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Coronary flow and physical activity

Latino Francesca[1], Mazzeo Filomena[2], Tafuri Domenico[3]
[1]*Department of Biomorphological and Functional Sciences, University of Naples Federico II, Italy*
[2]*Department of Science and Technology, University of Naples Parthenope, Italy*
[3]*Department of Sport Science and Wellness, University of Naples Parthenope, Italy*

Abstract. Inactivity is one of the major risk factors for heart disease. However, exercise helps improve heart health, and can even reverse some heart disease risk factors.
A sedentary (inactive) lifestyle is one of the top risk factors for heart disease. Fortunately, it's a risk factor that you can do something about. Regular exercise, especially aerobic exercise, has many benefits. Regular aerobic physical activity increases exercise capacity and plays a role in both primary and secondary prevention of cardiovascular disease.
Like all muscles, the heart becomes stronger as a result of exercise, so it can pump more blood through the body with every beat and continue working at maximum level, if needed, with less strain. The resting heart rate of those who exercise is also slower, because less effort is needed to pump blood.
A person who exercises often and vigorously has the lowest risk for heart disease, but any amount of exercise is beneficial. Studies consistently find that light-to-moderate exercise is even beneficial in people with existing heart disease. Moreover, anyone with heart disease or cardiac risk factors should seek medical advice before beginning a workout program.
Exercise has a number of effects that benefit the heart and circulation. These benefits include improving cholesterol and fat levels, reducing inflammation in the arteries, helping weight loss programs, and helping to keep blood vessels flexible and open.
The known benefits of regular aerobic exercise and current recommendations for implementation of exercise programs are described in this revised report.
Key words: *physical exercise, rehabilitation, cardiovascular disease, coronary flow*.

Introduction

Morfo-functional fluctuations of coronary vessels and coronary illness constitute the principal causes of death and invalidity in industrialized countries (1,2).
Full cardiac rehabilitation comprises training, counseling, appropriate medical and surgical treatment, suitable nutrition, abstention from smoking, maximum check of hematic lipids and blood pressure and a physical exercise program (3,4). These items all constitute a vital part of the therapy to be adopted in the case of patients who are post-infarct or have undergone a coronary by-pass.
Over the past 30 years, physical training has become the most effective part of rehabilitation and it has been the target studied by researchers (5). In the beginning, the principles of this cognitive behavioral therapy were greatly guided by a traditional school of thought: they were based on behavioral models and less attention was given to cognitive processes.
By contrast, the modern approach concentrates more on social cognitive and environmental factors. Contributions made by Multiple Risk Intervention Trial, and by the *Lipid Research Clinic Coronary Primary Prevention Trial and by STA Ford Five-City Project* (6), who have urged people to effect long-term changes over the years, have been inspired by theories of social learning.

Epidemiology

The physical activity described involves energy consumption of the skeletal musculature. Physical-fitness is a combination of essential practices when doing physical exercises and these involve the metabolic, hemostatic, cardiovascular, lung and neuromuscular systems (7,8). The amount of physical activity performed influences the patient’s health, the quality of life and longevity.
In the past, when people performed more physical activities, epidemiological studies were carried out in order to establish the muscular power required for different types of jobs (9).

Numerous random clinical trials have been carried out on the effects of physical education programs and on modification of risk factors regarding survival of post-myocardium patients (8). Obviously, physical education programs and modification of risk factors in treating coronary pathologic patients is of vital importance. It has been proved that these programs can have a positive effect on future morbidity and mortality subsequent to the first myocardial infarction. These trials suggest that exercise and modification of risk factors can have an important role in treating patients who are undergoing myocardial revascularization (10).

Optimal Physical Exercise

Taken strictly from a physical point of view, rehabilitation is initiated at the end of hospitalization and takes up physical activity from where it was left prior to cardiac disease or in cases where patients have led sedentary lifestyles (10,11). Such activity is slow and the intensity is established on the basis of stress tests to be effected within the first two months of the event. Generally, if a patient has recuperated satisfactorily at the start, his rehabilitation program can be agreed upon with the cardiologist during check-up and it therefore unnecessary to attend a rehabilitation centre.

However, prolonged hospitalization or an out-patients' centre is prescribed quite frequently to patients who are at risk in order to guarantee better results from the "Physical Reconditioning Program" (12).

In order to guarantee safe and efficient rehabilitation, as well as to ensure compliance, it is necessary to know the patient's health risks. In practice by taking into consideration myocardial ischemia, the functioning of the left ventricle of heart, the clinical course of the illness during hospitalization and the result on stress tests (limited to symptoms) (10,11), it becomes possible to categorize patients according to risk factors (13).

1. Low-risk patients: patients with uncomplicated clinical-hospital course history; patients without signs of myocardial ischemia; patients with functional capacity greater than 7 METS; patients with normal left ventricular function (ejection fraction >50%) and without significant premature ventricular contraction.
2. Intermediate Risk Patients: patients with ST segment depression > 2 mm; patients with reversible uptake of tallium defect at myocardial scintigraphy; patients with moderate/good left ventricular function (ejection fraction 35-49%); patients with recent-onset angina or angina has changed its properties.
3. High-Risk Patients: post-infarction patients with left ventricular involvement of 35% or more; patients with left ventricular function >35%; patients with systolic blood pressure decrease or its failure to increase during stress test; patients with recurrent or persistent angina; patients with functional capacity <5 METS and hypotensive blood pressure response or ST segment depression > 1 mm; patients with heart failure episode during hospitalization; patients with ST segment depression of 2mm to medium-low average load; patients with significant premature ventricular contraction.

On the basis of the patient's history, laboratory and instrumental tests, functional capacity, and also the patient's risk probabilities (low, intermediate and high) as well as the patient's personal expectations, it is possible to prescribe one of the following rehabilitation programs which also includes a physical exercise plan: hospitalization; out-patients; a mixture of both; hospitalization (at the end of stress tests during therapy); out-patients (at the end of stress tests in pharmacological wash-out); personalized (varying according to degree of complication).

In the past, cardiological rehabilitation is treated in three phases: 1st phase (acute stage of illness) - early mobilisation and rehabilitation program planning; 2nd phase (post-acute) - intensive program lasting several weeks; 3rd phase (maintenance) - long-life intervention.

