Acute Effect of Short Passive and Dynamic Stretching on 20m Sprint Performance in Handball Players

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Abstract

The aim of the present study is to investigate the acute effects of passive and dynamic stretching exercises on the 20m sprint performance of handball players. The sample consisted of 10 right-handed, highlevel handball players 19-25 years of age, who suffered from no myoskeletal disease. The research protocol comprised initial flexibility measurements, easy run, initial sprint measurements, muscle stretchingexercises (either passive or dynamic), ball exercises, shots to goal, as well as final flexibility and sprint measurements. Dynamic stretching was implemented in one of the programs, with the muscle being rhythmically stretched to full extended joint position by means of moderate oscillation; in the other program, static stretching was implemented, with the muscle being stretched to full extended joint positionwithout any muscle pain involved. The two programs were alternatively performed by the participants for a time span of 33.5 minutes each. The results of the study revealed that joint flexibility was significantly improved ($p<0.05$) on all joints measured following the implementation of the above mentioned stretching programs. On 20m sprint, the results indicated that handball players achieved better performance inless time only in the second measurement, i.e. after dynamic stretching performance. Such results lead to the conclusion that dynamic stretching exercises performed at full movement extent positively affect sprint performance; this is the reason why handball players should implement such exercises in their warm up session before each game.

Key words: dynamic stretching, passive stretching, sprint, joint flexibility.

Introduction

Sport is closely related to performance, which is the outcome of several factors in s ynergy. The structure of sports performance comprises a number of factors such as fitness, technique, tactics, etc. The fitness factor involves flexibility, which plays a rather significant role in performance development and maximization (Weineck 1992). The content of such joint flexibility consists of all those stretching exercises which promote and improve joint movement.

In the last decades, a great amount of research, referring to both advantages and disadvantages of dynamic and static stretching exercises in relation to sports performance, has been conducted and found its place in sports literature.

Kokkonen, Nelson, Eldredge and Winchester (2006) applied a 10-week intervention program in which they implemented static stretching to the participants-athletes' lower extremities. Before and after theend of the program, flexibility and strength (20m sprint) was measured. The results of the measurements indicated an improvement ($p<0.05$) in flexibility (18.1%), and 20m sprint (1.3%). The control group exhibited no improvement, whatsoever.

Nelson, Driscoll, Landin, Young, and Schexnayder (2004) applied a static stretching intervention program on high standard track and field athletes (sprinters). These athletes performed 20m sprint both before and after the implementation of the protocols. Three out of the four static stretching protocols implemented induced a significant increase in the 20m print performance time. Similar results were obtained by Winchester, Nelson, Landin, Young and Schexnayder (2007), on college sprinters. Vetter (2007) studied 6 different warm up protocols for sprint and long jump performance. The results of his researchindicated that a warm up session comprisin g static stretching might negatively affect long jump, but not sprint. Nelson, Kokkonen and Arnall (2005) suggested avoiding static stretching of a specific muscle group before any performance requiring maximum endurance concerning the strength of such muscle group. Another research conducted by Young and Behm (2003) reports that static stretching negatively affected both explosive strength and performance in jump. Similar results are provided by Cramer, Housh, Johnson, Miller, Coburn and Beck (2004) concerning maximum strain, which was limited following static stretching performance at 60^o and at 240^o/sec. The conclusion of the above mentioned research is that static stretching could weaken maximum strength output, such limitation negatively affecting sprint performance.

Bacuran, Monteiro, Ugrinowitsch, Tricoli, Cabral and Aoki (2009) applied static and ballistic stretching on lower extremities, then maximum leg strength was measured. Maximum strength was reducedfollowing static stretching exercises; yet, ballistic stretching did not affect it at all. In another research conducted by Bazett-Jones, Gibson and McBride (2008), static stretching was performed for a 6-week period, when sprint time was measured. The results revealed no difference. The researchers concluded that this 6-week static stretching program had neither a positive nor a negative impact.

Most recently however, an increasing number of researchers underline the significance of dynamic stretching as part of the warm up session in order for maximum performance in power sports to be achieved.This is the reason why there are several investigations comparing the above mentioned stretching techniques. Such studies apply both dynamic and static stretching to the sample, in order to investigate both techniques as well as their effectiveness in sport.

