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Prevention of sports injuries through Passive Stretching and Relaxation in Iranian Professional Handball Players

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ABSTRACT

Background: Since, a few reliable intervention training as a preventive measure to sport injuries in Handball is available so far. It was, therefore, thought desirable to prepare a training intervention, in addition, so that occurrence of sports injuries may be reduced.
Objective: to evaluate the effect of a preventive program included passive stretching of muscle groups and relaxation technique as post-exercise cool down in Iranian professional Handball players.
Participants: Eight of ten 15 clubs for professional male players (n=154; 80%) and all six clubs for professional female players (n=125; 100%) from the eight Province of the Iran Handball Associations participated in this study. One men club, comprising of 18 male and one women club comprising 24 female players, age varying from 17 to 32 years were selected randomly and participated voluntarily as experimental group. Other men and women clubs (237 players) were observed as control group.
Setting: The duration of league in one season, was divided in 3 equal phases. Intervention program was done at the end of every day, as a cool down, during second phase (Intervention Phase) in both men and women clubs of experimental group. During one season, the physicians or physiotherapists of all 14 clubs reported sports injuries on a standardized injury report form.
Results: Incidence of injuries in Iranian professional handball players was 32.9 per 1000 player match hours and 1.35 per 1000 player training hours. Fewer injuries occurred during matches (63:37.3%) than during training sessions (106:62.7%). There occurred no significant differences in numbers of total injuries between intervention phase (II) and two other control phases in experimental group. But there was significant difference among number of "Musculotendinous injuries" of three phases of experimental group.
Conclusion: Combination of "Passive stretching and relaxation exercises" following "Conventional training" may prove better than "Conventional training session only", for reduction in occurrence of "Musculotendinous unit" injuries.
KEY WORDS: professional Handball player, sport injury, *Passive Stretching, Relaxation*.

INTRODUCTION

Handball is a *team contact game* in which players dribble, pass, and throw the ball with their hands, trying to make it end up as many times as possible in the opponents' goal.[1]

It is played indoors or outdoors by both sexes and all ages: young children, juniors, and seniors. A dynamic development of Handball along with an increasing interest of the public has resulted, as in other sports, in major professionalization of all top teams, which has directly affected the performance in this sport. The players' speed, strength, and weight have increased. The tempo of the match has increased, throws and shots became more powerful. At trainings a lot of time is devoted to movements and specific exercises, in order to hinder the attacking team. When the concept of "disabling the opponent at any cost" is applied, numerous injuries may result; thus, prevention of sports injuries in Handball is the need of the day. [2,4,15,48]

Handball after soccer and various skiing activities, cause the greatest portion of injuries in Norway (Overall, 12% of all injuries in Norway occur in handball).[3] Steinbruck K. (1999) reported during 25 years in 30603 German sportsmen, handball after soccer and skiing were the greatest cause of sport injuries.[4] Traumatic injuries in handball are more than overuse injuries. [5,6,7,8] Knee joint and "Back/Pelvic/Ribs" region followed by Ankle joint are the most injured body part in handball players.[5, 9,10,11,1,12,13,14] Ligament injury is the most type of injury in handball [5, 15,10,16,14] Most of handball players after injury can continue playing without absent.[5,17,14] Women handball players are prone to injury more than men handball players,[5,17,14] but location of injuries do not vary significantly between men and women.[5,14]

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The Islamic Republic of **Iran Handball Federation** (IRIHF) is the governing body for Handball in Iran. It was founded in 1975, and has been a member of International Handball Federation since 1978. It is also a member of the Asian Handball Federation. The IRIHF is responsible for organizing the Iran national handball team.

