Exercise Program Proposal for the Rehabilitation of the Knee Joint after Medical Surgery for Cartilage Refine

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Abstract: The present study is geared towards designing a program that includes exercises for the rehabilitation of the knee joint after undergoing cutting off operations of the knee cartilage. A standardized experimental group from nine cases of knee cartilage injuries has been selected for the present study. The researchers used the experimental approach, using pre and post measure. An improvement in muscle strength working on the knee joint occurs in the case of contraction (20.13%) and in the case of extension (13.22%). An improvement in the knee joint motion range was in the case of contraction (51.35%) and in the case of Extension 31.25%. Also, threshold of pain associated with movements of the knee decreased to a low level and rate of improvement of 80%. The researchers recommend designing similar programs for the rehabilitation of injuries of sports various and using the suggested program at various rehabilitation centers.

Key words: Exercise program • Knee joint • Cartilage refine

INTRODUCTION

With the high increase in the number of heated sports’ competitions, the number of injuries among sportsmen and women increases as well. This is due to the fact that practicing sports exerts huge strain and pressure on muscles; joints; ligaments and muscle tendons. This, in turn, would possibly cause lots of chronic injuries. An injury, however, is considered one of the serious disabling handicaps that causes a decline in the player's level of fitness and skill performance that hinders him or her from training for long periods of time. Injuries of the joints are, therefore, of serious significance for sportsmen and women; as human movements in general and sportsmen's in particular, apparently depends on the basic movements performed by the joints and any injury in such joints would undoubtedly hinder the sportsman or woman from achieving his motor tasks successfully [1].

The knee is one of the complex and most vulnerable joints in the human body, because it connects femoral muscles to the ankle joints. Also, it carries the body weight. There are several other possible sports-related factors that would cause the knee to be vulnerable such as the sudden stops or rapid starts that require the players to move forwards or backwards, or take side movements in a time span less than a second. Also, the position of the knee joint represents a real challenge to those treating its injuries since it is; anatomically, a weak joint because it is located in the middle position between the femoral and the ankle joints. Therefore, it plays two different functions. It performs wide range motions together with carrying the heavy bodyweight. Despite its strength and tightness of structure, the knee joint can be vulnerable to various types of injuries when experiencing various violent sports movements. Statistics refers to the fact that the injury of the knee joint is common among sportsmen and women. It constitutes about 40.7% out of the total number of injuries in the Musculoskeletal system [2].

Consequently, injury of the knee cartilage is one of the commonest knee injuries during various sports competitions and it may be one possible cause to keep players totally away from sports championships as a result of the movements’ problems it causes to knee injured players [1].

Such an injury occurs mostly; unlike the case of the external knee cartilage, when the foot is in a steady position and the knee in a slightly bending position, while the whole body and the femoral bones are externally in a
revolving position; thus damaging part of the knee cartilage. The knee becomes, in turn, in a case that requires knee injured players to undergo surgical interventions, which are mostly followed by several setbacks that partly undermine the functional efficiency of such a joint; i.e. the capability of the working and anti muscular groups to generate strength necessary to reach the full range of movements, in addition to an accompanying acute pain during the stretching and contraction of the knee joint. This requires an immediate intervention to restore the functional efficiency of such a joint; as the more speedy the intervention is the fewer the setbacks become.

Hence, the role of rehabilitation for restoring the full function of this damaged body part becomes a must. This, however, depends basically on a precise assessment of the causes of the injury and possible methods of treatment with the aim of having the injured person capable of performing his/her motor functions and training tasks without, or at least with minimum, troubles.

Hence, the significance of studying such a case of injury becomes clear, as it is a widespread state of injury in numerous sports; such as Gymnastics, basketball, football, fighting games and many other sports fields.

Out of the researchers’ direct experience, as originally gymnastic and basketball players and their daily contact with players in various games, they recognized that the injury of the human knee cartilage is one of the commonest and most widespread injuries in the Egyptian playgrounds, to which players would be suddenly vulnerable.