Fletcher and Jones (2005) investigated several 20m sprint stretching protocols on rugby players. The groups that performed static stretching exercises exhibited a significant deterioration in sprint performance ($p <$ or $r = 0.05$), while those who performed dynamic stretching exhibited a significant improvement in sprint performance ($p \leq 0.05$).
Such results maintained that the latter group performed better in 20msprint.

Similar results concerning the improvement of performance following the implementation of dynamic stretching exercises have also been published in other studies as well. Little and Williams (2006)investigated several stretching protocols during warm up in professional football players of high sprint standard. The authors established that static stretching had no negative effect on sp rint performance; yetdynamic stretching during warm up was more effective in sprint performance concerning such football players.

The relevant literature also includes studies referring on a combination of static and dynamic stretching as well as on their impact on sports performance in general. Fletcher and Anness (2007) conducted astudy on sprinters with a combination of both static and dynamic stretching protocols in the performance of 50m sprint. The results show that static stretching decreases sprint performance, despite its combination with a dynamic stretching protocol - always in comparison to the application of dynamic stretching alone.

Faigenbaum, Bellucci, Bernieri, Bakker and Hoorens (2005) investigated several warm up protocols concerning the sports performance of children.

The results of this research indicated that it would be betterfor children to perform moderate to high intensity dynamic stretching exercises before activities requiring high strength output.

The combinational protocols of dynamic and static stretching produced contradicting results on a sample consisting of untrained individual sports athletes. Since handball players implement protocols combining static stretching and gymnastics (dynamic stretching), the investigation of the role of such protocols in sprint performance could be rather useful.

METHODS

The participants were 10 right-handed, high standard handball players 19-25 years of age, who suffered from no myoskeletal disease and experienced no serious injury in the last 12-month period before the measurements. The research was conducted in compliance with the Aristotle University of Thessaloniki Code of Conduct. As concerning flexibility measurements, two types of goniometers were used, namely:a) “Brodin” and b) “Myrin”.

Within the framework of the present research, “Myrin” measured body bend, hip extension, knee bend and bent-knee backward ankle bend; “Brodin” goniometer measured only hip abduction. All measurements were performed only on the participants’ right leg. Each training program comprised two flexibility measurements. The first one took place before the training program was started, while the second one after the program was completed.

The flexibility measurements were performed by two testers on a medical bed – except the ankle measurement which was performed at the stand-up position with the knee bent on a low and flat object. The points of each joint were marked by the same tester always – then the measurement instruments were put in place. In addition, one tester was responsible for maximum passive or active joint movement, while the other undertook the reading process of the instruments measuring joint flexibility. Maximum passive joint movement was assessed by the tester measuring the maximum joint resistance developed by the participant’s muscle group stretched. The testers were giving directions to the participants concerning the way the measurements were being performed, their length and other details as well.

There was no intermission between each joint measurement, except only the time necessary for the correct placement of the instrument on each joint. All measurements were performed under the same conditions for all participants (time of year: April; temperature: 19^{o}-23^{o}C, time: 17:00–19:00, no sport activity was performed either the day before or the day after the measurement).

Experimental protocol

In the first protocol, dynamic stretching was applied, with the muscle being rhythmically stretched to full extended joint position by means of moderate oscillation. The protocol comprised a) initial flexibilitymeasurement, b) 8-minute warm up session, c) initial sprint measurement, d) handball warm up session, e) 20-sec dynamic stretching program, repeated twice for 10-sec after a 10-sec intermission (2 ξ 10´´),f) 10-minute ball exercises session, g) 10-minute shots to goal session, h) final flexibility measurement, i) final sprint measurement.

In the second protocol, static stretching was applied, with the muscle being stretched to full extended joint position without any muscle pain involved. This protocol was similar to the first one, except that dynamic stretching was replaced by the static one, of same duration. The two programs were alternatively performed by the participants for a time span of 33.5 minutes each.

Stretching program

The stretching program was performed both statically and dynamically by the participants, so as to have their anterior (quadriceps) femoris muscles (knee bend), posterior femoris muscles (body and back bend), posterior tibial muscles (ankle bend), iliopsoas muscle (hip extension) and adductor muscles (hip abduction) stretched. Each stretching exercise lasted 10 seconds and was repeated twice. The intermission between two repetitions lasted 10 seconds, as well.
After the repetitions on each muscle group were finished, the next muscle group was taken on. All stretching exercises were performed before pain limit.