At the 15th Asian Summer Games 2006 in Doha, the four players of the Iran national senior handball team could not participate, because of sport injury. Also, several reports from Iran handball professional clubs about their harmfulness due to huge numbers of injured players, it was decided, in medical committee of Iran Handball Federation, to establish a comprehensive activity in order to prevent and minimize Handball injuries in Iranian professional Handball players. Shadanfar (2011) reported incidence of injuries was 32.9 per 1000 player match hours and 1.35 per 1000 player training hours. Less of injuries (37.3%) occurred in matches than during trainings (62.7%). Most injuries (74.6%) were traumatic and 25.4% were overuse. Knee joint was the most frequently injured body part (17.2%). Joint and ligament injuries were the most common type of injuries (44.4%). Contact injuries (57.4%) happened more frequently than noncontact injuries, and 41.4% of injuries caused by contact with opponent. 59.5% of match injuries were due to violation of laws from opponent as judged by the team physician and the injured player.[5]

Since, a few reliable intervention training as a preventive measure to sport injuries in Handball is available so far (table 1). It was, therefore, thought desirable to prepare a training intervention, in addition, so that occurrence of sports injuries may be reduced.

Table 1

Author and year	Country	Participants	Skill level	Intervention Group	Intervention	Period of intervention	Conclusion
Wedderkopp (1999) [27]	Denmark	237 female handball players	playing at elite, intermediate, recreational levels(aged 16–18)	11 teams; n = 111 players	various functional activities followed by use of ankle disc for 10–15 min at all practice sessions.	August–May 1996; 10 months	Injuries in intervention group were reduced
Wedderkopp (2003)[28]	Denmark	163 female European handball players	elite, intermediate and recreational levels(aged 14–16)	n = 77 players	Functional training and ankle disk performed for 10–15 min at each training session plus strength activities. (Control group performed functional training only)	One season	Ankle disc reduced traumatic injury when added to functional strength training.
Olsen (2005) [29]	Norway	1837 handball players (1586 female, 251 male); from 123 clubs.	Youth players(aged 15–17)	61 clubs; 958 (players; 808 female, 150 male)	Technical, balance and strengthening exercises structured 20 min group programme (warm-up, technical, balance and strengthening exercises).	One season (8 months)	An injury prevention protocol can prevent injuries in youth handball.
Myklebust (2003)[31]	Norway	control season, 60 teams (942 players); first intervention season, 58 teams (855 players); second intervention season, 52 teams (850 players).	Three top divisions(I-III)	first intervention , 58 teams (855 players); second intervention, 52 teams (850 players).	A five-phase program (duration, 15 min) with three different balance exercises focusing on neuromuscular control and planting/landing skills was developed.	Two seasons	It is possible with the use of neuromuscular training in female elite team handball players, but successful prevention depends on good compliance among the players.
Petersen (2005)[30]	Germany	276 handball players(20 teams)	Two of the teams were from the third highest league ,four were of a superior amateur level and four teams were of a lower amateur level	Ten female handball teams (134 players)	1. Information about injury mechanism, 2. Balance-board exercises, 3. Jump training	One season	Proprioceptive and neuromuscular training is appropriate for the prevention of knee and ankle injuries among female European team handball players.

A review on intrinsic and extrinsic risk factors in sport injuries reveals that muscle stiffness[18], psychological factors[19] and fatigue[20] have major role in sport injuries. Muscle stiffness which is described as "the resistance of muscle fibers to deformation" might impact on the risk of injury.[18] Injury risk may be reduced by improving flexibility through stretching because reduced flexibility has been known as a risk factor in acute muscle strain injuries.[21,22,23,24] Several investigators have assessed the effect of passive stretching on reduction of sports injuries (table 2), but there is controversy in the results. Also limited researches assessed efficacy of passive stretching as

post-exercise cool down on reduction of sports injuries, thus, such investigation was necessary.

