SUBJECTIVE PERCEPTION OF PAIN CHARACTERISTICS IN TEAM HANDBALL PLAYERS WITH “GOALIE’S ELBOW”: EFFECTS OF A MUSCLE STRENGTHENING PROTOCOL

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Abstract
Goalkeepers’ injuries in the elbow in handball players are frequent and usually led to definite absence from participation in this sport event. The aim of the present study was to evaluate the effects of a muscle strengthening program on the symptoms of “handball goalie’s elbow” injury and especially on the pain, as well as on the subjective sense of deterioration and the competitive consequences of injuries, such as the absence from the training. The sample consisted of sixteen top level Greek male goalkeepers who had suffered from goalie’s elbow injury. Participants were divided into those who underwent a three month strengthening programme (n=8) and a control group (n=8). As for the pain intensity the results showed a significant decrease in the study group (p =.018), while there was no significant difference in the control group (p =.531). Regarding the subjective sense of the elbow deterioration, there was a tendency of decrease in the experimental group and of increase in the control group. However, these findings were not significant (p =.664, p =.156, respectively). As for the goalkeepers’ absence from training and game, the results showed a significant decrease in the study group (p =.001), whereas the control group did not present significant difference (p =.368). The application of muscle strengthening training program is strongly suggested in handball goalkeepers suffering from elbow injury.

Keywords: handball, elbow, goalkeeper, strength training

Introduction
It is known that occasional handball injuries are inevitable, they occur quite frequently and they may be serious (Aronen & Garrick, 1999; Biener, 1982; Hatzimanouil, Oxizoglou, Kanioglou, Manavis, & Stefas, 2008; Lindblad, Hoy, Terkelsen, & Helleland, 1992; Lindblad, Jensen, Terkelsen, & Helleland, 1993; Nielsen & Yde, 1988). Furthermore, there are injuries that occur according to positional role of the player such as the goalkeepers’ injuries in the elbow. Researchers described these injuries by the term ‘handball goalie’s elbow’ (Tyrdal & Bahr, 1996; Tyrdal & Pettersen, 1998). This term concerns every clinical finding and symptom that appears in handball goalkeeper’s elbows (Popovic & Lemaire, 2002).

It seems that repetitive hyperextension stress of the elbow in team handball goalkeepers increases medial laxity of the elbow. This laxity ultimately leads to chronic repetitive injuries of the elbow, especially in goalkeepers with low dynamic muscular elbow stabilisation (Tyrdal & Finnanger, 1999). This is the main reason of the triggered symptoms as well as the reason for aggravation and relapse of the injury (Popovic & Lemaire, 2002; Tyrdal & Bahr, 1996; Tyrdal & Finnanger, 1999).
The goalkeepers cope with an interrupted pain in all areas of the joint as well as with elbow instability in various duration (Popovic & Lemaire, 2002; Tyrdal & Bahr, 1996; Tyrdal & Finnanger, 1999). In one of these studies (Popovic & Lemaire, 2002), it was stated that pain in the elbow is a common problem for team handball goalkeepers at all levels of competition. As well as that, a similar study reported that repetitive hyperextension trauma of the elbow results in microrupture of soft tissue around the elbow (Tyrdal & Finnanger, 1999) while the previous mentioned study found that the incomplete healing process of the injured elbow, results in the thickening of these joint structures (Popovic & Lemaire, 2002). Consequently, there is an altered muscular efficacy and poor dynamic muscular stabilisation of the joint. As a result, it seems that muscle strengthening may became efficient in order to deal with these concrete injuries.

Numerous studies have shown that systemic exercise improves the muscle function and the joint stability (Hollman, Deusinger, Van Dillen, & Matava, 2002; Skoufas et al., 2008; Tyrdal & Pettersen, 1998). The activation and the strengthening of the muscles, that are adjacent and cooperate with the medial collateral ligament of the elbow joint, may possibly enforce the elbow stability and contribute to the prevention or healing, after an injury of the medial collateral ligament in athletes participating in throwing events (Davidson, Pink, Perry, & Jobe, 1995). For all the above reasons, it was suggested strength exercise drills as an extra preventive step for this specific injury (Tyrdal & Pettersen, 1998).