Sprint test

Both before and after stretching, the participants performed a 20m dash (sprint test) in the handball ground. The measurement was held by means of SPORT RADAR GUN, which instantaneously measures the maximum speed of an object. Sprint started from a stationary position, with one foot in front of the other – the front foot being right behind the starting line. The tester whistled the starting signal on such starting point.

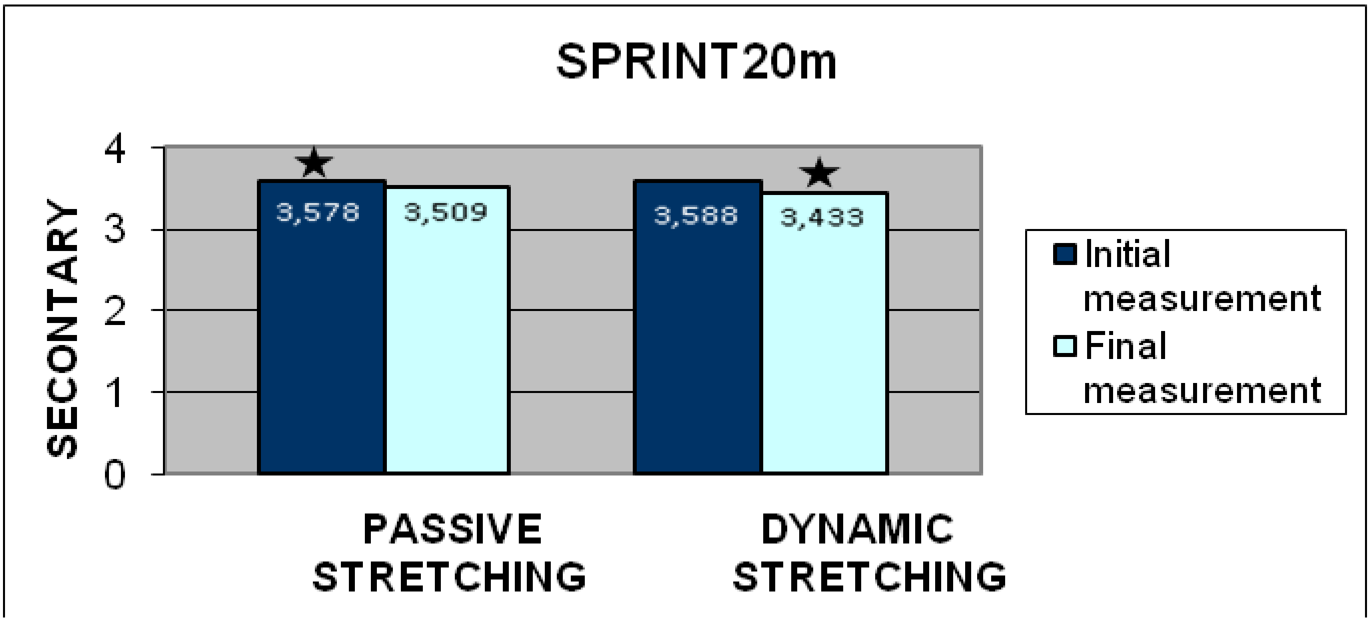
Statistical Analysis

For the statistical data analysis paired t-test analysis was applied, while the *significance level* was determined at $p<0.05$.