**MATERIALS AND METHODS**

**The Study Sample:** A standardized group of nine cases of knee cartilage injuries has been selected for the present study. They were medically checked, before the rehabilitation program, to come to know how ready they are for starting the rehabilitation process after having cutting off operations done to them in their injured knee-cartilages.

Table 1 shows that the range of Skewness lies between ±3 for all of the femoral variables and acuteness of pain, in addition to muscle strength and range of motion in both of the bending and stretching movements. This clearly indicates that the sample participants are in an almost similar range on these variables.

**Sampling Criteria:** Participants are those who underwent knee cartilage cutting off operations. They attended the rehabilitating exercises during the experimentation process on regular basis.

**Study Objectives:** The present study seeks to set up a rehabilitating program that includes exercises for the rehabilitation of the knee joint after undergoing cutting off operations of the knee cartilage with the aim of:

- Restoring the full working muscular strength of the knee joint;
- Restoring the full motion range of the knee joint movement; and
- Ameliorating the acuteness of pain resulting from the internal knee cartilage injury after undergoing cutting off operations by means of.

**Hypotheses:**

- There are statistically significant differences between the pre and post measurements means in the working muscular on the knee joint in favor of the post measurement.
- There are statistically significant differences between the pre and post measurements of the motion range of the knee joint in favor of the post measurement.
- There are statistically significant differences between the pre and post measurements means in the reduction of acute pain resulting from the motor performance of the injured participants in favor of the post measurement.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Scenes</th>
<th>Deviation</th>
<th>Median</th>
<th>Mean</th>
<th>Harmony</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years</td>
<td>0.36</td>
<td>3.09</td>
<td>22.375</td>
<td>22</td>
<td>Harmonious</td>
</tr>
<tr>
<td>Length in Centimeters</td>
<td>1.09</td>
<td>7.53</td>
<td>175.75</td>
<td>173</td>
<td>Harmonious</td>
</tr>
<tr>
<td>Weight in Kilograms</td>
<td>0.29</td>
<td>14.41</td>
<td>72.375</td>
<td>71</td>
<td>Harmonious</td>
</tr>
<tr>
<td>Femoral Circumference</td>
<td>-0.75</td>
<td>6.88</td>
<td>42.44</td>
<td>44.15</td>
<td>Harmonious</td>
</tr>
<tr>
<td>Muscle strength KG</td>
<td>-0.79</td>
<td>8.12</td>
<td>24.125</td>
<td>26.25</td>
<td>Harmonious</td>
</tr>
<tr>
<td>Range of Motion in points</td>
<td>-1.37</td>
<td>2.72</td>
<td>56.625</td>
<td>57.5</td>
<td>Harmonious</td>
</tr>
</tbody>
</table>
The Pilot Study: The researchers conducted a pilot study on two cases of knee joint injury out of the original sample; provided that they were of the cases which underwent surgical cutting off operations, during the period of time from 28th of January, 2010 to 6th of February, 2010.

The Pilot Study Objectives:

- Ensuring the safety and reliability of the tools and equipment used in measurements.
- Identifying how far knee injured players are responsive to the movements' exercises used.
- Assessing the difficulty level of training exercises used in the program.
- Identifying the possible difficulties that would arise during the administration of the proposed program.

The Experimental Study: The researchers conducted an experimental study on 9 cases. These cases include those who underwent cartilage cutting off operations during the time period from 9th February, 2010 to 17th of August, 2010.

Methods of Collecting Data:

- Form of collecting participants' particulars of the sample under study.
- The Dynamometer apparatus for measuring the muscular of the front and the back muscles working on the knee joint in kilograms.
- Goniometer apparatus for measuring the range of movement of the knee joint in angular points.
- Visual Analogue Scale for measuring the pain level in points; appendix.
- The rehabilitating program.

RESULTS AND DISCUSSION

The First Hypothesis: Tables 2 and 3 indicate that there are statistically significant differences between the mean scores of the Pre and the Post tests, for the experimental group, in the value measurements of the muscular of the contraction and stretching muscles in the knee joint. The calculated T-values; for all of the contraction and stretching muscle groups in the knee joint, were greater than their corresponding tabular ones at a significant level of 0.05. The percent of improvement of the contraction muscles reached 20.13% while the stretching ones reached 13.22% for the injured knee.