At the moment, distinction is made on the basis of risk conditions of the patient and the degree of illness, the type and duration of treatment: *intensive rehabilitation, intermediate rehabilitation, extensive rehabilitation.*

Intensive Rehabilitation (Tab I). Treatment applied to patients at intermediate-high risk levels in acute and post-acute phases of the illness and periodic reassessment on a long-term basis for patients at high risk (10,13). This type of rehabilitation is mainly carried out as hospital stay.

Table I. Intensive rehabilitation

INTENSIVE REHABILITATION		
Days	**Mobilization**	**Other activities**
1st day	Supine to 30°-45° Breathing Exercises Passive exercises	
2nd day	Free exercises	Washing yourself partially Eating by yourself
3rd day	Active exercises (5-10 reps twice daily) Chair 15’	Washing to the sink while seated
4th day	Active exercises Chair 30’ Walking around bed	Washing to the sink
5th day	Active sitting exercises	Eating at the table
6th day	Active standing exercises Walking in the room	Eating at the table
7th day	Active standing exercises Walking in the room + 6 steps	Going to the bathroom with supervision

Intermediate Rehabilitation (Tab. II). Treatment applied to patients at intermediate-low risk levels in post-acute phase of the illness and periodic reassessment on a long-term basis for patients at intermediate and high risk (10,13). This type of rehabilitation is carried out either at home or in out-patients rehabilitation centers. The intensive and intermediate phases correspond to the first and second traditional phases. To obtain maximum benefit from a training program patients must carry out exercises which involve the muscles of the entire body and are repeated on a regular basis: maximum attendance should be three times a week, alternate days, to allow full recovery (6). Physical training must be controlled via Telemetry.

Table II. Intermediate rehabilitation

INTERMEDIATE REHABILITATION		
1st Week	**Warm-up** **Exercise** **Warming down**	Breathing Exercises: 5 minutes Free standing exercises, 1st level: 10 minutes Stretching Cyclette: 10 minutes Cooling down: 5 minutes
2nd - 3rd Weeks	**Warm-up** **Conditioning** **Cool-down**	Breathing Exercises: 5 minutes Free standing exercises, 1st level: 10 minutes Stretching Cyclette 25 watt: 20 minutes or treadmill 2.7 Km/h Cool-down: 5 minutes

Extensive Rehabilitation (Tab. III): The main aim of this phase is to allow the patient to improve his physical condition. Patients enter this phase once their health is resumed from a medical point of view and the objectives of the therapy by means of physical exercise have been accomplished (10,13).

After 2-6 weeks of convalescence at home, the patient can then begin the real phase which is maintaining the rehabilitation treatment. The training program is planned bearing in mind the patient’s individual requirements and the sessions are usually organized three times a week at the Rehabilitation Centre.

Patients should be guaranteed constant medical supervision which includes registration of electrocardiogram and the presence of specialized personnel (11).

Besides the training program, patients should be advised about *stress* treatment, abstention from smoking, diet and weight loss (4). The duration of this phase is about 3-6 months.
The program has to be adapted to the patient according to various elements which are, in order of importance, the patient's age, sex, associated pathologies, muscle-skeletal situation, motivation and acceptance of physical exercise, and last, but of not least importance, the results of the ergometric tests and categorization of final risk (14,15).

EXTENSIVE REHABILITATION		
4th – 12th Weeks	**Warm-up**	Breathing Exercises: 5 minutes Free standing exercises, 1st level: 5 minutes
	Conditioning	Free standing exercises, 1st and 2nd level Stretching Cyclette or treadmill: 20 minutes with incremental workload in order to maintain training heart rate mesasured during stress test Walking (300 m) + 2 stairs
	Cool-down	Breathing Exercises: 5 minutes Free standing exercises, 1st level: 5 minutes Stretching

Table III. Extensive rehabilitation

Sessions are organized either on a daily basis or three times a week: daily sessions are necessary for elderly patients and for those who require a very gentle progression of the training regime. Exercises will include free standing exercises and bicycle sessions or treadmill (16, 17). On the basis of level of tolerance of these exercises in the case of strain, a program can be designed.
It is, nonetheless, counterproductive to make the patient work intensively against his will in as much as the patient's functional capacity will improve with both brief periods of intensive training and long periods of less intensive training.
It is always worth remembering that the principle of training is reached when the exercise is brought almost to the limit of the anaerobic threshold – Low Intensity Exercise=<40%VO_2max, Moderate Intensity Exercise = <60%VO_2max (17, 18).
As it is not possible to directly measure the $V0_2$ max value the maximum heart rate reached will be used with the ergometric test and two possible criteria will be considered (19): the percentage of the maximum heart rate and Karvonen formula.
In the first case the cardiac frequency between 50% and 80% interval of max heart rate is to be maintained, while in the second case we will get The patient is actively involved in his rehabilitation recovery, either by teaching him to the heart rate range, taking into account the basal heart rate (19,20).
measure pulse and count his heart rate, or either by utilizing an *effort intensity scale* like the Borg scale. The session begins with a warm-up phase, including gentle body exercises mainly muscular stretching exercises, after which endurance training or interval training is carried out. This last type of training which is carried out either by body exercise or on apparatus, alternates periods of work out (pre-established intensity) with periods of non work out or minimum work out, and is very useful to patients who suffer from: Angina pectoris, under-trained, Aged patients with left ventricular contractile dysfunction (19,20).
Continuous training guarantees maximum recovery of functional capacity and this is evident from testing at Ergometric Bicycle (Tab. IV) or at the treadmill. Endurance training is the form of exercise which allows the maximum increase of aerobic capacity. The following activities are to be preferred: bicycle-ergometer and treadmill walking.

