ABSTRACT: Collagen catabolism in the locomotion system implies liberation of an increased hydroxyproline (HYP) level in winary excretion, which in turn constitutes a biochemical marker indicating damage in the conjunctive tissue. The objective of the present study was to verify the locomotion systems collagen catabolism degree through the HYP level excreted in ten (ten) non – athletes adults men’s wire, with age group between 24 to 45, submitted to dynamic stretch in liquid medium or ground medium. Four movements limited by both muscular elasticity and joint mobility were selected for dynamic stretch performance and three urine sample collections were used in laboratory. As a methodological procedure sample collection was carried out for a two hour period (2:00) post hydration, and taken to the laboratory within 3 (three) hours. The HPLC – system liquid chromatographic determination of total hydroxyproline in urine – was used with reference value of 15 – 43 mg/dL (Cherneeky et al., 1993). The first collection was carried out 24 hours before the dynamic stretch to verify the basal level of HYP as sample group reference of volunteers. The second and the third collections were carried out 24 hours after the dynamic stretch was accomplished in both means. The results found for HYP levels (for p= 0.05) were for the basal level 39.07 ± 15.27; for the levels 24 hours post – ground training were 71.28 ± 12.15 and for the levels 24 hours post-water training were 66.74 ± 10.31. From the results it is concluded that there is difference between the basal instants and the 24 hour post – training, indicating therefore the occurrence of damage of the conjunctive tissue. The direct analysis among the environments didn’t present a significant difference (for p < 0.05). In spite of the occurrence of damage in both means with the results obtains, it isn’t possible to conclude which mean can prevail for the training with lesser risk of damage.

Keywords: locomotion system, lesion, collagen, hydroxyproline and stretch.
INTRODUCTION

The progressive understanding of the society about their concerning needs at an appropriate health level and of better physical conditioning seems to induce the appearance of a phenomenon relative to the increase of the population participation in physical activity programs.

For lesions prevention and prophylaxis, needs to elaborate and promote safe methods for the physical conditioning related to the health, as for the specific performance training.

Studies point a complex relationship of risk factors between muscular-skeleton lesion and exercise. The risks of these kinds of lesions increase in agreement with the intensity levels and training duration. Between the most common adverse effects of the regular exercise and of the physical activity for the individuals of all ages meets the muscular-skeleton lesion (ACSM, 2003).

Dantas (2003) defines the flexibility as the responsible physical quality for the voluntary execution of a maximum angular width movement, for an articulation or group of articulations, inside of the morphologic limits, without the risk of provoking a lesion. The same author affirms that the flexibility training (stretching) improves the physical acting and makes possible the risk decrease of muscular-skeleton lesion. In spite of this, it suits to stand out that the ideal flexibility level and of the training intensity still a susceptible to controversy subject.

In agreement with ACSM (1998), the flexibility includes the movement’s width, even the simplest that involve multiple articulations.

Graph 1 - Decrease of the Articulation Width with the chronological age increase

Source: DANTAS, 2002
lations, and the ability of carrying out specific tasks. This physical quality decreases with age. Regressive changes in all tissues can be observed starting from the 20 years old, being verified decrease of the movement’s width in about 20 to 30%, between the 30 and the 70 years old.

The limitations of the articulations width for the increase of the number of lived years happen more about certain articulations, as display the graph that proceeds:

According to Fox; Bower; Foss (1991), between the factors that influence the flexibility, are the articulation mobility (47%) and the muscular elasticity (41%) the factors of larger resistance for obtaining of the articular arches.

Exists two basic types of flexibility: the static, related to the movements width of an articulation, without emphasis in the speed nor in the final posture maintenance; and the dynamics, expressed by the maxim articular movement width in the performance of a physical activity, without, therefore, conserve the final position, with normal or increased speed (NORKIN; WHITE, 1997).

In agreement with Dantas (2005), the stretching is a “work form that seeks to obtain a flexibility improvement through widths of superiors articular arches movement to the originals”, in other words, the work will take place in maximum levels of the articular widths. This work can be accomplished, according to the author, through two methods: the static stretching and the dynamic stretching.

The present study refers to the dynamic stretching that consists of the accomplishment of dynamic exercises that, due to the inertia of the corporal segment, result in a ballistic nature moment, pointed as “intense dynamic prolongation.”

When searched for superior movement’s arches to the originals, there will be a overload on muscles, articulations, ligaments and tendons very close to the lesion threshold of those structures. Therefore, to know how to workout in the most possible intense way, minimizing the micro risk or, even of macro lesions is a subject that interests all the linked health professionals to the human movement.

The fact of an articulation present mobility and stability, at the same time, it makes the problem to appear in subject, that is, the need to analyze with the imperatives criteria of the stretching in each articulation and in each movement, making possible to minimize the risks of osteoarticular lesions.