This, however, shows that a remarkable improvement took place in the value of muscular for the experimental group. The researchers, here, attributes this amount of improvement to the variation of the methods and strategies used in developing the muscular of the contraction and stretching muscles in the knee joint, which led to the acquisition of muscular clearly shown in the muscle anatomical plane. This was one of the most important goals the suggested rehabilitation program sought to achieve. Moreover, the results indicate that the gradual rehabilitation of muscular capacity led to the stimulation and preparation of the fiber packages to partially and fully cope with the movements' loads. This refers to the fact that the more the rehabilitation program is administered to all of the muscular work, the more they develop and improve since the angles which the muscle work on greatly differ from each other where one part of the muscle is responsible for initiating the movement [3]. Moreover, it helps it to continue together with its responsibility for its completion, having each part working at a different angle. The same, also, confirms what came to refer to as the rehabilitating exercises helps rebuild the muscular of the muscles concerned [4].

Table 2: Significant differences between the Pre- and the Post score means in the variable of femoral circumference of the experimental sample (N = 9)

<table>
<thead>
<tr>
<th>Group</th>
<th>Variable</th>
<th>Joint</th>
<th>Std Dev</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Mean</th>
<th>Mean Difference</th>
<th>Percent of Change</th>
<th>T.test</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>Femoral Circumference</td>
<td>Injured Knee Joint</td>
<td>45.15</td>
<td>2.11</td>
<td>43.66</td>
<td>1.64</td>
<td>2.49</td>
<td>5.39%</td>
<td>2.79</td>
<td>Significant</td>
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<tr>
<td>Tabulated (T) value = 2.31, significant at 0.05</td>
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</table>

Table 3: Significant Differences between the Mean Scores of the Pre- and the Post Administration of the Program in the Variable of Muscular strength for the Experimental Group (N = 9)

<table>
<thead>
<tr>
<th>Group</th>
<th>Joint</th>
<th>Variable</th>
<th>Movement</th>
<th>Std Dev</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Mean</th>
<th>Percent of Change</th>
<th>Mean Difference</th>
<th>T.test</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>Injured Knee Joint</td>
<td>Muscular</td>
<td>Contraction</td>
<td>3.97</td>
<td>36</td>
<td>4.13</td>
<td>28.75</td>
<td>20.13%</td>
<td>7.25</td>
<td>3.79</td>
<td>Significant</td>
</tr>
<tr>
<td></td>
<td></td>
<td>strength</td>
<td>Extension</td>
<td>2.14</td>
<td>47.5</td>
<td>2.89</td>
<td>41.22</td>
<td>13.22%</td>
<td>6.28</td>
<td>5.27</td>
<td>Significant</td>
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<tr>
<td>Tabulated (T) value = 2.31, significant at 0.05</td>
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</tbody>
</table>
Table 4: Significant Differences between the Mean Scores of the Pre- and the Post Administration of the Program in the Variable of motion range for the Experimental Group (N = 9)

<table>
<thead>
<tr>
<th>Group</th>
<th>Variable</th>
<th>Joint</th>
<th>Movement</th>
<th>Pre: Mean</th>
<th>Std Dev</th>
<th>Post: Mean</th>
<th>Std Dev</th>
<th>Percent of Change</th>
<th>Mean Difference</th>
<th>T.test</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>Muscular strength</td>
<td>Injured</td>
<td>Contraction</td>
<td>4.67</td>
<td>37</td>
<td>4.11</td>
<td>56</td>
<td>51.35%</td>
<td>19</td>
<td>9.05</td>
<td>Significant</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Knee Joint</td>
<td>Extension</td>
<td>6.74</td>
<td>176</td>
<td>8.91</td>
<td>121</td>
<td>31.25%</td>
<td>55</td>
<td>14.78</td>
<td>Significant</td>
</tr>
</tbody>
</table>

The results also show that there is proportional replication of measurement values between the contraction and stretching muscles of the knee joint, as the suggested rehabilitation program led to the development in the muscular of the contraction and the stretching muscles in a balanced manner. This does also conform to the conclusions reached by previous studies [5] which stress the necessity of developing the proportional muscular on both sides of the knee joint between the basic motion motivating muscles and the opposite ones. There is a strong inversely corresponding relationship between the muscles and the joints, as any dysfunction in muscle efficiency would surely lead to a corresponding dysfunction in the efficiency of the joints and vice versa [6, 7].