Conclusions

During the exercise training process, there is an increased hemodynamic load on heart of the athletes. One basic compensatory mechanism that happens in the heart is myocardial hypertrophy,
which is defined as an increase in the left ventricular mass (21). This article confirms the benefits of exercise-based cardiac rehabilitation

Table IV. Workout with cyclette

Warm-up	Exercise	Warming down
Low impact Workload from 0 to training exercise 3-5 minutes	High impact Increasing workload 15 minutes	Low impact Decreasing workload 5 minutes

within the context of today's cardiovascular diseases.
Data clearly indicate that physical activity is associated with decreased cardiovascular risk. No previous study has assessed the association of duration of exercise episodes, apart from its contribution to total energy expenditure, with coronary heart disease risk. Two trials investigated the effects of short versus long sessions of exercise on cardiovascular risk factors (15). Furthermore, they lend some support to recent recommendations that allow for the accumulation of shorter sessions of physical activity, as opposed to requiring 1 longer, continuous session of exercise. This may provide some impetus for those sedentary to become more active (22,23). This Study continue to show that physical activity and avoiding high-fat foods are the two most successful means of reaching and maintaining heart-healthy levels of fitness and weight (24,25)
Exercise training, in fact, increases cardiovascular functional capacity and decreases myocardial oxygen demand at any level of physical activity in apparently healthy persons as well as in most subjects with cardiovascular disease. Regular physical activity is required to maintain these training effects. The potential risk of physical activity can be reduced by medical evaluation, risk stratification, supervision, and education (26-28). Data recommends that individuals perform moderately-intense exercise for at least 30 minutes on most days of the week.
Moreover, Klasnja et al. showed that Athletes demonstrated greater maximal cardiac pumping capability and reserve than non-athletes (29,30). Further studies are needed to evaluate maximal cardiac pumping capability in athletes of different sports and to assess its association with the athlete's performance.

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Corresponding Author
Filomena Mazzeo
Department of Science and Tecnology
University of Naples Parthenope
Naples, Italy
E-mail: *filomena.mazzeo@uniparthenope.it*

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Advantages and limitations of generic tools for evaluating the quality of life in patients with spastic hemiparesis

Brindusa Ilinca Mitoiu [1,2], Dana Galieta Minca [1]
[1] *Carol Davila University of Medicine and Pharmacy, Bucharest, Romania*
[2] *National Institute of Rehabiltation, Physical Medicine and Balneoclimatology, III^rd University Clinic, Bucharest, Romania*

Abstract. Quality of life is an increasingly important matter to relate to in modern societies due to deeper concern in the economic area as well as in the evaluation of the eficiency of the medical services not only on health, but on all aspects of patient's life. Assessment of quality of life after stroke, as a major disability starter, is the first step in the challenge to improve the quality of stroke survivors.
This review is the first step in a larger study that aims to assess the benefits of the rehabilitation program in patients with spastic hemiparesis in terms of quality of life as a final point of interest in clinical and functional therapeutic target. It contains a summary of the most used generic tools for the assessment of quality of life in stroke and aims a short analysis of their advantages and disadvantages.
Conclusions. The perfect, optimal quality of life instrument varies depending on the intended purpose and is based on its different psychometric attributes. These scales are not recommended for monitoring each patient and should not replace existing standardized instruments that examine deficiencies or functional limitations, but they could be implemented by therapists as a means of identifying specific elements that affect quality of life. Using such an instrument as part of a battery of tools will help in identifying and targeting all aspects of health to provide the best results in the management of stroke survivors.
Key words: *stroke, disability, rehabilitation*.

The interest to study the quality of life is increasing in modern societies for many reasons, such as deeper concern for raising the welfare of the population in general and individuals in particular, interest in evaluating the quality of medical services, particularly treatment selection and care costs in short, medium and long term (1).
Along with issues of medical care, a patient's wellbeing is influenced by many other factors. Focusing on quality of life as a result of development and organization of healthcare programs and the analysis of their formation process is based on the fact that all aspects of care are under the control of healthcare professionals, but there are other factors that influence the state of a patient. Assessing the quality of nursing and medical care, selection of the proper qualitative and financial treatment for the patient, and detecting non-medical aspect that influences patient quality of life are current issues in the health team professionals must respond (2).
The definition of quality of life covers physical, mental, financial, social, personal and professional aspects and the balance between all the above mentioned.
Health related quality of life is a subjective analysis related to patients' perception of disease, health, life in general.
Initially this analysis used as variables symptoms and physical, psychological and adaptation data, and later the views and opinions of the patient were studied and included too (3).
Stroke is one of the leading causes of mortality and morbidity in the world and the most important cause of long term disability in Europe and demographic changes have resulted in an increase of both its incidence and prevalence. The subject is extremely current and debated in the media often involving significant impairment of individuals quality of life. Thus, it is increasingly suggested the need to evaluate wellness and influence of all factors by applying standardized, efficient and fast methods.
This review is the first step in a larger study that aims to assess the benefits of the rehabilitation programs in patients with spastic hemiparesis in

terms of quality of life as a final point of interest in clinical and functional therapeutic target.

Quality of life assessment tools can be "generic" and "specific" for certain diseases. Generic tools are varied and addresses to general, not specific health concepts.

Short Form Health Survey (SF-36) is a commonly used measurement scale, recommended in clinical practice guidelines of the Agency for Health Care Policy and Research (AHCPR) of the U.S. in post-stroke rehabilitation. It contains 36 items and the questionnaire is completed by the patient. The items are grouped into eight areas that embrace a wide range of physical and psychosocial activities, including knowledge and general health assessment. Scores range on a scale from 0 to 100, a higher score indicating a better health status (4). Journal of Rehabilitation Medicine published in 2009 the results of a study on the assessment of the quality of life after stroke using the SF-36, developed in the Institute of Gerontology, University of Jonkoping, Sweden (5). OASIS (Outcome Assessment Using SF-36 v2 in Stroke Patient Study) was also recently completed. It evaluated, using the same instrument, stroke patients in Japan for a period of 6 years (2006-2012). It was a large scale study, and the final results have not yet been published.

Short Form Health Survey (SF-12) is an abbreviated version of SF-36 that generates the summary for the physical and mental component with considerable accuracy, while imposing a minimal burden on respondents. It was shown that scores of SF-36 components evaluated were reproduced by SF-12. In 2010 "Quality of Life Research" published the result of a research supported by a team of U.S. specialists demonstrating the validity of the SF-12 in people with a history of stroke (6).

Sick Impact Profile (SIP) is a reliable instrument with 136 items grouped into 12 sections or scales. Unlike other QOL scales, its elements are focused on specific behaviors that relate to recent restrictions or changes in functionality instead of subjective feelings or perception. The total scores are converted to a percentage from 0% (no impairment) to 100% (maximum impairment). There is a short version of this scale called SA (stroke-adapted) SIP 30. In September 2011, "Annals of Physical and Rehabilitation Medicine" published the findings of a study from the University Victor - Segalen of Bordeaux that evaluates the quality of life of patients with hemiplegia using SIP (7).