The muscular suffering is intimately related with damages in the conjunctive tissues associated to the muscle. Abraham’s investigations (1977; 1979, apud ALTER, 1999) confirm this theory; because, through his research, this author revealed a significant positive correlation between urinary HYP excretion and subjective incidence of muscular suffering and irritation or damage of the conjunctive tissue.

The conjunctive tissue is damaged in larger extension, following by eccentric contraction, due to a larger passive tension on it (SUTTON, 1984, apud ALTER, 1999). With base in this theory, it is possible to infer that the conjunctive tissues, including the tendons, are susceptible to suffer lesion so much in force work, as in stretching; exercises that cause tension and flexibility exercises strengthen the tendons, the ligaments and the muscles, allowing like this, a good articular width (DANTAS, 2005).

The conjunctive tissue, constituted by fibrous proteins, is popularly considered the “cement” of the human organism and it is abundantly present in several structures, as skin, fascias, ligaments, tendons, articular capsules and muscular fascias. Each one of those structures possesses different influence degree in the limitation of the maximum width of movement; in other words, of the flexibility (DANTAS, 2003). In what concerns the collagen, this is the most abundant protein in the human body, having its specific structural function (WYNGAARDEN; SMITH, 1984), being found in the skin, conjunctive tissue, sclera, cornea and blood vessels walls. In the course of time, the collagen increases in solubility, becoming thicker, suffering an increment in content in the muscle, with consequent decrease in the movement width (DANTAS et al., 2002). This, for its time differs in their chemical properties for its content in amino acids, with a third of the amino acids residues being constituted by glicine and the other third by proline, hydroxyproline (HYP) and alanine.

The HYP is an amino acid present in great amount in the collagen, approximately 14% of the molecule collagen, constituent of the bone matrix, does not comes from dietary sources, but of the hydroxylation of the proline during the initial stages of the collagen biosyntheses.

It is possible to verify the HYP levels in the urinary excretion through laboratorials exams and, like this, once considered as biochemical marker of the bones formation and reabsorption, the increase of their levels in the urine indicates collagen catabolism of the locomotor apparel; post-exercise lower levels characterize a smaller degree of micro lesion on the mentioned apparel. Like this, it is possible to infer that to verify the smallest collagen catabolism in certain training atmosphere (liquid or terrestrial) can indicate the most insurance way of accomplishing the stretching.

**METHODOLOGICAL PROCEDURES**

**Subjects Selection**

For determination of the sample size, comes from the data obtained in the pilot study that made possible the accomplishment of a study of the power of the experiment according to the appropriate protocol (BURNES, 2000).

The volunteers’ group was constituted of 10 integral men of the Center of Qualification of Professionals of safety of the Military police of the State of Rio de Janeiro (PMERJ), inserted between the age group of 24 and 45 years. The subjects that participated in the investigated group assisted to the following inclusion criteria: any apprentice of physical activity in a systematized way; non users of ergogenic-nutritional, pharmacological or physiologic resources, alcohol or any other resource that could influence the hydroxyproline levels in the urinary excretion; none of the subjects presented significant muscle skeleton overload; and all presented favorable health condition.

**Collection of Data**

The study was accomplished in three stages: preliminary procedures, intervention in the liquid and terrestrial environments (dynamic stretching accomplishment) and urine collection 24 hours after the interventions.
Preceding the stages, the limited movements were selected by the muscular elasticity and articular mobility for the dynamic stretching accomplishment.

First, the HYP basal level was verified in the urinary excretion of the group (referential of the volunteers’ group) before the dynamic stretching, having as reference value the HYP level for older than 21 years, from 15 to 43 mg/d, according to Wynaarden and Smith (1984); for the second stage, the subjects were submitted to the dynamic stretching in the liquid and in the terrestrial environment. The intervention was accomplished in the same way in both environments. Each articular movement was worked in 3 series of 10 repetitions / insistences, with movement alternation for articulation. The four selected movements involved the shoulder and hip articulations, being two for each articulation. The first exercise was: waist scapular retraction (Photo 1); the second, scapular waist protation (Photo 2); the third party, flexing of the hip articulation (Photo 3); and the fourth exercise, extension of the hip articulation (Photo 4). And, finally, in the third stage the subjects collected the urine 24 hours after the dynamic stretching accomplishment (the intervention) for laboratorial verification of the HYP level, according to the procedures and suitable orientations.

The statistical procedures used for an appropriate analysis of the picked data were worked in the following way: descriptive statistics, inferential statistics; significance analysis of the means differences and significance level and potency of the experiment.

The descriptive statistics was used, aiming to define the data group profile, were calculated the location and dispersion measures; among the first ones, are given mean and median, central tendency measures, in other words, they identify the location of the data group center.