In the other hand, some psychological factors like situational anxiety, excessive muscle tension and impaired ability to attend to the play the game, can make players susceptible to injuries.[19]These factors can be controlled by relaxation therapy because endocrine glands function may be affected by relaxation therapy and relaxation can correct stress-induced endocrine changes [25]and serum cortisol level can be decreased by relaxation exercises.[26] Thus, relaxation exercises by controlling psychological risk factors of sports injuries may diminish susceptibility to sports injuries. Moreover, fatigue has a major role in sports injuries[20], which may be controlled by relaxation.[47]

Table 2

Author and year	Intervention	Time of Intervention	Period of intervention	Control	Results
Pope et al. (1999)[32]	One 20 s static stretch for each of 6 lower extremity muscle groups	Warm-up	40 sessions over 12 weeks	Warm-up only.	No significant effect of pre-exercise stretching on all-injuries risk, soft-tissue injury risk or bone injury risk.
Pope et al. (1998)[33]	Two 20 s static stretches for each of their soleus and gastrocnemius muscles	Warm-up	11 weeks	Two 20 s static stretches for wrist flexors and triceps muscles during warm-up.	No significant effect of pre-exercise stretching on all-injuries risk
Van Mechelen *et al.* (1993)[34]	Three 10 s static stretches for each of five lower extremity muscle groups	Warm-up and Cool down	Twice daily for 16 weeks	Subjects continued with normal programme of stretching, warm-up and cool-down.	No significant difference in injury incidence between groups.
Ekstrand *et al.* (1983)[35]	10 min of contract-relax stretching for five lower extremity muscle groups	Warm-up	6 months	Subjects continued with usual activities.	A significant difference in injury incidence between groups was found
Hartig and Henderson (1999)[36]	Five 30 s static stretches for the hamstrings	Warm-up	three times daily for 13 weeks	Normal pre-exercise stretching.	Subjects in the intervention group had significantly fewer lower extremity overuse injuries.
Cross and Worrell (1999)[37]	Three 15 s stretches for each of four lower extremity muscle groups	Warm-up	One year	General pre-practice stretching for upper and lower extremities.	A significantly lower incidence of injury was found in the intervention group.
Bixler and Jones (1992)[38]	90 s static stretching routine performed following 90 s warm-up at the end of half-time.	Warm-up	One season	Normal half-time Activities	Subjects in the intervention group had significantly lower third quarter sprains and strains per game.

The **aim** of this study was to evaluate the effect of a preventive program included passive stretching of muscle groups and relaxation technique which were done as post-exercise cool down in Iranian professional Handball players.

METHODS

In 2008, the Iranian professional Handball Super League comprised 10 men clubs and 6 women clubs with a total of 279 players. All 16 clubs were invited to participate in this study.

Official letters signed by president of the IRIHF were sent to the 16 professional Handball clubs from the eight Province of the Iran Handball Federation (centre, north, south, east, south east, and northwest of Iran). All clubs agreed to participate in this study; therefore, 8 (80%) professional men clubs with 154 players and six (100%) professional women clubs with 125 players participated in this study. Player's age ranged from 16-36 years. Based on the federation rules, players could change their club in the half season. The 14 official physicians or physiotherapists of the clubs were educated to collect the injury and exposure data for the present study by Medical

Committee of Iran handball federation and were research members in this study.
One men club, comprising of 18 male and one women club comprising 24 female players, age varying from 17 to 32 years were selected randomly and participated voluntarily as experimental group. Other men and women clubs (237 players) were observed as control group.

Table 3
Exercise were imparted as intervention program in intervention phase (phase II) of experimental group[40]