Euroqol consists of only six parts and includes six areas. Each item has a response range from 0 to 3. In addition, Euroqol uses a visual analogue scale from 0 to 100 to provide an assessment of overall health related quality of life. In 2011 "Arquivos neuro-psiquiatria" published a study that examined the validity of Euroqol for patients post stroke (8).

Quality of Life Index (QLI) is a scale designed for people with chronic illnesses and adjusted for patients with stroke. The initial version was a questionnaire with 38 questions grouped into four subsections. For specific version of the QLI stroke were added 3 sections: communication, self-care and mobility. Satisfaction and importance are measured on a scale from 1-6. Total score ranges from 0-30, higher scores indicate better quality of life. “Stroke” published in 1996 a study made by a scientist from the Northwestern University Medical School, Department of Physical Medicine and Rehabilitation, Rehabilitation Institute of Chicago that aimed to examine overall and domain-specific quality of life in long-term stroke survivors and to identify variables that predict quality of life after stroke using QLI (9).

Nottingham Health Profile (NHP) is an instrument designed to measure health related quality of life using a questionnaire consisting of 38 items that require a "yes" or "no" to questions grouped into six subscales. Scores for each interval group are between 0-100, where 0 indicates perfect health. A research group from Istanbul published in 2005 in “Journal of stroke and cerebrovascular diseases” a study about „Quality of life for patients poststroke and the factors affecting it” (10).

Generic tools are designed to be used in order to assess a wide range of populations and pathologies, allowing to compare the effects of different diseases and interventions on quality of life (11).

Another advantage associated with the generic scales is the ease in their management. There are variants of self-completion at the hospital, at home through direct interview, telephone, or by mail.

A final significant advantage associated with generic tools is the short time required for their administration. In general they can be completed within 5-15 minutes, and in a clinical healthcare system limited in time are a realistic and valuable option (12).

Although these generic tools can provide important information on patient outcomes achieved following treatment, it is also important to understand their limitations. A potential limitation is discussed for patients suffering significant cognitive or speech dysfunction and are not able to complete complex questionnaires. Excluding these individuals from studies the assessment of quality of life post-stroke will exclude a significant part of post-stroke survivors. To accommodate this limitation, a caregiver respondent can be used to answer questions on behalf of the patient.

However, data obtained from caregiver respondents should be used with caution. The balance between respondents and patients answers is more stable for domains that are directly observable and instable for the subjective ones (13-15).

Another failure of the generic scales is their low precision. When scores are reported as very low or very high, there is a so-called "floor effect" and "ceiling effect", a situation that leads to the impossibility of fair assessment of patients standing around those levels. The degree of accuracy also vary significantly between scales, each of them having domains with different importance (16).

A criticism of generic quality of life instruments used in patients with stroke is content validity that refers to the ability of the test to indicate significant values and specific symptoms or problems within a given population.

The desire to eliminate these problems has led to an improvement process and validation of more stroke specific scales (17).

Analyzing the above mentioned we turn to the conclusion that the optimal quality of life instrument - the ideal tool - varies depending on the intended purpose and is based on its psychometric attributes, related to the feasibility, validity, reliability and sensitivity to change.

Data collection method requires a compromise between cost and response rates, non-response, bias and quality of data (18).

These scales are not recommended for setting the goals of patients as individuals and monitoring progress of each patient and should not replace existing standardized instruments that examine deficiencies or functional limitations.

Most of these tools are not sensitive enough to monitor individual changes. However, they could be implemented by therapists individually or in teams of interdisciplinary health assessments of patient care and pathology as a means of identifying specific elements that affect patient quality of life in order to detect problem areas and highlight them for possible intervention or referral (18-20).

Medical personnel must therefore accept responsibility for improving patient well-being and not limit examinations and interventions in the physical and functional areas.

The World Health Organization defines health as "a state of complete physical, mental and social, and not merely the absence of disease or infirmity".

Using a quality of life assessment instrument as part of a battery of tools will help in identifying and targeting all aspects of health to provide the best results in the management of stroke survivors (21).

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Coresponding author
Brindusa Ilinca Mitoiu
Carol Davila University of Medicine and Pharmacy
Bucharest, Romania
Phone: +0723552797
E-mail: *brindusailinca@yahoo.com*

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Resistance exercise loading pattern and antioxidant capacity of saliva

Rahmati S[1], Arazi A[1], Sariri R[2]
[1]*Faculty of Physical Education and Sport Sciences, University of Guilan, Rasht, Iran*
[2]*Department of Biology, University of Guilan, Rasht, Iran*

Abstract. The purpose of this study was to compare changes of antioxidant status after two different resistance exercise loading patterns (pyramid and inverse pyramid). Alteration in biological activity of superoxide dismutase (SOD), radical scavenging activity on 2, 2-diphenyl-2-picrylhydrazyl hydrate (DPPH) and concentration of uric acid (UA) in human saliva was investigated. In practice, 25 experienced trained male participated in the study. During 2 test days, subjects performed resistance exercise protocols with pyramid and reverse pyramid loading patterns. Their un-stimulated saliva samples were obtained pre exercise and 5 minute post exercise. The results showed that after exercise, SOD activity was significantly higher in both PLP and RPLP when compared to their values at rest. However, the SOD values for the RPLP were significantly higher than for the PLP ($p<0.05$). Uric acid values increased significantly in the two resistance exercise systems (PLP, RPLP) when comparing to the resting values ($p<0.05$). In addition, there was no significant difference between corresponding UA values of the two systems ($p> 0.05$). In the case of radical scavenging activity (%DPPH), both PLP and RPLP showed significant increases 5 minutes after exercise sessions compared to pre-exercise ($p<0.05$). In conclusion, inverse pyramid loading pattern proposed in the current study promoted higher oxidative stress biomarker (DPPH, SOD and UA) and antioxidant modulations compared with resistance traditional interval training.
Key words: *resistance exercise, antioxidants, salivary biomarker.*

Introduction

Resistance exercise is among the fastest growing and most popular types of exercise in recent years. It is performed for various purposes including general fitness, rehabilitation, or athletic performance. Resistance exercise could be designed in many different forms, each of which can produce distinctly different responses (e.g. increased size, strength, power, contraction velocity, muscular endurance, etc). Regular resistance exercise is associated with numerous health benefits and has been recommended by major health organization. However, several studies have reported that resistance exercise can result in increased oxidative modifications to proteins, nucleic acids, and lipids (1). In acute or single bout of resistance exercise, the body cannot adapt to the oxidative challenge. Under these conditions, reactive oxygen species (ROS) are generated leading to oxidative damage on macromolecules.