Results

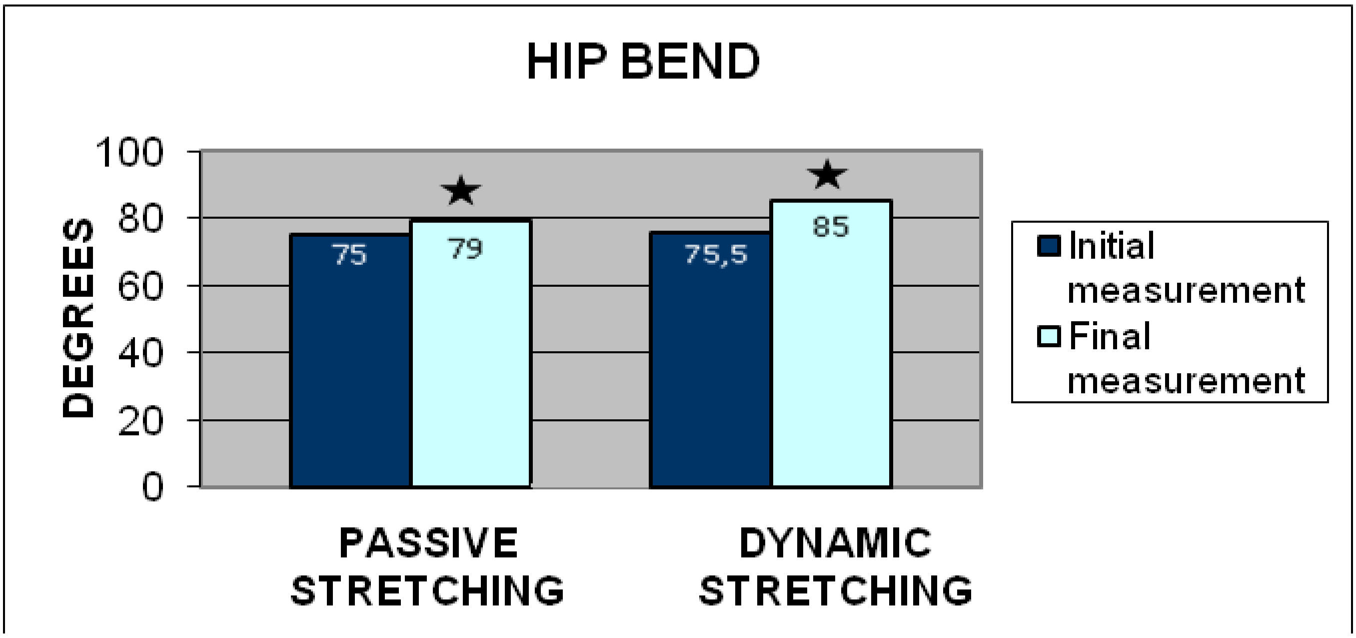
Statistical data analysis indicated that joint flexibility was statistically significantly improved ($p < 0.05$) on all joints measured after the implementation of both stretching programs. This is more analytically presented in the following diagrams, comparing the impact of the two stretching protocols on 20m sprint, the results mai ntained that, when dynamic stretching came before, handball players achieved performance in less time only in the second measurement, ($p<0.05$).

In 20m sprint, in the passive stretching protocol, it is observed that the initial measurement was 3.578 sec and the final
one 3.509 sec. In the dynamic stretching protocol the initial measurement
was 3.588 secand the final one 3.433 sec.



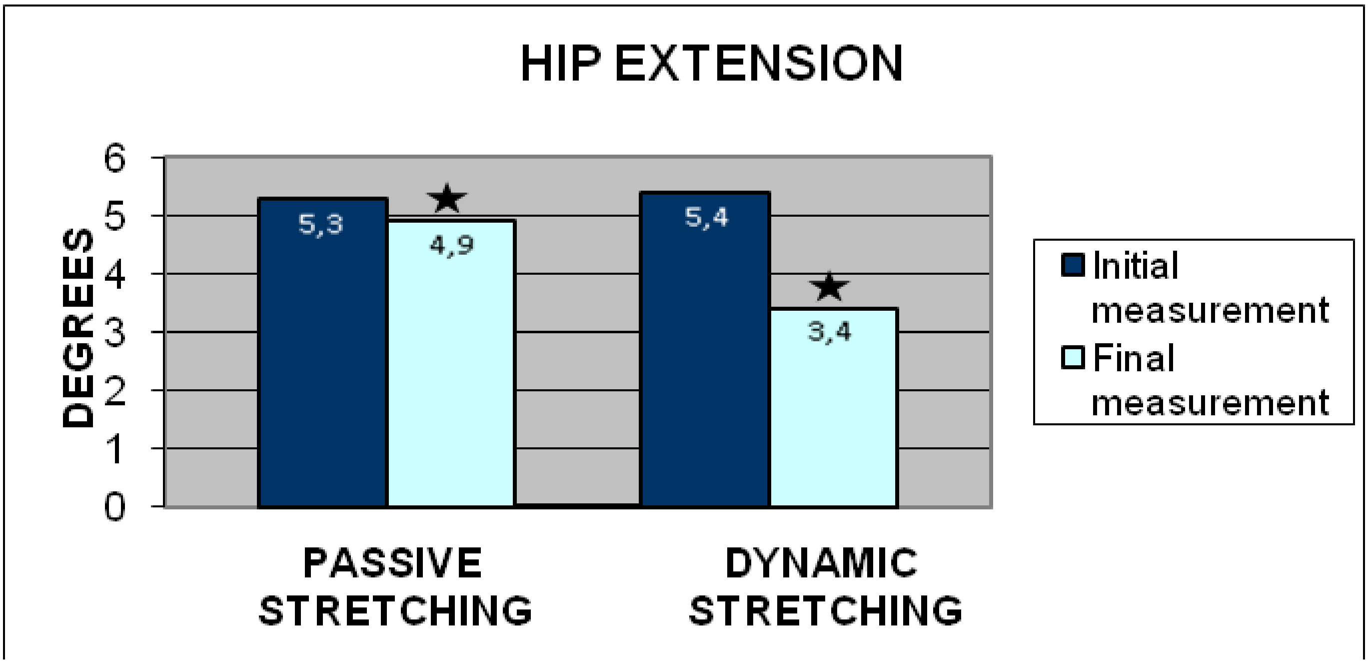
*20m sprint, before and after the implementation of stretching protocols on handball players. (*p < 0.05)*