Name	Joints position during this technique	Stretched muscles	Duration (Minutes)
Bound Angle Stretching Technique	Spine neutral extention when upright, moving to the mild flexion when bending forward (but not too much flexion, which will reduce the action in the pelvic); sacroiliac joint nutation; hip flexion and external rotation; knee flexion; ankle dorsiflexion; foot supination; scapula neutral on rib cage; glenohumeral joint external rotation; anatomically neutral ; elbow flexion; forearm supination; head and finger flexion.	adductor longus and brevis, and gracilis / tensor fascia latae /gluteus medius and minimus / Hamstring	02
Spinal Twist Stretching Technique	Spinal rotation toward raised (top) leg, neutral extension. Top leg: deep hip flexion, adduction, internal rotation; knee flexion. Bottom leg: moderate hip flexion, adduction, external rotation, knee flexion. Front arm (contralateral arm rests on top leg): scapula in neutral, glenohumeral external rotation, extension; elbow extension; wrist dorsiflexion.	Spine: Bottom leg side: internal oblique, erector spinae, splenius capitis, latissimus dorsi. Top leg side: external obliques, rotators, multifidi; sternoclidomastoid. Legs: Top: piriformis /gemelli and obturator internus /Obturator externus/ gluteus maximus /gleuteus medius and minimus. Bottom: piriformis /gluteus medius and minimus Arm: Front: rhomboids / latisimus dorsi / Back: pectoralis major, long head of biceps, pectoralis minor, coracobrachialis.	02
Great Seal Stretching Technique	Spine: atlanto-occipital joint flexion; strong axial extension; mild axial rotation in the thoracic spine(necessitated by the turning of the pelvis). Extended leg: hip flexion adduction internal rotation, knee extension, ankle in pulled into dorsiflexion. Folded leg:hip flexion, abduction ,external rotation; knee flexion; ankle plantarflexion; foot supination. Shoulders and arms:scapula upward rotation, slight abduction, elevation; glenohumeral flexion and adduction; elbow extension; forearm pronation; wrist neutral extension; hand and finger flexion working against the pressure of the foot.	Spine: posterior suboccipitals (eccentrically), sternocleidomastoid. Extended leg: Hamstrings, gluteus maximus, piriformis, obturator internus, gemelli, some gluteus medius and minimus, gastrocnemius, soleus. Arms: The rhomboids /lower trapezius and latissimus dorsi.	02
Reclining Hero Stretching Technique	Spine axial extension; sacroiliac joint counter nutation; hip extension, internal rotation, and adduction; Knee flexion and tibia medially rotated; ankle plantar flexion; scapula upward rotation, abduction, elevation; glenohumeral joint flexion, external rotation, elbow flexion.	Rectus abdominis, psoas major (the lower part at first, and the upper part as the pose deepens), iliacus, rectus femoris, Sartorius, perhaps the tensor fascia latae, gluteus medius and minimus; vastii, tibialis anterior, extensor digitorum longus, extensor halucis longus; piriformis, gemelli, and obturator internus / adductor longus and brevis /pectineus.	02
Upward Bow Stretching Technique	Full-spine extension; sacroiliac counternutation; hip extension, internal rotation, adduction; knee extension; ankle dorsiflexion, scapula upward rotation, abduction (deepens into scapular adduction with more thoracic extension); glenihumeral flexion, external rotation, adduction; elbow extension; forearm pronation; wrist dorsi flexion.	Leg: Rectus femoris, psoas major, and iliacus. Torso: Abdominal muscles and anterior rib cage muscles, primarily internal intercostals and anterior neck muscles. Arms: Pectoralis major and minor, latissimus dorsi	02
Belly Twist Stretching Technique with leg extended	Axial rotation of the spine, hip flexion, knee flexion, scapula resting on rib cage, external rotation in far arm, internal rotation in near arm.	Top Leg: External obliques; intercostals; transversospinalis; gluteus medius, minimus, and maximus; piriformis; gemelli; and obturator internus. Bottom leg: internal obliques, intercostals, oblique muscles of erector spinae. Side of neck the head is turned toward: sternoclidemastoid. Side of neck the head is turned away from: Capitis posterior, obliqus capitis inferior, splenius capitis, rectus capitis anterior, scalene. Arm the head is turned toward: Pectoralis major and minor, corachobrachialis, latisimus dorsi	02
Embryo Stretching Technique	Full spinal flexion (maybe slight cervical extension, depending on the head position or the length of the neck); hip flexion, neutral rotation, adduction; knee flexion; ankle plantar flexion; scapula abduction and downward rotation; glenohumeral internal rotation; elbow extension; forearm pronation.	extensors of spine, gluteus maximus, piriformis and other rotators, hamstrings, gluteus medius, and minimus / tibialis anterior, peroneus tertius, extensor digitorum longus and brevis, and extensor hallucis longus and brevis	02
Dead Pose (Relaxation Technique)	The players are to lie on his back, and fully relax his muscles. The players should take a particular part of the body and thoroughly relax its muscles. Then they should concentrate upon that part and imagine that every muscle tissue in that part is further relaxing. While trying to relax the different parts of the his body, the player should attempt relaxation of more than one part conjointly, so that he can ultimately succeed in relaxing all the parts of his body at one and the same time.	Psychological Relaxation of whole body	14
		Rest in Between each Technique (30 Seconds)	04
		TOTAL	(Minutes) 30