A single bout of resistance exercise can result in activation of several radical generating systems (2). These include xanthine and NADPH oxidase production, ischemia reperfusion, prostanoid metabolism, phagocytic respiratory bursts, disruption of iron containing proteins, and excessive calcium accumulation (3, 4). It must be remembered that oxidative stress occurs when free radical generation exceeds the antioxidant capacity of cells or extracellular fluids.

Pyramid and reverse pyramid loading patterns (equal volume) are 2 types of hypertrophic-strength systems of resistance exercise most widely used by athletics and many power lifters. Individuals interested in increasing 1RM lifting ability also use these systems. However, to our knowledge, the oxidative stress biomarker responses to high-load resistance exercise are unknown and no study has compared the effect of high-load equal volume resistance exercise on free radical scavenger activity and antioxidant activity in resistance trained men.

The fact that a linear relationship exists between salivary and serum levels of biochemical factors, suggests that saliva may be a useful surrogate for blood testing (5). Moreover, saliva provides a useful, non-invasive alternative to serum and plasma, because it can be collected rapidly, frequently and without stress. Therefore, the purpose of this study was to compare salivary oxidative stress biomarker response to an acute session of pyramid and reverse pyramid loading patterns in resistance trained men.

Material and Method

Subjects. Twenty five experienced resistance trained male athletes participated in the study. All the subjects experienced resistance training, and trained regularly for least 2 years. The inclusion criteria consisted of the following: a) the subjects did not have any medical conditions that might be aggravated by participation in resistance exercise; and b) subjects did not use any mineral or vitamin supplements and they were nonsmokers. All subjects read and signed an informed consent document and were asked to not participate in any resistance training during this study period. The Institutional Review Board of University of Guilan approved the research protocol.

Anthropometric measurements. Age, weight, height, body mass index, body fat percentage were recorded (Table I). Body fat percentage was assessed using skin folds and the Buan equation (6).

Characteristic	Body fat (%)	Height (Cm)	Body mass index (kg.m²)	Age (Years)
Mean±SD	10.17 ± 2.18	182.04 ± 4	20.86 ± 1.82	26.68 ± 3.02
Range	9.12-12.42	178-186	18.05-22.85	23.55-29.68

Table I. Descriptive characteristics of the subjects **Values are mean ±SD, n=25*

Repetition Maximum Testing (1RM). Two familiarization sessions were designed to habituate subjects with the testing procedures and laboratory environment. After familiarization, for measurement of one repetition maximum (1RM), we used a method described by McGuigan (7) to determine the hack squat (HS), leg press (LP) and leg curl (LC) bench press (BP), let pulls down (LPD), biceps curl (BC).

Briefly, before performing the tests, and after the general warm up, all subjects completed five repetitions with 30% (2 min rest), four repetitions with 50% (2 min rest), three repetitions with 70% (3 min rest), and one repetition with 90% (2 min rest) performed for special warm up. After performing the lift with 90% of 1-RM, for calculating 1-RM load in the next attempts added 2.5kg after each success effort and with 4 min rest. Each the greatest load lifted was considered the 1RM load and used to calculate 85%, 90% and 95% resistances for each exercise (7).

Exercise sessions. The study was based on a randomized, double-blind, cross-over design. On the subsequent 2 test days, subjects performed resistance exercise protocols with pyramid and reverse pyramid loading patterns in the following order: HS, LP, LC, LPD, BP and BC. The subjects were instructed not to engage in any strenuous exercise for the 72 h period preceding the exercise tests and both tests were performed at the same times in the morning on separate days. In the session of pyramid loading pattern subjects begins with a set of 6 repetitions with 85% 1RM then the resistance increased over 3 sets until only a 1RM is performed. In the reverse pyramid loading patterns session, the same sets and resistances repeated but in a reverse order with the last set consisting of one repetition (Figure 1). Before the test and training sessions, the subjects performed a warm-up which included 10 min of general warm-up and stretching exercises for the whole body muscles, followed by specific warm-up in which subjects performed five repetitions with 30% 1RM. The rest interval between sets and exercises was 3 minutes.

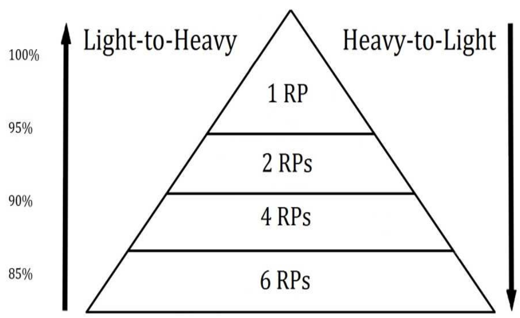

Figure 1. Schematic of two resistance exercise patterns

Saliva collection, flow rate and storage. The first saliva sample was collected 5 minutes before sessions and the next exactly 5 minutes after trial respectively. Before donating their un-stimulated saliva samples, the volunteers had brushed their teeth, rinsed their mouth once with distilled water and kept their saliva for exactly three minutes.

The samples were collected in calibrated sterile tubes and the flow rate was calculated as ml/min. The samples were immediately centrifuged at 900×g for 10 min at 4°C to remove squamous cells and cell debris. They were then marked, sealed in a container and stored at -80ºC until further examinations.

Materials. 2, 2-diphenyl-2-picrylhydrazyl hydrate (DPPH), was purchased from Sigma representative in Iran. Kit of uric acid and superoxide dismutase assay kit (Cayman chemical, Cat No.706002, USA) were purchased from a local representative. All solvents were reagent grade and obtained from Merck representative in Iran. A UV-visible spectrophotometer (Ultrospec 3000, Pharmacia Biotech™, Sweden) was used throughout the research.