In hip bend, when followed by the passive stretching protocol, the initial measurement was 75º and the final one 79º; when followed by the dynamic stretching protocol, the initial measurement was 75.5º and the final one 85º.



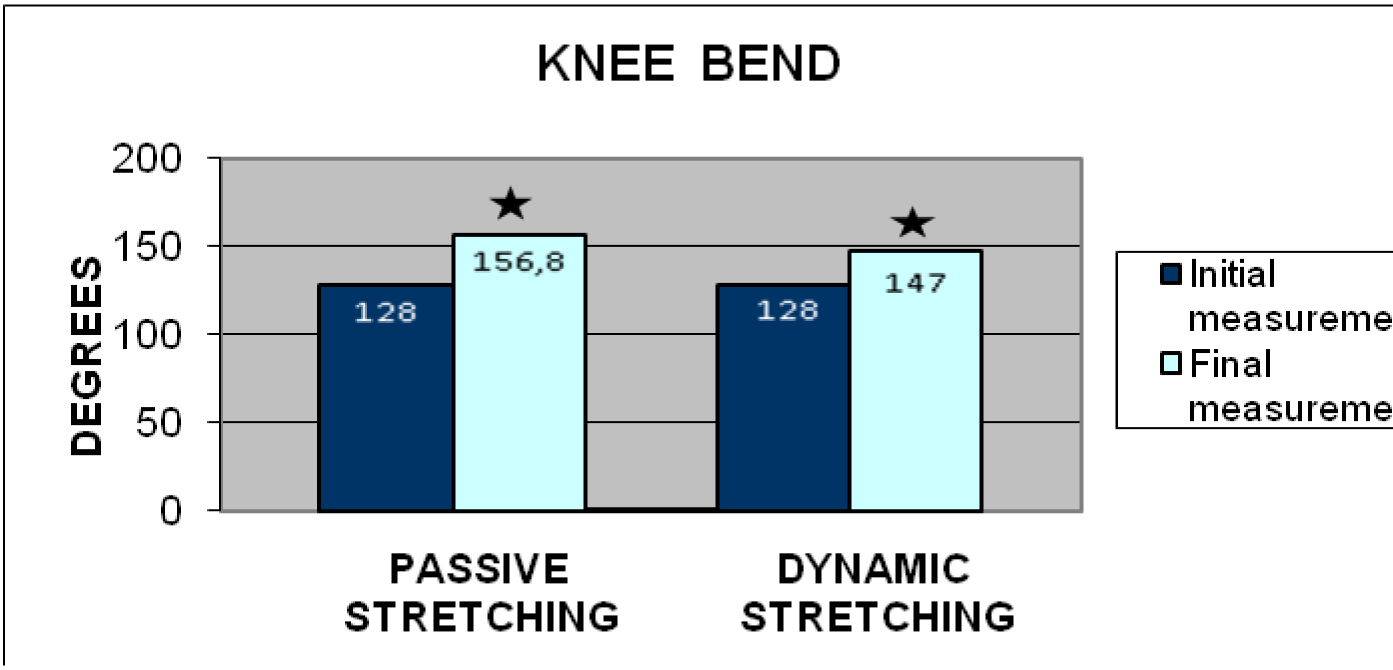
*Hip bend range of motion (RoM), before and after the implementation of stretching protocols on handball players. (*p < 0.05)*

In hip extension, in the passive stretching protocol, the initial measurement was 5.3º and the final one 4.9º. In the dynamic stretching protocol, the initial measurement was 5.4º and the final one 3.4º.



