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# Isokinetic strength training improves knee symptoms and function as evaluated with 2000 ikdc

## Abstract

**Background:** Knee pain is most common complaint in athletes which may be caused by physical activity and exercises with many other causative factors. Sports injuries may lead to decline in muscle strength. This loss of muscular strength is strongly associated with decline in athletic performance. Improvement in strength may result in improved physical functions in injured athletes.

Aim of this study was to evaluate the effectiveness of isokinetic strength training in athletes with knee pain.

**Subjects:** The average age of the athletes was 23.48 ± 4.71 years (Range: 18 - 34). Mean body mass of the athletes was 63.35 ± 15.52 kg (Range: 39 - 93.90). 25 male and 1 female athletes participated in this study.

**Methods:** 25 athletes with knee pain completed the isokinetic strength training sessions by using Biodex Isokinetic system 10 sessions on alternate day basis. International Knee Documentation Committee (IKDC) 2000 form was used to assess the functional status and symptoms of the athletes at baseline and after completing 10 sessions.

**Results:** The average IKDC score was 45.64 (Range20.68-62.06) at baseline and 84.08 (range 68.96- 93.1) after completion of 10$^{th}$ sessions. Significant improvement was there when paired sample T test was used to find out pre and post changes in individual items of IKDC. Most of the individual items improved significantly as $p$ value is <0.001.

**Conclusion:** Isokinetic strength training significantly improves knee symptoms, level of sports activities, and function in patients with athletic knee pain

**Keywords:** Athletes, Knee pain, Isokinetic training, Biodex, IKDC

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## Introduction

Sports are considered to be integral part of a healthy society. Professional and amateur sports nowadays have become more challenging due to increased number of sport events every year. This increased physical demand renders athletes vulnerable to musculoskeletal injuries.[1] Knee is one of the most commonly involved joint in such injuries as in all sports injuries ratio of knee injury is about 15–50%.[2] Non-traumatic knee pain is most common complaint in athletes which may be caused by physical activity and exercises with many other causative factors.[3] Most patient's complaint of patella being the source of pain. Patellofemoral pain syndrome can have many causes as overuse, poor tracking of patella and may be abnormal biomechanics and foot problems.[4] Muscular strains are also common injuries in adults which can contribute to dysfunction at knee joint and complaints of pain around knee joint.[5]

A recent study conducted in Pakistan about common sports injuries reported that 17% of all injuries in different sports were concerned with knee joint.[6] Incidence of knee injuries is 1 per 1000 in sports that do involve rapid cutting and stopping movements.[7] The dynamic stability of knee joint is mostly controlled by two muscle groups which are responsible for flexion and extension of knee joint the hamstrings and quadriceps respectively. These muscles play multiple roles during human locomotion which can be observed during normal walking as they work in both concentric and eccentric manner.[8] Management of athletic injuries could be conservative or surgical. Physical rehabilitation is an integral part of management of any sports injury. Conservative treatment includes rest, ice, compression, and elevation of the affected body part. Reduction of the symptoms i.e pain and swelling can be managed by using different modalities.[5] McDaniel & Dameron in 1980 explained that Quadriceps and hamstrings strength is important for knee functions and DeLorme emphasized that in some type of knee injuries exercises alone can provide optimum results without the need of a surgery.[9,10] Surgical interventions can be done to stabilize the knee joint after traumatic injuries and usually require physical rehabilitation after the surgery.[11]

Sports injuries may lead to decline in muscle strength.[12] This loss of muscular strength is strongly associated with decline in athletic performance and different studies have shown that improvement in strength may result in improved physical functions in athletes and older adults.[13] Dynamic strength of the muscles can be measured while moving through Range of motion (ROM) by using isokinetic dynamometer or different machines.[14] Isokinetic machines provide an effective way to overload your muscles. Isokinetic dynamometers have been used for strength testing and training as well. Muscular strength can be increased by simulating the training at different speeds by using isokinetic systems.[15] By measuring force productions at different constant velocities throughout Range of motion the force and velocity characteristic can be observed which is that force production will be reduced on increasing speeds.[16]

Many studies have been conducted on the use of isokinetic dynamometry to assess muscular strength and effects of training on physical performance and gait, in stroke patients, osteoarthritic patients, as well as healthy individuals. Several such studies have reported significant improvement in muscle torque production compared to non-exercisers.[17-21] There are several available methods to quantify the symptoms and

functional level of knee both objectively and subjectively. One of the subjective tools is The International Knee Documentation Committee (IKDC) 2000 Subjective Knee evaluation form. IKDC form was developed to evaluate the knee condition in term of symptoms, function, and sports activity in patients with knee problems. It can help in measuring a numerical value to easily interpret the functional status of the knee and a comparison can be possible by comparing the scores obtained before and after physical rehabilitation as a way to evaluate progress. This form is the standard form for all publications on results of treatment of knee injuries developed in 1987.[22]