Measurement of uric acid in saliva samples. The amount of uric acid was measured by an enzymatic method described for assay of uric acid in serum (8). The complete assay was based on enzymatic reaction of uricase on uric acid to form allantoin and hydrogen peroxide (H_2O_2). Production of hydrogen peroxide was coupled with catalytic oxidation of p-hydroxybenzoate and 4-aminoantipyrine oxidation in the presence of peroxidase. The pink chromophore thus formed was then detected at 505 nm.

DPPH radical scavenging assay. In this chemical assay, an antioxidant reduces the stable $DPPH^{\bullet}$ by donating a hydrogen to it. In the present piece of research, a modification of the method described in (9) was used. The radical scavenging activity of saliva samples against stable DPPH° was determined spectrophotometrically. The color of $DPPH^{\bullet}$ changed from deep-violet to light-yellow due to its reduction. The color change was measured at 517 nm using a UV/visible light spectrophotometer (Ultrospec 3000 from Pharmacia Biotech). 1500μl of freshly prepared $DPPH^{\circ}$ solution in methanol (6×10^{-5} M) was added to 77μL of centrifuged saliva in 1 cm path length disposable microcuvettes and mixed. Absorption was measured at 517 nm (A_c) after solution remained for 30 min at room temperature and in dark. Using methanl as blank, the absorbance of methanolic solution of $DPPH^{\circ}$ was measured as control (A_c). All experiments were carried out in duplicate and radical scavenging activity was calculated by following relationship:

DPPH radical scavenging activity (%)=$[(A_c–A_S)/A_c]\times100$

Measurement of superoxide dismutase activity. Salivary superoxide dismutase activity was measured by an enzyme assay kit (Cayman chemical, Cat No.706002, USA). According to procedure given in the kit, tetrazolium salt was used for detection of superoxide radicals generated by xanthine oxidase and hypoxanthine. One unit of SOD was the amount of enzyme needed to exhibit 50% dismutation of superoxide radicals. The whole experimental section was performed by an experienced technician blind about cases.

Statistical analysis. Data were analyzed using SPSS 19.0 J (SPSS Japan, Tokyo,) with advanced modules. Values were expressed as the mean±SD. Kolmogorov-Smirnov test was used to normality of data. Homogeneity of the sample was tested using Levine's test. All variables presented normal distribution and Homogeneity. Paired-Sample t test was used to compare antioxidant status in different times of examination. Independent-samples t test was used to evaluate differences on the antioxidants responses to acute different resistance exercise systems (PLP, RPLP). Based on the statistical rules, here too $p<0.05$ was considered as significant.

Results and discussions

Salivary flow rate. In Table II, the flow rates of saliva before and after both types of exercise are compared. Salivary flow rates were expressed as volume of un-stimulated saliva (ml) collected per minute. It was found that the flow rate of saliva differs before and after exercise. However, the values were not significantly different. According to the results, saliva flow rate ranged between 0.44-0.772 $ml.min^{-1}$ before and reduced to 0.38-0.78 $ml.min^{-1}$ after resistance exercise. As shown in Table 1, the loading patterns did not significantly affect this type of alternation. It was found that in both type of resistance exercise loading patterns, the flow rate was decreased. Similar to other biological fluid such as tears (10), the flow rate of saliva depends on various external and internal factors (11, 12). During a previous research, we have found a significant decrease in salivary volume and rate of flow in smokers which we suggested to be due to the presence of various toxic chemicals in cigarette smoke (13). On the other hand, intense exercise also caused decreased flow rates (10).

It is worth indicating the decrease in flow rate was more in the case of RPLP type of resistance exercise which is due to the more intense nature of the activity. It has been reported that fluctuations of flow rate due to various external factors is better tolerated by athletes as compared to other individuals (14). For example, a significant decrease in salivary volume and rate of flow was previously observed in smokers (13). It must be reminded that normal flow rate and volume of saliva could play a significant role to maintain healthy environment inside oral cavity.

Table II. The flow rate of saliva in trained men after resistance exercise

Flow rate (ml/min)	Before exercise (n=25)		After exercise (n=25)	
	PLP	RPLP	PLP	RPLP
Mean ± SD	0.53±0.06	0.53±0.06	0.49±0.10	0.45±0.10
Range	0.44-0.77	0.44-0.77	0.41-0.78	0.38-0.69

Uric acid in saliva. It is a well known fact that strenuous exercise can accelerate production of many reactive oxygen species (ROS). As a result, they exceed the capacity of the antioxidant defense system resulting in serious oxidative stress (15). Saliva possesses an interesting antioxidant system which is composed of various polar and non-polar molecules and enzymes. Among these, uric acid is the most important water soluble antioxidant molecule, contributing approximately 70% of the total salivary antioxidant capacity (16). It is established that the antioxidant power of uric acid is related to its ability of chelating transition metals and to react with biological oxidants and different ROS such as hydroxyl radical. In addition to its role as ROS scavenger, uric acid, which is one of the final metabolic products of purine bases, is also an excellent scavenger of reactive nitrogen species (RNS) (17). Its presence and alternation in various body fluids would, therefore, be critical for its important action, i.e remaining oxidant/ antioxidant balance.

In this study, we found that uric acid values increased significantly in the two resistance exercise systems (PLP, RPLP) when compared to the resting values ($p<0.05$). In addition, no significant difference ($p>0.05$) between corresponding UA values of two systems was observed (Figure 2).
Comparable to our study, increases in uric acid concentration in blood (23%) and in saliva (36%) after the acute session of resistance exercise has been reported (18). These researchers reported a significant correlation between uric acid concentration in saliva and plasma.
The results we obtained in our present work, confirm the sensitive behaviour of uric acid in saliva induced by exercise which is supported by other studies. It has been reported salivary uric acid increases after a 10 km race (19).
In support of our study, it has also been found that a significant correlation existed between concentration of uric acid in saliva and aerobic exercise (20).