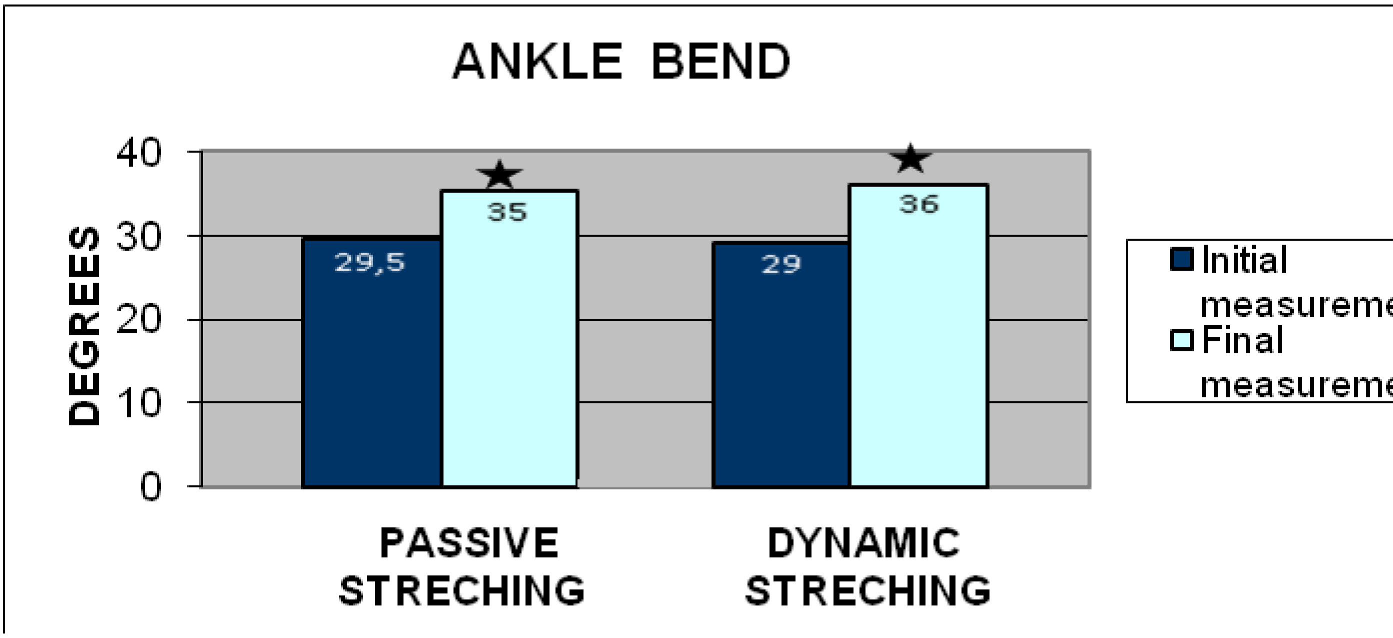
*Hip extension range of motion (RoM), before and after theimplementation of stretching protocols on handball players. (*p < 0.05)*

In knee bend, when followed by the passive stretching protocol, the initial measurement was 128º and the final one 156.8º; when followed by the dynamic stretching protocol, the initial measurement was 128ºand the final one 147º.



