15</td>
</tr>
<tr>
<td>Weight</td>
<td>63±0.06×0.04</td>
<td>62±26±5.77</td>
</tr>
<tr>
<td>Lower limb length</td>
<td>81±0.4×0.79</td>
<td>82±56±3.69</td>
</tr>
<tr>
<td>BMI</td>
<td>21±89±2.08</td>
<td>21±74±2.7</td>
</tr>
<tr>
<td>Bilateral squat test (count during 30 sec)</td>
<td>15±0±2.87</td>
<td>14±0±2.28</td>
</tr>
<tr>
<td>Step test (count during 30 sec)</td>
<td>18±9±1.7</td>
<td>14±0±1.9</td>
</tr>
</tbody>
</table>

Table 2: Quadriceps/Hamstring ratio in two different speeds (60 and 120 degree per sec)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Normal</th>
<th>Patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>H/Q ratio during extension (60 degree per sec)</td>
<td>0.79±0.17</td>
<td>1.19±0.20</td>
</tr>
<tr>
<td>H/Q ratio during extension (120 degree per sec)</td>
<td>0.98±0.17</td>
<td>1.05±0.18</td>
</tr>
<tr>
<td>H/Q ratio during flexion (60 degree per sec)</td>
<td>0.51±0.11</td>
<td>0.84±0.19</td>
</tr>
<tr>
<td>H/Q ratio during flexion (120 degree per sec)</td>
<td>0.5±0.16</td>
<td>0.77±0.19</td>
</tr>
<tr>
<td>Hamstring isometric maximum peak torque</td>
<td>84.2±27.37</td>
<td>75.0±22.17</td>
</tr>
<tr>
<td>Quadriceps isometric maximum peak torque</td>
<td>157.4±45.07</td>
<td>111.8±41.08</td>
</tr>
</tbody>
</table>

H = Hamstring muscle, Q = Quadriceps muscle

Table 4: Pain intensity measured by VAS scale

<table>
<thead>
<tr>
<th>Pain</th>
<th>Normal</th>
<th>Patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>During step up-down</td>
<td>0</td>
<td>4.16±2.09</td>
</tr>
<tr>
<td>During sitting with knee flexion</td>
<td>0</td>
<td>5.96±1.45</td>
</tr>
<tr>
<td>During isometric contraction</td>
<td>0</td>
<td>1.63±0.99</td>
</tr>
<tr>
<td>Average</td>
<td>0</td>
<td>3.90±0.81</td>
</tr>
</tbody>
</table>

DISCUSSION

Isokinetic exercises could increase strength and power of muscles, but because these exercises are not functional, there is no relationship between power improvement and functional capacity. Present result was the same as other researchers (Alaca et al., 2002; Anderson et al., 1991; Ostenberg and Raos, 1998; Swaroop et al., 1992; Barber et al., 1990).

We noticed that there was no relationship between functional test results and isokinetic parameters of quadriceps and hamstring muscle in both 60 and 120 degree per sec. Because the speed of Isokinetic exercises was changed during the task, this result was obtained (Juris et al., 1997; Destaso et al., 1997; Anderson et al., 1991; Wilk et al., 1994; Tsiokanos et al., 2002). Another result of this study was no relationship between subjective assessment of knee function (Kujala questionnaire) and functional tests. This result was the same as Borsa et al. (1998) and Wilk et al. (1994). Also we noticed that there was a weak relationship between Kujala questionnaire score and functional test performance (Squat and Step-down). This result was the same as the findings of Noyes et al. (1991), Wilk et al. (1994), Borsa et al. (1998) and Sermert et al. (1999).

Present results about the presence of a reversed relationship between subjective assessment of knee function and pain scale was the same as other researches (Alaca et al., 2002; Holmer et al., 1995; Divir, 2004).

It means that functional activity capacity will increase as patellofemoral pain decreased. Result of comparison between Isokinetic parameters of knee muscles in healthy
subjects and patients with patellofemoral pain syndrome, showed that in patients group all Isokinetic parameters (peak torque, peak torque/body weight and muscle power) of quadriceps muscle, both concentrically and/or eccentically in 60 and 120 degree per sec were significantly less than healthy subject group. This result was the same as Alaca et al. (2002), Anderson et al. (2003), Dvir (2004) and Wilk et al. (1994).

The main causes of these results are as followed:

- In low speeds, patellofemoral joint exposed to high external load and high stress for a longer period that lead to quadriceps muscle inhibition.
- Quadriceps muscle inhibited due to low activation of muscle reflex are because of joint over loading and pain.

We noticed that eccentric/concentric activity ratio of quadriceps muscle in patients group decreased at both 60 and 120 degree per sec.

Malone (1992) and Dvir (2004) maintained that this decrease is related to selective quadriceps muscle inhibition due to pain, because of high eccentric torque and high stress in patellofemoral joint. This study was a basic one and now we continue the same research on sport injured athletes before and after functional and neuro-muscular training exercises.

REFERENCES