IKDC is a reliable and valid instrument and can be used in all populations to assess knee status in terms of symptoms, everyday functions and sports activities.[23]

## Materials and methods

The design of the present study was single-group pretest-post trial. A total of 26 athletes with knee pain (25 male and 1 female) participated in the study with 1 drop out. The study was conducted according to the research guidelines outlined by Declaration of Helsinki and Pakistan Medical Research Council (PMRC). Ethical approval for the study was obtained from the ethics review committee of the Pakistan Sports Board. All subjects provided written, signed consent prior to their participation in the study. The average age of the athletes was 23.48 ± 4.71 years (Range: 18 - 34). Mean body mass of the athletes was 63.35 ± 15.52 kg (Range: 39 - 93.90). Other details can be seen in Table 1. Information regarding gender distribution, leg side involved, and sports practiced by the athletes are provided in Table 2.

**Table 1** Demographic details of the study participants

| Demographics | | | |
|---|---|---|---|
| | **Mean** | **St. Deviation** | **Range** |
| Age (yrs) | 23.48 | 4.71 | 18 - 34 |
| Body mass (kg) | 63.35 | 15.52 | 39.0 - 93.9 |
| Height (m) | 1.71 | 0.09 | 1.5 - 1.86 |
| BMI (kg/m2) | 21.65 | 4.78 | 16.1 - 34.9 |

**Table 2** Subject information

| **Gender** | |
|---|---|
| Male | 25 |
| Female | 1 |
| **Side Involved** | |
| Right | 11 |
| Left | 15 |
| **Sports Played** | |
| Football | 10 |
| Hockey | 7 |
| Badminton | 3 |
| Volleyball | 3 |
| Handball | 2 |
| Shotput | 1 |

The International Knee Documentation Committee (IKDC) 2000 Subjective Knee evaluation was used to assess the symptoms, sports activities, and function of athletes. Data was collected at baseline and after completion of 10 sessions of isokinetic strength training to investigate the changes in subjective knee evaluation scores.

### Training protocol

Isokinetic strength training was provided using the Biodex System 3 Pro (Biodex Medical Systems, Inc. NY, USA). Participants were trained on 5 different velocities (30°/s, 90°/s, 150°/s, 210°/s, and 270°/s for both knee flexion and extension. A total of 10 sessions were administered with a training frequency of 3 sessions per week. A familiarization was conducted for every subject before the first session. Prior to every training session, the subjects performed level treadmill walking at speed adjusted according to their height on Biodex Gait trainer followed by 5 repetitions of manual muscle stretching of the knee extensors and flexors given by the same physiotherapist.

The subjects were asked to sit in the dynamometer with upright spine while hip and knee joints were kept in 90 degree flexion. The exercise was performed unilaterally on the involved leg and five trials were done at all movement velocities for both flexion and extension tasks.

## Results and discussion

The sum of all items in IKDC knee evaluation form is used to assess the IKDC scores. Paired sample t test was used to compare pre and post different in individual items of IKDC score and for most of the items there is significant improvement as *p* value is less than 0.001 (Table 3).