Two basic procedures of inferential statistics were accomplished: Normality analysis and Significance analysis. And for the first the test of Kolmogorov-Smirnov was accomplished for a sample (BUNCHAFT and KELLNER, 1999), with $\alpha = 5.00\%$. This analysis was developed to characterize the probability distribution of the studied group, aiming to identify the proximity with the Normal Distribution. For the Significance analysis, basing on the previous results, was opted to use the non parametric test of Wilcoxon (SIEGEL, 1957). The experiment potency can be calculated (BUNCHAFT; BURNS, 2000; and KELLNER, 1999; COSTA GRANDSON, 2000) and for the significance level, this was equal to 5.00%.
**RESULTS**

The descriptive results of the subjects are presented in the table 1, as for the physical characteristics, as age, stature, total body mass (Weight) and body mass index (BMI).

Analyzing the table 1, it was observed that the group presented age of 32.47 ± 6.08 years; therefore, according to the World Health Organization (WHO), of the point of view of the process of Man’s Aging and Development, the Classification of the Age groups is inside of the Ages Young (18-30 years) and Mature (31-45 years).

It also deserves prominence the estimate pattern error that came high for the “Weight” variable; therefore, there is no expectation of results maintenance, when considered another experimental group, even if similar to the used in the present work.

After accomplished the data collections in the specific moments: basal, 24 hours after terrestrial training and 24 hours after water training, the results were organized and put in table with specific times, suitable in the table 2.

Analyzing the table 2, it was observed that the group presented level of basal hydroxyproline of 39.07 ± 15.27 mg/d. According to Wyngaarden and Smith (1984), the values of laboratorial references of clinical importance for individuals older than 21 years old are around 15 and 43 mg/d, therefore, the basal verification is inside of the laboratorial references in agreement with the age group. It is also observed that the level of basal hydroxyproline presented high dispersion (CV > 20.00%), therefore, except this, the other variables have in the mean the best estimate of central tendency.

Stands out that the estimate pattern error that came high for the “HYP-basal” variable, for that there is no expectation of results maintenance, when being considered another experimental group, even if similar to the used in the present work.

(WYNGAARDEN E SMITH, 1984)

The group presented significant increase (for p < 0.05) of the hydroxyproline levels after the specific trainings (PTT and PTA), when compared at the basal levels. Therefore, the accomplishment of the dynamic stretching in both environments made possible the occurrence of micro lesion. In consensus with the literature, Martin et al. (2002) and Brown et al. (1999) infer that the identification of the collagen levels related to the biochemical components is decisive in the lesions verification for the molecular bioactivities increase. Knowing about this relationship of the collagen components levels (in degradation) in the urinary excretion, this study verified the relationship between stretching exercises, lesion occurrence in the connective tissue and hydroxyproline levels excreted in the urine.

**ANALYSIS OF THE NORMALITY**

Aiming to verify the Normality of the group, the Kolmogorov-Smirnov Test (TKS) was used, because this test is adapted to

<table>
<thead>
<tr>
<th>Table 1 - Experimental group characteristics</th>
<th>Variable</th>
<th>Mean</th>
<th>Md</th>
<th>α</th>
<th>s</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>32.47</td>
<td>32.50</td>
<td>1.57</td>
<td>6.08</td>
<td>18.72%</td>
<td></td>
</tr>
<tr>
<td>Stature</td>
<td>177.33</td>
<td>179.50</td>
<td>1.43</td>
<td>5.55</td>
<td>3.13%</td>
<td></td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>87.13</td>
<td>91.00</td>
<td>3.94</td>
<td>15.24</td>
<td>17.49%</td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>27.07</td>
<td>27.95</td>
<td>1.19</td>
<td>4.61</td>
<td>16.30%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2 - Levels of HYP in specific times</th>
<th>Variable</th>
<th>Mean</th>
<th>Md</th>
<th>α</th>
<th>s</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>HYP - Basal</td>
<td>39.07</td>
<td>36.00</td>
<td>5.16</td>
<td>15.27</td>
<td>39.08%</td>
<td></td>
</tr>
<tr>
<td>HYP-24h (after water training)</td>
<td>66.74</td>
<td>65.07</td>
<td>10.31</td>
<td>4.73</td>
<td>14.45%</td>
<td></td>
</tr>
<tr>
<td>HYP-24h (after earth training)</td>
<td>71.28</td>
<td>69.12</td>
<td>12.15</td>
<td>7.38</td>
<td>17.04%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 3 - Evaluation of the Experimental Group Normality</th>
<th>Variable</th>
<th>p-Value</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>HYP-Basal</td>
<td>0.01</td>
<td>Doesn’t follow Normal distrib.</td>
<td></td>
</tr>
<tr>
<td>HYP-24h (after water training)</td>
<td>0.00</td>
<td>Doesn’t follow Normal distrib.</td>
<td></td>
</tr>
<tr>
<td>HYP-24h (after earth training)</td>
<td>0.01</td>
<td>Doesn’t follow Normal distrib.</td>
<td></td>
</tr>
</tbody>
</table>