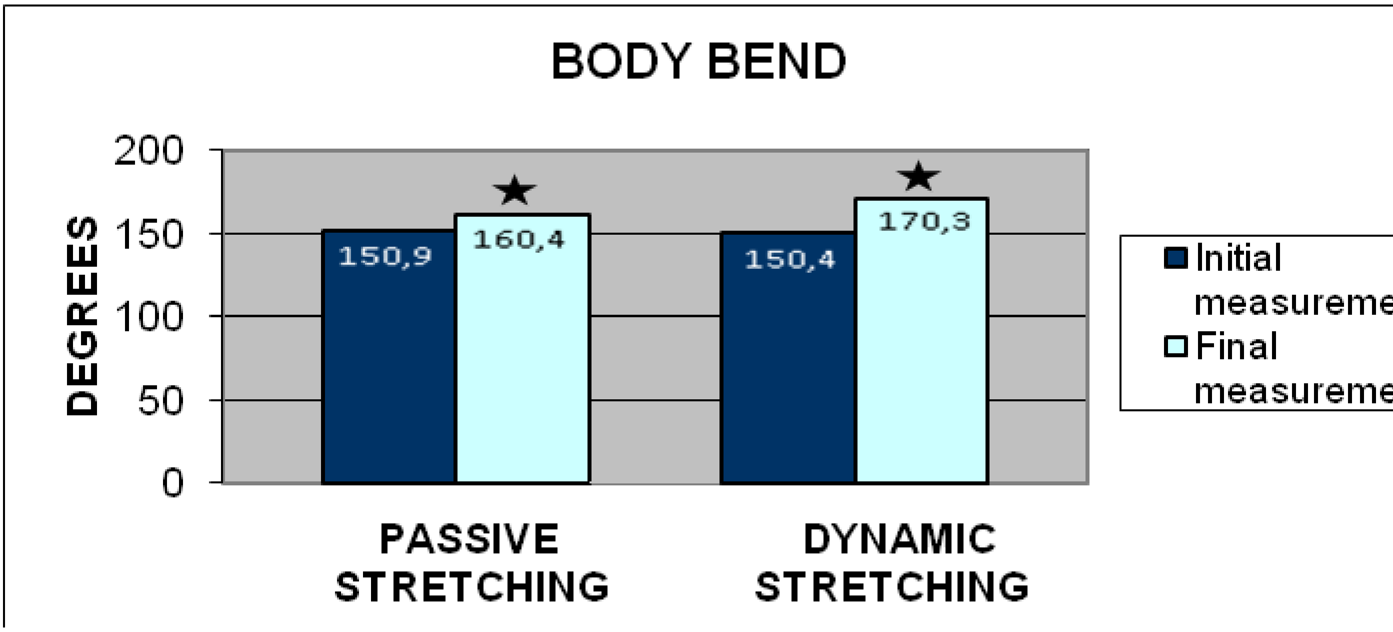
*Knee bend range of motion (RoM), before and after the implementation of stretching protocols on handball players. (*p < 0.05)*

In ankle bend, when followed by the passive stretching protocol, the initial measurement was 29.5º and the final one 35º; when followed by the dynamic stretching protocol, the initial measurement was 29º,and the final one 36º.



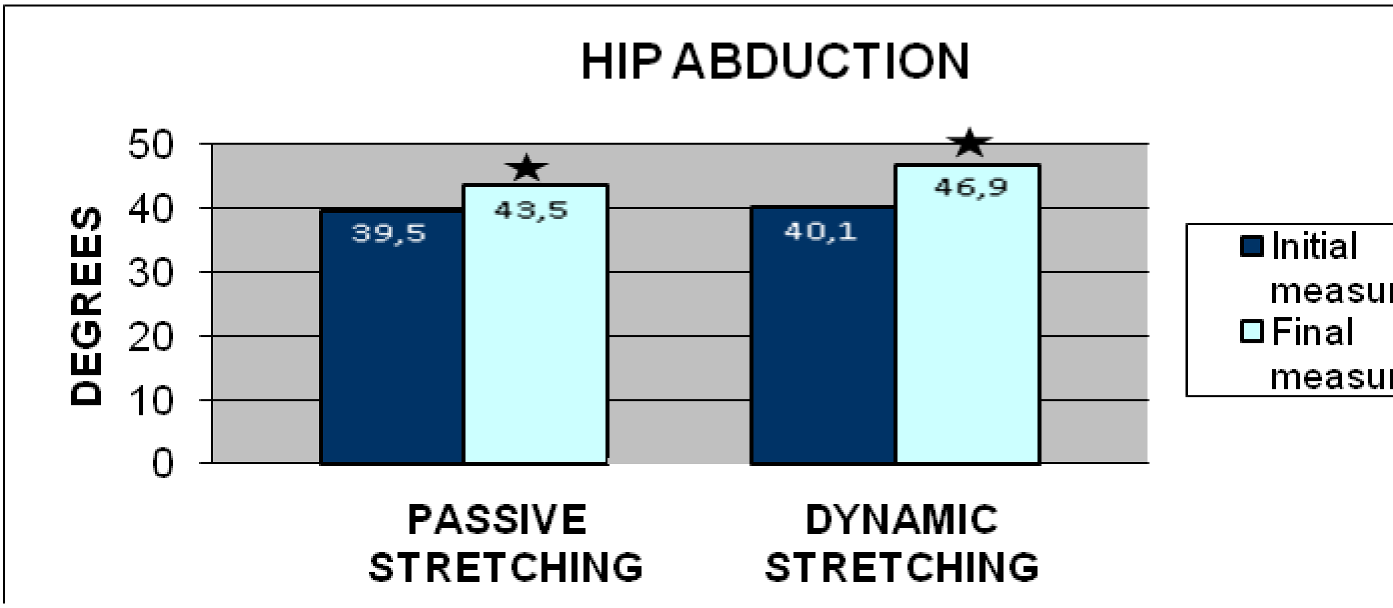
*Ankle bend range of motion (RoM), before and after the implementation of stretching protocols on handball players. (*p < 0.05)*