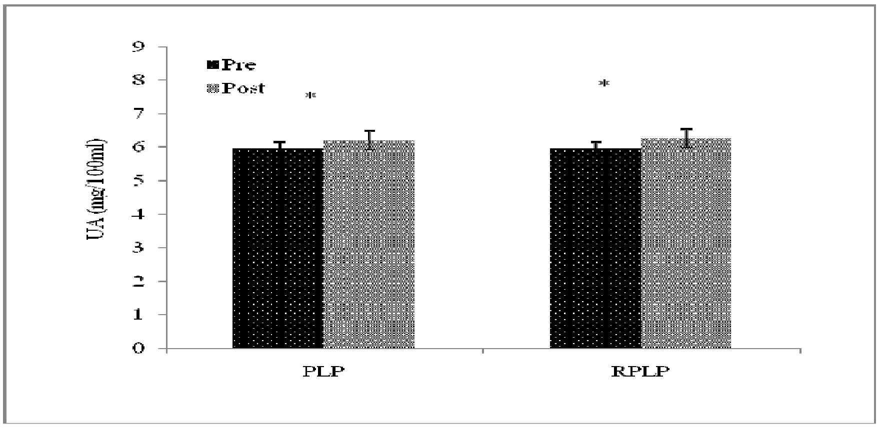

Figure 2. Concentration of salivary uric acid (UA) in mg/100ml before (pre) and after (post) pyramid loading pattern (PLP) and inverse pyramid loading pattern (RPLP) (* shows significant differences)

DPPH radical scavenging activity. Differences in DPPH activity for PLP and RPLP systems are presented in Figure 3. Within response to PLP and RPLP significant increases in DPPH activity were demonstrated between before and 5 minute post exercise sessions (P<0.05). When the DPPH activity was compared between PLP and RPLP, significant increase was demonstrated at RPLP post exercise (P>0.05). In support of the present results, other factors may lead to increase in antioxidant activity of saliva. We have previously found that salivary antioxidant level is increased in patients diagnosed with peptic ulcer (21) and also in healthy individual who are on a vegetarian diet (22).

Activity of superoxid dismutase. After exercise, SOD activity was significantly higher in RPLP when compared to the values at rest. On the other hand, SOD values for the RPLP were higher when compared to the PLP (P>0.05) (Figure 4). It is known that aerobic exercises could increase rate of production of reactive oxygen species (ROS) including superoxide, and hydroxyl radicals. Human response to higher amounts of ROS is increase in the production of antioxidants. In agreement with the present results, increase in activity of SOD has also been reported in saliva of elite judo players after exercise (23).

It has been claimed that the type of stress may cause variations in antioxidant status of saliva (23). A study on children playing computer games has revealed that enzymatic antioxidants such as SOD significantly increased in their saliva samples (24). The antioxidant activity could not reach its original value even after 3 hours of finishing the game indicating the high oxidative stress imposed on a child during computer games (24).

The beneficial effect of exercise on SOD activity enhancement could positively be affected when combined with some other natural factors such as daily consumption of green tea (25). Finally the result of SOD from this study has also been approved by observing enhancement of other antioxidant enzymes of saliva including peroxidase in saliva due to exercise intensity (26).

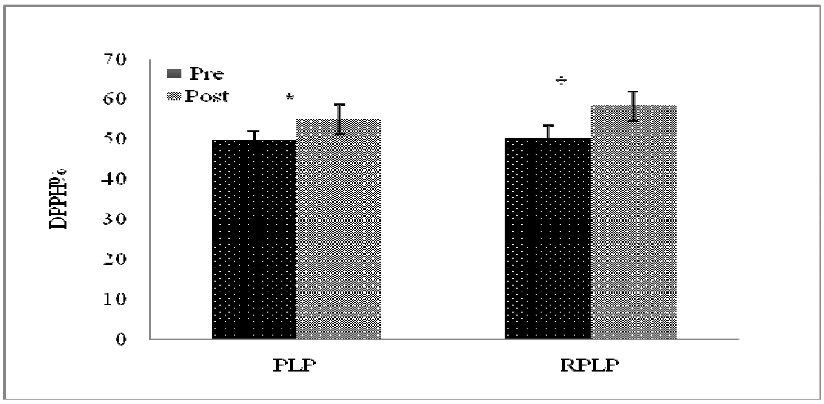

Figure 3. DPPH free radical scavenging activity (%) in saliva before (pre) and after (post) pyramid loading pattern (PLP) and inverse pyramid loading pattern (RPLP) *(* shows significant and † not significant difference*)

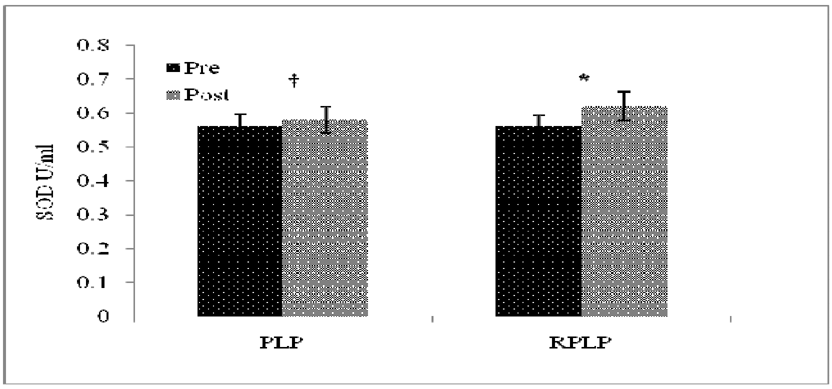

Figure 4. Activity of superoxide dismutase (U/ml) in saliva before (pre) and after (post) pyramid loading pattern (PLP) and inverse pyramid loading pattern (RPLP). (* *shows significant and † not significant difference*)

Conclusions

Based on the present study, although exercise promotes ROS formation causing oxidative stress, it could also stimulate the production of many endogenous antioxidants. Human saliva saliva possesses an antioxidant system including various non-enzymatic and enzymatic molecules. Many advantages are found for saliva sample as a noninvasive biological fluid to replace blood sampling. These include its short collection time and non-invasive nature of sampling. However, an important disadvantage of saliva as a diagnostic body fluid is that it is needed to be standardized. Important points such as food and water ingestion and oral hygiene before collection as well as salivation stimulation and blood contamination of saliva samples must be added to the designed standard method. In comparison, it has been shown that blood sampling time is a dependent factor for assessment of oxidative stress biomarkers induced by exercise (27). On the other hand, in the present study, the exercise was a short period type of training meaning that longer times could also be examined. It was shown here that oxidative stress biomarkers and antioxidants induced by acute resistance training in saliva are significantly altered according to the pattern of loading. The reverse pyramid loading pattern had a more announced effect of generation of various types of antioxidants. We have planned that in our future research that saliva sampling be compared with blood samples in order to build the standard method for saliva sampling technique.