**Picture 1 - Laboratorial values of biochemical clinical importance**

<table>
<thead>
<tr>
<th>Exam</th>
<th>Specimen</th>
<th>Reference Variation</th>
<th>Reference Variation (international measures)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydroxyproline</td>
<td>Urine 24 h</td>
<td>Age</td>
<td>Mg/d*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 – 5 years</td>
<td>20 – 65 mg/d</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6 – 10 years</td>
<td>35 – 99 mg/d</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11 – 14 years</td>
<td>63 – 180 mg/d</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18 – 21 years</td>
<td>20 – 55 mg/d</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 21 years</td>
<td>15 – 43 mg/d</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>µ/umol/d*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 – 5 years</td>
<td>150 – 496 µmol/d</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6 – 10 years</td>
<td>270 – 750 µmol/d</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11 – 14 years</td>
<td>480 – 1370 µmol/d</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18 – 21 years</td>
<td>150 – 420 µmol/d</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 21 years</td>
<td>114 – 330 µmol/d</td>
</tr>
</tbody>
</table>
verify if the variables are close of the normality or of the normal distribution.

As the data presented in the table 3, it was verified that the estimates of p-value for TKS, are below 0.05, so the variables do not follow the normal distribution.

The results of the table 3 indicate that the HYP levels in these three instants don’t present distribution probability close to the Normal distribution. Therefore, the inferential analysis of those varied will follow the non-parametric approach (COSTA NETO, 2000), which was executed through the Wilcoxon Test. The use of this was appropriate done for the group in pair (SIEGEL, 1957).

**Result of the test of h yp levels comparison**

After accomplished the data collections in the experimental pre and post test group, the results were organized and put in table and graph with specific instants. The collected data were organized in three instants: basal → 24 hours after the water training; basal → 24 hours after earth training and 24 hours after water training → 24 hours after earth training.

Considering the existence of statistically significant difference between the levels of basal hydroxyproline and 24:00 after earth training, came in a more decisive way than observed between basal and 24:00 after water training. Consequently, in spite of also happen in the aquatic way, in that adapts the lesion was shown less effective than in the terrestrial. The direct comparison between the atmospheres didn’t point significant difference for the found difference of 1.00%, the one that, probably, might have happened for the intervention intensity. Besides, the lack of commitment with the orientations supplied to the volunteers can also have impacted the results, and that was not possible to check such influence.

In sense to prevent and made the prophylaxis of lesions, in the exhaustion of the potential acting and of an ideal training adjustment, the flexibility training is an element that cannot be substituted or unknown in the process of physical conditioning, independently of the accomplishment means, in the terrestrial or liquid way.

It is considered imperative to know the benefits and risks, in short and long period, of the exercises programs; because the risk factors knowledge is essential to help to prevent the possible current lesions of the physical training.

It is possible to infer that the conjunctive tissues, including the tendons, can suffer micro lesion in a work of dynamic stretching, so much in the liquid as in the terrestrial environment, in spite of considering that exercises that cause tension and exercises of flexibility strengthen the tendons, the ligaments and the muscles. For consequence, such exercises can determine the prevention or the unchaining of the muscle-skeleton lesions. In last analysis, it is possible to accept an existent significant correlation between the practice of physical activities and the osteoarticular health; in other words, the form of the work (to workout) can prevent or provoke muscle-skeleton lesion. Like this, in agreement with the literature, a complex relationship of risk factors exists between lesion muscle-skeleton and exercise.

It is ended that the lesion risks can increase, in agreement with the intensity levels and training duration. Therefore, to determine the ideal flexibility level and of the training intensity still a controverted subject, mainly in the knowledge, prevention and decrease of the lesion risk.

With base in what aims to the flexibility training, the stretching makes possible superior widths arches movement to the originals, and the involved muscle-conjunctive structures are submitted to an extreme stretching, with risk of provoking damages to the conjunctive tissues. These possible damages were verified, in this study, through the hydroxyproline levels excreted in the urine of the subjects submitted to the dynamic stretching, in the liquid and terrestrial environments.

The direct analysis between the atmospheres, in that concerns the lesions occurrence, it didn’t present significant difference (for p < 0.05), in spite of the aquatic atmosphere present an indication of smaller benefit of micro lesion (infragroup analysis); the data prove the non significant difference (p = 0.06). Like this, it is possible to conclude that the results obtained in this study, in spite of the occurrence of the lesions in both environments, don’t allow to affirm that preponderance exists of some of the environments in what says respect to the indication of training with smaller lesion risk.

**BIBLIOGRAPHICAL REFERENCES**