Duration of one season, for men and women, was divided into three equal phases. In men's club, the duration of league in one season, was divided in 3 equal phases, first six weeks as self-control phase (phase I), second six weeks as intervention phase (phase II) and third six weeks as detraining phase (phase III). And the duration of league for women's club, was divided in three equal phases, first 4 weeks as self-control phase (phase I), second 4 weeks as intervention phase (phase II) and third 4 weeks as detraining phase (phase III). Intervention program was done at the end of every day, as a cool down, during intervention phase in both men and women clubs of experimental group.

Incidence and circumstances of injuries in players of 14 teams were observed during one season, during three phases of experimental group and control group (in the men league September 2008 to February 2009 and in the women league November 2008 to February 2009). An injury was defined as "any physical complaint sustained by a player that result from a handball match or handball training, irrespective of the need for medical attention or time-loss from handball activities". Before beginning the season, all information about age and previous injuries of players were recorded. At the end of every training session or matches its duration and number of participating players were recorded. When an injury occurred, all information of that injury were recorded in a standardised injury report form published by Junge *et al.,* (2006).[39]

Diagrammatic presentation of Experimental Group:

SELF-CONTROL PHASE	INTERVENTION PHASE	DETRAINING PHASE
6 weeks practices and matches for men's club	6 weeks practices and matches for men's club	6 weeks practices and matches for men's club
& 4 weeks for Women's club	& 4 weeks for Women's club	& 4 weeks for Women's club
(n=42) Conventional Training session	(n=42) Conventional Training session + Passive Stretching & Relaxation Exercises	(n=42) Conventional training session

(Observation on practice and match sessions and recording injuries happened during trainings and matches, in three phases)

Table 3 reveals the name, purpose and duration of all exercise, which were used as passive stretching and relaxation, in intervention phase of experimental group.

Statistical Analysis

Difference of "numbers of injuries", among self-control phase (I), intervention phase (II) and detraining phase (III) of exprimental group, was calculated and examined by Repeated Measure Analysis of variance, to find out the effects of stretching and relaxation exercises on total number of injuries among professional handball players. Then obtained "F" ratios were tested, at 0.05 level of confidence.The level of significance was set at 0.05 level of confidence, which was considered adequate for the purpose of this study. Then, this test was employed for difference of numbers of "Musculotendinous, Joint and Ligament injuries", among three phases, and again for difference of numbers of "Musculotendinous unit " injuries, among three phases. The "Paired Sample t–Teas" was administered to find out the significant paired means differences.
SPSS software version 11 was used for statistical analysis.

RESULTS

In total 169 injuries were reported from 118 matches and 1262 hours team training in women and 2152 hours team training in men. Fewer injuries occurred during matches (63:37.3%) than during training sessions (106:62.7%).