Also, when setting up any building program, it is vitally important to select the types of exercise that train both sides of the joint and thus the body and the Body Hoists become in a steady and stable condition, as it is important to equally develop the of the player's muscles as much as possible [5]. So, the present study could successfully verify its first hypothesis.

The Second Hypothesis: Table 4 indicates that there are statistically significant differences between the mean scores of the pre and the post measurements of the motion range of the contraction and stretching muscles in the knee joint. Calculated T values for all the working muscles concerned were greater than those of their corresponding tabular ones at a significance level of 0.05. The percentage of improvement in the motion range of the knee joint was 31.25% when stretched and 51.35% when contracted.

According to the previous results, the positive change in the measurement values of the motion range for the experimental group becomes clear. The researchers attribute this improvement to the effects of the suggested rehabilitation program, which helped restore the natural full motion range of the knee joint on both of the contraction and stretching sides, by using a varied administration of muscle stretching exercises according to the level of rehabilitation. The researchers, however, administered these exercises individually to get the best possible results providing that they are performed compulsory, with some help, freely or against resistance according to the level of rehabilitation, the injured capability within the limits of the positive motion range and also according to acuteness level of pain.

Therefore, the suggested rehabilitation program could successfully restore the amount of knee joint flexibility, which the players lost because of their abstaining from training to avoid the movements' accompanying pain. However failure of regularly using joints during the time period of injury would cause the loss flexibility for a short period of time [8]. Therefore individuals with knee injuries should be trained to the full motion range exercises for continual movement so as to keep their joints conveniently at their full motion range. This also coincides with the results reached by prior studies [9-11] which indicated that there are statistically significant differences favoring the experimental groups rather than the control group in the value measurements of the motion range and flexibility of joints; which is most possibly one of the positive effects of the rehabilitation program and the varied standardized exercises administered to the experimental group.

The stretching exercises, which seek to stretch the muscles and tendons and increase the motion range of the joints, are considered the best and most effective means for developing flexibility. The static flexibility exercises not only help to improve the muscular strength but they also increase the muscle reaction during the state of contraction. Thus, the suggested rehabilitation exercise program had a clearly positive effect in improving the knee joint flexibility following the surgical intervention for cartilage cutting off; verifying the second hypothesis of the study.

The Third Hypothesis: Table 5 shows that there are statistically significant differences between the mean scores of the pre and the post measurements of the experimental group in the level of pain concerned in
Table 5: Significant Differences between the Mean Scores of the Pre- and the Post Administration of the Program in the Variable of level of pain for the Experimental Group (N = 9)

<table>
<thead>
<tr>
<th>Group</th>
<th>Variable of pain</th>
<th>Joint</th>
<th>Pre</th>
<th>Std Dev</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Mean</th>
<th>Mean Difference</th>
<th>Percent of Change</th>
<th>T.test</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>Injured</td>
<td>Knee Joint</td>
<td>9</td>
<td>1.70</td>
<td>46</td>
<td>9.21</td>
<td>37</td>
<td>80.43%</td>
<td>2.79</td>
<td>Significant</td>
<td></td>
</tr>
</tbody>
</table>

Tabulated (T) value = 2.31, significant at 0.05

CONCLUSION

- Rehabilitative exercises have the effect of an effective restoration of the knee joint flexibility and strength of thigh muscle groups - by loads codified according to the degree of injury.
- Functional improvement in muscle strength and flexibility helps to gradually remove the pain

Recommendations:

- Preparation of similar programs for the rehabilitation of injuries of various sports.
- Using the suggested program at various rehabilitation centers.

REFERENCES