Pain and elbow functional inefficiency are serious issues and affect a great number of team handball players. “Handball goalie’s elbow” leads the athletes to interrupt competitive as well as non-competitive physical activities, since they trigger problems in their daily activities (Tyrdal & Bahr, 1996; Tyrdal & Finnanger, 1999). There is only one study about a rehabilitation program of this injury (Tyrdal & Pettersen, 1998). However, these authors subjected only amateur handball players without adjusting regularly the workload of the strengthening program during the period of their study or even assessing the pain characteristics.

The aim of the present study was to inquire the effect of a muscle strengthening program on the symptoms of the injuries and especially regarding the pain in handball goalkeepers’ elbow injury, as well as to evaluate the subjective sense of deterioration and the competitive consequences of the injury, such as the absence from training.

Methods
Subjects
Sixteen top level male handball goalkeepers of the Greek national premier league were randomly chosen to participate in the study. The participation was voluntary and the study was designed and carried out according to the guidelines of the declaration of Helsinki. The subjects were informed about the study and provided written informed consent. The mean age of the subjects was 23.6 ± 5.3 years. All the players experienced full active attendance in their teams for the last two years and they were injured and presented problems to their elbow in the past. In particular, the goalkeepers’ problem was the appearance of complains for pain in the elbow joint, during games and training sessions. All athletes did not have any specific orthopaedic elbow problem as it was ascertained by an orthopaedic specialist who examined them.
Measurement procedure
At first, every athlete was asked to report his subjective sense of the deterioration of the injury and the seriousness of the consequences regarding the goalkeepers’ absence from training. Furthermore, the pain intensity was measured in these athletes (numerical pain scale). These measurements were performed just before the beginning of the season and they were repeated after three months, in the middle of the season and also six months post the initial measurements, at the end of the season. After the baseline measurement, the sample was divided randomly in two groups: A (experimental) and B (control). Between the first and the second measurement, group A performed a specific muscular strengthening program in the elbow area for three months. Group B was not subjected to any particular strengthening program for the elbow during this period.

The aim of this strengthening program was the development of the maximal strength of upper arms. The program contained elbow flexion and extension, wrist flexion and extension and forearm pronation and supination strengthening exercise patterns. The players of the experimental group trained both upper limbs. The specific strengthening sessions were held out three times a week. The program consisted of three sets and each set of four repetitions. The time of rest between the sets was set at two minutes. The contraction types used in training were both eccentric and concentric and the intensity of the muscular strengthening program was quite high (90%). Each month, every athlete's muscular strength was assessed, in order to readjust the work load for every muscular group. For every movement and every muscular group that participated in the program, the subjects had determined the 90% of their 1RM. Every month, each athlete performed approximately six repetitions in order to ascertain the 80% of each 1RM and to adjust an updated 90% of work load.

Concomitantly, there was a calculation of 90% for work load for each athlete and every month the subjects performed all drills with their specific work load. An instructor was present during the training program at the beginning of the three months period and when the subjects were familiarized with the program they kept on executing the program by themselves during the remaining period of the study. A high-load-low-repetition-training regimen was decided to be used. Researchers reported that maximum strength can be improved with such training regimens (Fleck & Schutt, 1983). Overall, after the final measurements, the injuries in the elbow area were ascertained in relation with the subjective sense of deterioration, the seriousness of complains according to the goalkeepers’ absence from training and the pain intensity, during the training and the games of the competitive season.

Description of tools/equipment.
- The subjective sense of deterioration was used in order to ascertain the frequency that the athletes felt complain in a specific time period.
- The injury seriousness was evaluated, according to the athletes’ absence time from training.
- The numerical pain scale was used for the quantitative evaluation of the pain intensity. It consisted of an isomeric scale with eleven numbers (0-10).