Incidence of injury was 2.83 per 1000 hour player exposure risk. Incidence of match injuries was 32.9 injuries per 1000 hour player match exposure to risk. And with 3414 hours training, the incidence of training injuries was 1.35 injuries per 1000 hours players training exposure to risk. Iranian professional Handball players were 22.37 times more likely to be injured in games than in practice sessions.

In Iranian men professional Handball players, in 88 matches (1008 player hours during matches) 29 injuries were recorded (28.76 injuries per 1000 hour player match exposure to risk) and in Iranian women professional Handball players, in 30 matches (420 player match hours) 18 injuries were recorded (0.6 injuries per match or 39.7 injuries per 1000 hour player match exposure to risk).

In Iranian men professional Handball players, in 51655 hours training exposure to risk 63 injuries were recorded (1.22 injuries per 1000 hours players training exposure to risk) and in Iranian women professional Handball players, in 19060 hours training exposure to risk, 33 injuries were recorded (1.75 injuries per 1000 hours players training exposure to risk).

Frequencies of injuries in both men and women teams of experimental group are described in table 4.

Although, table II shows that in both men's and women's clubs, numbers of injuries occurred in intervention phase (men=3, women=4) were lesser than self-control phase (men=5, women=6) and detraining phase (men=6, women=7), but it is found from the statistics that there occurs no significant differences in numbers of injuries between intervention phase (II) and two other control phases; self-control phase (I) and detraining phase (III) of experimental group. Also, although in both men's and women's clubs, numbers of "Musculotendinous, Joint & Ligament" injuries occurred in intervention phase (men=2, women=2) were lesser than self-control phase (men=4, women=6) and detraining phase (men=5, women=7). But statistically, there isn't significant difference in numbers of "Musculotendinous, Joint & Ligament" injuries among three phases of experimental study.

Table 4
Numbers of injuries in three phases of study in experimental group

Phases of study		Self control (phase I)	Intervention (phase II)	Detraining (phase III)
Total Injuries	Men team	5	3	6
	Women team	6	4	7
	Total	11	7	13
Musculotendinous, Joint and Ligament Injuries	Men team	4	2	5
	Women team	6	2	7
	Total	10	4	12
Musculotendinous unit Injuries	Men team	2	0	2
	Women team	3	0	4
	Total	5	0	6

The results revealed that there is significant difference among number of "Musculotendinous injuries" of three phases of experimental group.

Also, it's found from statistics that number of "Musculotendinous unit" injuries between self-control phase (I) and intervention phase (II) did not differ significantly in experimental group. And, there is significant difference between numbers of "Musculotendinous unit" injuries in intervention phase (II) and detraining phase (III) of experimental group. And, there isn't significant difference in numbers of "Musculotendinous unit" injuries between self control phase (I) and detraining phase (III) of experimental group.

The results revealed that there isn't significant difference among number of "Musculotendinous injuries" of three phases of control group.

DISCUSSION

The results of this study in control group reveal there wasn't any accumulation of frequencies of "Musculotendinous unit" injuries during any specific part of the season. This finding is in consonance with the results of Seil *et al.,* (1998) which revealed any predominant type of injury at any moment of the season could not be identified. He explained that no accumulation of practice or game injuries during any specific part of the season could be indicated.[35]

Since, there isn't any accumulation of injuries during any specific part of the season, Hence, reduction in "Musculotendinous unit" injuries in intervention phase (II) than detraining phase (III), might have been due to inclusion of passive stretching and relaxation exercises in the conventional training in intervention phase (II) of experimental group. Thus, the "conventional training schedule plus passive stretching and relaxation exercises" may prove better than "conventional training session only" for reduction of occurrence of "Musculotendinous unit" injuries.

Efficacy of passive stretching and relaxation exercises in reduction of "Musculotendinous unit" injuries which are found in present study might have been due to reduction in "muscle stiffness" and “fatigue" also controlling psychological risk factors.