**Table 3** Subjective knee status evaluation before and after isokinetic training

| | **Baseline (PRE)** | | **Post-training (POST)** | | **Pre vs. Post** |
|---|---|---|---|---|---|
| **Symptoms** | **Mean** | **SD** | **Mean** | **SD** | ***p* value** |
| Highest level of activity without pain | 1.4 | 0.5 | 3.1 | 0.4 | 0.001 |
| Frequency of pain | 3.2 | 1.2 | 7.6 | 1.2 | 0.001 |
| Intensity of pain | 2.5 | 1.3 | 7.6 | 1.0 | 0.001 |
| Swelling | 2.6 | 0.7 | 3.6 | 0.5 | 0.001 |
| Highest level of activity without swelling | 2.4 | 0.7 | 3.6 | 0.5 | 0.001 |
| Knee locking/catching | 0.8 | 0.4 | 1.0 | 0.2 | 0.245 |
| Highest level of activity without knee giving way | 2.2 | 0.9 | 3.5 | 0.5 | 0.001 |
| **Sports Involved** | | | | | |
| Highest level of regular activity | 2.2 | 0.7 | 3.4 | 0.5 | 0.001 |
| Effect of knee on: | | | | | |
| Go up stairs | 2.0 | 0.8 | 3.5 | 0.7 | 0.001 |
| Go down stairs | 2.4 | 1.0 | 3.6 | 0.6 | 0.001 |
| Kneel on the front of your knee | 2.0 | 1.2 | 3.6 | 0.5 | 0.001 |
| Squat | 2.2 | 1.1 | 3.5 | 0.5 | 0.001 |
| Sit with your knee bent | 2.0 | 1.0 | 3.5 | 0.6 | 0.001 |
| Rise from a chair | 2.2 | 1.0 | 2.6 | 1.2 | 0.265 |
| Run straight ahead | 2.5 | 1.0 | 3.6 | 0.5 | 0.001 |
| Jump/land on involved leg | 1.9 | 1.0 | 3.4 | 0.5 | 0.001 |
| Stop and start quickly | 1.8 | 1.0 | 3.5 | 0.7 | 0.001 |
| **Function** | | | | | |
| Current function | 3.0 | 1.0 | 8.7 | 0.9 | 0.001 |

The average IKDC score was 45.64 (Range: 20.68 - 62.06) at baseline and 84.08 (Range: 68.96 - 93.1) after completion of 10th session which shows a significant improvement in IKDC score (Figure 1). This signifies that isokinetic strength training can be used to significantly improve symptoms and functions in athletes with knee pain. A past study show has shown that IKDC score can predict functional outcomes in ACL reconstruction and rehabilitation by reporting the increase in IKDC score after 1 year follow-up about 91.2 (Range: 32.2 - 100).[24] (24) Many other factors such as severity of injury, duration of injury, and injury to non-dominant leg can affect the IKDC scores in different activities of daily living. The increase in IKDC score is linearly with baseline IKDC score; a higher score at baseline would produce a further high score after rehabilitation.

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However, the IKDC scores should be interpreted with caution as outlined by Ibrahim et al.[25] Another study has shown improvement in IKDC score after surgery in patients with anterior cruciate ligament injuries.[26]

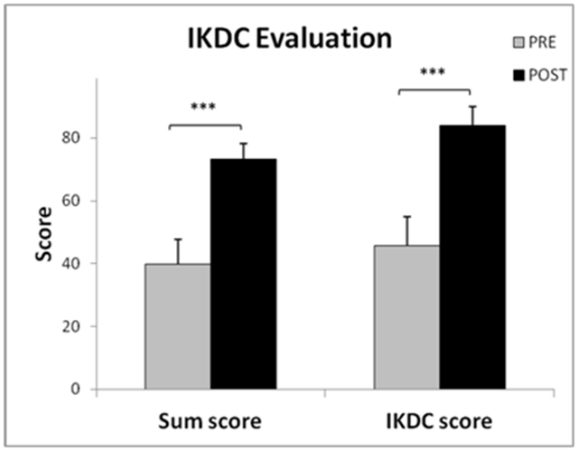


**Figure 1** Effects of isokinetic strength training on subjective knee evaluation through 2000 International Knee Documentation Committee (IKDC) form.

In terms of individual items of the IKDC, significant improvement were there in pre and post 'highest activity level without pain' in athletes after 10 sessions on IKDC score $p$ value < 0.001. The 'intensity of pain' was also improved significantly as $p$ value is 0.001 which can be a reason for improvement in function and reducing symptoms. Several studies showed that isokinetic strength training improves force production by contracting muscles and a greater torque which also can be reason for improved every day functions and improvement in sports activities.[17-21] Isokinetic exercises after ACL construction and conservative treatment after ACL injuries and two years follow up showed that IKDC score was higher in conservative group than was after reconstruction surgery.[27] The everyday functions improvement was significant ($p < 0.001$) in 'going upstairs', 'going downstairs', 'run straight ahead', 'sudden stopping and starting' and also 'jumping on involved leg'. There was no significant improvement in rising from chair while sitting after training. One possible reason for that can be that athletes were using uninjured leg to support the body weight during rising from chair before the training began.

Finally, 'current function level' improved significantly as a result of isokinetic training ($P$ <0.001).

## Conclusion

Isokinetic strength training significantly improved the functional status and reduced symptoms in athletes with knee pain. The current study provides evidence supporting the integration of isokinetic training in the rehabilitation plans of athletes with knee pain. It is recommended to conduct a randomized controlled trial with larger sample and multiple training options to confirm the findings of the current study.

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None.

## Conflicts of interest

None.

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