In body bend, when followed by the passive stretching protocol, the initial measure ment was 150.9º and the final one 160.4º; when followed by the dynamic stretching protocol, the initial measurement was150.4º and the final one 170.3º.



*Body bend range of motion (RoM), before and after the implementation of stretching protocols on handball players. (*p < 0.05)*

In hip abduction,
when followed by the passive stretching protocol, the initial measurement was 39.5º and the final one 43.5º; when followed by the dynamic stretching protocol, the initial measurement was 40.1º and the final one 46.9º.



*Hip abduction range of motion (RoM), before and after the implementation of stretching protocols on handball players. (*p < 0.05)*

Discussion

Passive stretching is widely used by athletes – and especially handball players – during warm up sessions. Recently, many handball teams have implemented dynamic stretching. The results of the present research establish that the implementation of both passive and dynamic stretching improves joint movement on all joints measured. Our results comply with other studies that investigated passive (Smith 1994,Kokkonen et al. 2006, Zakas et al. 2006) and dynamic stretching (Zakas et al. 2003). Following the implementation of stretching protocols, decrease in performance time – i.e. improvement – was observed in 20m sprint only after the implementation of dynamic
stretching. The results of the present research also comply with those of
Fletcher and Jones (2005) as well as Little and Williams (2006) concerning dynamic stretching, while they are contradictory to the results of
Fletcher and Jones (2005) as well as Kokkonen et al. (2006) concerning passive stretching.
Fletcher and Jones (2005) establisheddeterioration in sprint performance following the implementation of passive stretching, while Kokkonen et al. (2006) established improvement in the same area. Such variation of results might be due to the sample of athletes used and, mainly, the protocols implemented. The sample in the above mentioned studies consisted of high standard sprinters and the researchers' hypotheses investigated the impact of improved flexibility on the sprinters' joints. The present study investigated the immediate impact of static stretching on sprint performance, implementing stretching protocols of 20-sec. total duration, while the above mentioned studies investigated the impact of static stretching implemented in a period of several weeks.

Although the present study did not investigate any mechanisms that might be responsible for the sprint outcome following static stretching implementation, yet, other researches include potential mechanisms that might deteriorate sprint performance. Kokkonen et al. (1998), Nelson et al. (2001), as well as Cornwell et al. (2001), report potential mechanisms involved
in the decrease of musculotendinous stiffness, whileBehm et al. (2001), as well as Fowles et al. (2000) report nervous inhibitions.

Muscle tissue damage is another potential factor explaining the mechanism respons ible for decreased sprint performance, since it is observed that extended static stret ching can significantly increase muscletissue damage, as indicated by the increased levels of *creatine kinase* (CK) found in the blood (Smith et al. 1993).

Shrier (2004), also, reported that the sprint performance deteriorating mechanism, due to static stretching, in all probability relates to the damage caused to the muscle during
stretching. Stretching beyond the20% of the muscle fiber length can damage the co ntractile units, resulting in direct deterioration of strength output – and thus sprint

performance, since the latter is affected by the muscle strength applied.Despite the vast number of studies reporting potential mechanisms responsible for the deterioration of strength following static stretching, nevertheless, the exact mechanism leading to such strength deterioration is not yet clear (Behm et al. 2001).

Since the exact factors which negatively affect sprint performance have yet to be illuminated, there is a need for further research so as to extensively investigate the mechanisms that might be responsible for the deterioration in sprint performance.

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