Muscle stiffness is defined as “the resistance of muscle fibers to deformation” and static flexibility is defined as “the range of motion (ROM) available to a joint or a series of joints with no emphasis on speed during the stretch”[18,41]There are several suggested mechanisms to explain how passive stretching can reduce muscle stiffness and improve static flexibility. Goldspink, G. (1968) suggested that after applying passive stretching, over a period of time, the number of sarcomers increase in series.[42]This permanent adaptation leads to plastic deformation in muscle

tissue and an increase in muscle length. But Halbertsma *et al*. (1996) cited this increased flexibility is because of analgesic effect of passive stretching leads to increase in stretch tolerance rather than a decrease in muscle stiffness.[43]Akeson, W.H. (1980) believe that stretching stimulates production of some lubricant substances such as glycoaminoglycans which lubricate the tissue fibers and preventing them from sticking together and reducing stiffness in muscle tissue.[44]Noonan *et al.* (1994) showed a non-significant increase in force to failure, deformation and energy absorbed in muscles passively stretched to 20% of failure force, but a nonsignificant decrease in the same parameters in muscle stretched to 30% of force to failure.[45]Also several authors have known reduced flexibility as a risk factor in acute muscle strain injuries[21,22,23,24] and muscle stiffness was known as a risk factor of sport injuries.[18] So reduction of "Musculotendinous unit" injuries in present study might have been due to stretching exercises in intervention phase.

Situational anxiety, excessive muscle tension (associated with sympathetic nervous system over-arousal, a negative impact on smoothness of coordination, more impulsive movement), impaired ability to attend to play the game, are some of the psychological risk factors susceptible players to injuries. [19] Gallois P.H. *et al* (1984) have found that endocrine glands function may be affected by relaxation therapy and relaxation can correct stress-induced endocrine changes.[25] Kamei T. *et al* (2000) reported that relaxation can decrease serum cortisol level.[26] Therefore relaxation exercises by controlling psychological risk factors of sports injuries might have reduced "Musculotendinous unit" injuries in experimental group.

Mair *et al.,* (1996) investigated the role of fatigue in susceptibility to acute muscle strain injury. He found that fatigued muscles are able to absorb less energy before reaching the degree of stretch that causes injuries.[20] The ability of an active muscle to resist lengthening and hence injury, is largely dependent on contractile strength and is substantially reduced when a muscle is fatigued.[20,17] After vigorous exercise of the muscles, there is a decrease in ROM lasting 2 to 3 days. As the reason, after several days of practice or matches each week, accumulation of toxics and accumulation of micro-trauma can cause hypertonia also muscle stiffness which may lead to muscle tightness.[19] Cross and Worrell (1999) revealed, when stretching exercise follows the same vigorous exercises, following injuries can be prevented.[37]Yavuz *et al*., (2010) by assertion of electromyography of fatigued muscles, found that electromechanical delay of muscles were increased by fatigue; this issue predisposes muscles and tendons to injuries. He explained that of the two fatigue types (central and peripheral), it is more likely that the peripheral fatigue is more effective on the electromechanical delay of muscles. Since the action potential propagation along T-tubules is impaired in the peripheral fatigue because of the K+ efflux during maximum contraction, this may slow down the development of twitch force and so electromechanical delay of muscles.[46]And this delay predisposes muscles and tendons to be injured sooner. Also, Solberg *et al*., (2000) indicated relaxation techniques may reduce the lactate response to a vigorous exercise.[47] Therefore, in present study relaxation exercise which followed vigorous activity in intervention phase, by cleansing toxic substances from cellular level and diminishing the harmful effects of fatigue, might have reduced vulnerability to musculotendinous injuries.

Conclusion

Combination of "Passive stretching and relaxation exercises" following "Conventional training" may prove better than "Conventional training session only", for reduction in occurrence of "Musculotendinous unit" injuries. But “passive stretching and relaxation exercises” have not any significant effect in reduction of total injuries. Also, there isn't any accumulation of injuries during any specific part of the season in Iranian professional handball players.

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