Description of trials
- As for the subjective sense of deterioration, the athletes were asked to answer how many times they had felt complains in the elbow area.
b) The seriousness of injuries was evaluated according to the athletes’ absence from training. Thus, injuries were divided into four categories: mild (absence from practice less than 1 week), moderate (absence between 1 and 2 weeks), serious (absence between 2 and 4 weeks) and severe (absence of more than 4 weeks) (Seil, Rupp, Tempelhof, & Kohn, 1998).

c) In the numerical pain scale every athlete chose a number, evaluating in this way, the pain intensity from 0 up to 10. A value of 0 represented absence of pain, while 10 was the most intensive pain. The process was also repeated after one week. The reliability of the numerical pain scale was tested with the factor Alpha of Cronbach and was found to be high in all three measurements.

**Statistical analysis**
The statistical program used for the analysis of the results, was the SPSS 14.0. Descriptive statistics were performed (mean±SD). In order to indicate the analysis effect and to present more comprehensible results, the index Eta Squared (E.S.) was used. The level of significance was set at .05. In cases that the conditions of parametric tests applications were not satisfied, non parametric tests were executed. In the variables “subjective sense of deterioration”, “absence from training” and “pain intensity”, Friedman’s non parametric test was used for each group (study - control) between the measurements.

**Results**

*Subjective sense of the elbow deterioration.*
The results did not show statistically any significant differences in the study group between the three measurements $\chi^2(N = 8) = .818$, p = .664. Also, there were not present any significant differences in the control group $\chi^2(N = 8) = 3.714$, p = .156 (Table I).

**Table I. Subjective sense of elbow deterioration.**

<table>
<thead>
<tr>
<th></th>
<th>Study Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(MR) (M) (SD)</td>
<td>(MR) (M) (SD)</td>
</tr>
<tr>
<td>SEPTEMBER</td>
<td>2.00 3.8 ± 6.97</td>
<td>1.63 0.6 ± 0.91</td>
</tr>
<tr>
<td>DECEMBER</td>
<td>2.19 2.87 ± 3.39</td>
<td>1.88 1.87 ± 2.58</td>
</tr>
<tr>
<td>MARCH</td>
<td>1.81 2.00 ± 3.85</td>
<td>2.50 3.12 ± 3.04</td>
</tr>
</tbody>
</table>

Values are mean rank of the test (MR) and the mean (M) ± standard deviation (SD).

*Seriousness of complaints according to the goalkeepers’ absence from training.*
The results showed significant differences in the group A from measurement to measurement $\chi^2(N = 8) = 14.21$, p = .001. On the contrary, there were no significant differences in the control group $\chi^2(N = 8) = 2.00$, p = .368 between the three measurements (Table II).
Table II. Absence duration from the athletic activity.

<table>
<thead>
<tr>
<th>STUDY GROUP</th>
<th>CONTROL GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(MR) (M) (SD)</td>
</tr>
<tr>
<td>SEPTEMBER</td>
<td>2.69 2.12±0.83</td>
</tr>
<tr>
<td>DECEMBER</td>
<td>2.31 1.62±0.74</td>
</tr>
<tr>
<td>MARCH</td>
<td>1.00 0.25±4.62</td>
</tr>
</tbody>
</table>

Values are mean rank of the test (MR) and the mean (M) ± standard deviation (SD).

Numerical pain scale.
Group A presented significant differentiation from measurement to measurement regarding the numerical pain scale $\chi^2 (N = 8) = 8.07, p = .018$. However, this finding was not evident in group B $\chi^2 (N = 8) = 1.26, p = .531$ (Table III).

Table III. Pain intensity.

<table>
<thead>
<tr>
<th>STUDY GROUP</th>
<th>CONTROL GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(MR) (M) (SD)</td>
</tr>
<tr>
<td>SEPTEMBER</td>
<td>2.75 5.75±2.71</td>
</tr>
<tr>
<td>DECEMBER</td>
<td>1.81 2.37±2.44</td>
</tr>
<tr>
<td>MARCH</td>
<td>1.44 1.75±2.76</td>
</tr>
</tbody>
</table>

Values are mean rank of the test (MR) and the mean (M) ± standard deviation (SD).

Discussion
As for the subjective sense of the elbow deterioration, the results did not show significant differences in the study group. However, a tendency of decrease appeared throughout the
measurements during the season. On the contrary, the control group presented a tendency of increase; however, this finding was not statistically significant. Probably, there would be significant changes in the experimental group, if the adapted program lasted for a longer period of time. As Tyrdal and Pettersen stated (Tyrdal & Pettersen, 1998), the muscle strengthening improvement was evident after 4.5 ± 3.1 months. Probably, a longer duration of training was required in the present study, so that significant differences might appear in the study group. Furthermore, the results of the present study should be interpreted with some caution due to the small number of participants. Furthermore, long – lasting studies with an increased sample of athletes are required, in order to conclude safely about the role of strength training in the subjective sense of the elbow deterioration.

The results regarding the severity of complain, according to the duration of the absence from the athletic activity, showed that the experimental group presented significant seasonal changes. Thus, it was ascertained that the duration of absence from the athletic activity in all three different measurements was decreased. On the contrary, there were no relative significant differences in the control group and therefore this group presented constancy in this parameter. The altered absence from training is of great importance since it leads to a new perception for the management and the prevention of the elbow injury. According to Tyrdal and Bahr (Tyrdal & Bahr, 1996), goalkeepers with elbow problems were absent from training at about 52%. The present study showed that the absence from training was decreased and probably the team performance was improved, since various performance parameters are ameliorated by the minimization of the absence from training. This fact presumably affects the overall team performance, because of the importance of the goalkeeper’s position.

The present study showed that the pain intensity for the experimental group was decreased from measurement to measurement, while it remained stable in the control group. The pain and the participation inability in athletic activities are significant issues for a great number of goalkeepers in team handball. For these athletes, although their competitive and non competitive problems are relatively unimportant, the symptoms become substantial, when they engage with team handball for a long period of time (Tyrdal & Bahr, 1996; Tyrdal & Finnanger, 1999). Therefore, it is clear that the decrease of the pain intensity is a very significant outcome for a goalkeeper during the competitive season. This fact may also be beneficial for the team performance, since it decreases the handball players’ absence from training or game. Moreover, if athletes exhibit decreased pain intensity, they may have benefits in their non competitive activities also.

As for the specific injuries, these are chronic and concern a great number of goalkeepers. Therefore, the significance of the symptoms limitation or elimination is very obvious. Thus, Tyrdal and Bahr (Tyrdal & Bahr, 1996), seem to be right, when they reported that goalkeepers consider strength training to be the most effective and acceptable method of therapy.

The importance of the prevention training programs or methods and injury management, concerning the “handball goalie’s elbow” should be further recognized. The specific application of the muscle strengthening programs should be considered to be the first choice among the treatment methods, since their efficiency is obvious in team handball players. Also, Tyrdal and Pettersen (Tyrdal & Pettersen, 1998), ascertained that muscle strengthening training, not only helped goalkeepers to cope with their injuries and competitive problems, but it also improved the management of their daily activities. Future studies should focus on the subjective sense of the elbow deterioration and the relation with strength training. Moreover,
in these studies an increased number of subjects and a control group is needed while a training period of increased duration is necessary to make clear the importance role of strength training in “handball goalie’s elbow”.

In conclusion, a three month strengthening program leads to a decreased pain intensity and presents a tendency for decrease of the subjective sense of the elbow deterioration. Furthermore, the handball players who participated in the training program reduced significantly their absence from competitive and non-competitive activities. Thus, this specific muscle strengthening method acts efficiently, as a prevention and management mode for the goalkeepers’ elbow injury in team handball.

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References


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