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Corresponding author
Sariri Reyhaneh
Department of Biology, University of Guilan,
Rasht, Iran
E- mail: *sariri@guilan.ac.ir*

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A cross-sectional study for the relationship between body composition and body surface area with echocardiographic variables in endurance-trained athletes

Kulroop Kaur
Sports Medicine Department, Guru Nanak Dev University, Punjab, India

Abstract. *Aim*. We ought to study the relationship between echocardiographic variables and body composition & body surface area in endurance trained athletes. Endurance training is associated with an increase in cardiac structural dimensions and mass in athletes. In other populations, body surface area was found to influence cardiac dimensions. We hypothesised that the increase in cardiac musculature dimensions observed with training may be a normal response to the increased training load and increased body surface area. *Materials and Methods.* Fifty male endurance athletes (cycling, N=16; long distance running, N=22 and swimming, N=12) with eighteen male control subjects underwent echocardiography and dual photon x-ray absorptiometry body composition analysis. Correlation analysis was sought for echocardiographic variables and body surface area and body composition. *Results and conclusion.* All subjects were in the age group of 18-25 years of age. The endurance athletes had enlarged cardiac dimensions than the control subjects ($p<0.001$). Left ventricular mass, size and thickness correlated significantly with the body surface area and lean mass but did not significantly relate to the body fat percentage and fat mass. Lean mass was found to be an independent predictor of left ventricular measurements.
Key words: *lean mass, echocardiography, body surface, endurance.*

Introduction

The athlete's heart characterised by hypertrophy and dilatation of the left ventricle is an area of study since many decades. Generally, it has been studied that endurance type sports are associated with left ventricular (LV) dilatation and strength trained are related with increase in thickness and they show LV hypertrophy (1). The previous researchers were not able to conclude the cardiac differences and adaptation to the resistance and endurance trained heart (2,3). These changes in the cardiac morphology have been found to be a normal physiologic variation to the exercise training. Both LV size and LV mass has been found to be related to body size (4-7) and were divided by body surface area to determine the normal ranges and to detect the presence of pathological LV hypertrophy (8,9). However, this overestimates LV hypertrophy in lean subjects, while underestimating LV hypertrophy in obese individuals. However, recent studies have demonstrated that in non athletic populations the fat free mass (lean body weight) has a close relationship with the LV mass and remodelling (5,7) than body surface area and fat mass. But as lean body weight is difficult to measure in populations, it is rarely used and its accurate measurement is a rather difficult procedure.

If lean body weight is the determinant of LV mass in non athletic population, it might be in athletic population too. And if it is the determinant of the cardiac ventricular remodelling in athletes than the increase in left ventricular mass and size can be predicted by increase in lean body weight.

Even though the morphology of athlete's heart has been studied by several authors for different endurance sports, the studies relating the echocardiographic variables with body composition & body surface area are scanty. It is vital to determine the best parameter for indexing absolute amounts of LV dimensions and other cardiac parameters. Most of the studies have concentrated on LV dimensions so in the study we intended to take up all the cardiac morphological parameters. Whalley et al (10) have shown that Lean Body Weight is the best predictor of LVM and left ventricular end-diastolic dimension (LVEDD) in both young and old male endurance athletes. George et al in 2001 have found significant relationship between body surface area (BSA) and LVM in different athletes (11).

Thus, we chose to focus on the relationship of echocardiographic variables and body composition & body surface area in athletes under endurance training i.e. dynamic training (cycling, long distance running and swimming sports). All the cardiac morphological structures will be studied and its relationship with body composition and body surface area parameters will be studied for every sub variable of echocardiography.

Material and Method

Subjects: Fifty endurance athletes (cycling, N=16; Long Distance Running, N=22; Swimming, N=12) with the mean age of 19.75±1.75years, mean body height of 166.20±8.35cm, mean body weight of 54±7.70kg and eighteen male control subjects were taken in the study. All the athletes had minimum experience of five years. All readings were taken in the competitive season just before a inter university competition. The whole study group was considered free of structural heart disease on the basis of their medical history, physical examination and electrocardiography. None of the athletes reported use of anabolic steroids. Written informed consent was obtained by all study participants and the study protocol was approved by the ethical committee of the institution.

Parameters. Electrocardiography (ECG). All athletes underwent 12-lead ECG in the supine position just before echocardiography and all had normal ECG criteria for participating in the study and none reported any obvious structural cardiovascular disease.

Echocardiography. Two-dimensional and M-mode echocardiography was performed on all the subjects in the morning after their regular conditioning workout (using Philips iE33, Xmatrix, USA). Measurements of left ventricular end–diastolic dimension, septal and posterior wall thickness, aortic root diameter, right ventricular thickness and dimension were taken through M-mode echocardiography, left ventricular end–diastolic volume and left ventricular end-systolic volume were taken by two dimensional echocardiography. Left ventricular mass (LVM, gram) was calculated from the formula (12,13) $LVM=0.8\{1.04[(\{LVEDD+IVS+PWT]^3–LVEDD^3)]\}+0.6$.

(LVEDD=Left ventricular end diastolic diameter (mm), PWT=posterior wall thickness (mm), IVS= Interventricular septal thickness (mm) in diastole. LVM index (g/m^2) was also calculated taking height and weight of the participants in consideration. Relative wall thickness (RWT) was calculated as twice diastolic posterior thickness divided by diastolic cavity diameter (14,15).

RWT was defined concentric remodeling if RWT>0.45. The RWT was considered reduced and defined eccentric remodeling if RWT ≤0.42.

Body Surface Area. Anthropometric measurements were made on each subject. Height was measured in the upright position to the nearest millimetre. Body mass was determined using a balance. Body surface area (BSA) was estimated through applying height and weight using the equation of Dubois and Dubois (16).

Dual Energy X-ray Absorptiometry (DEXA): Total body composition was estimated by dual-energy X-ray Absorptiometry (DXA) (QDR-1000; Hologic, Waltham, MA). And the fat percentage, fat mass lean body mass was calculated for all subjects.

Statistical analysis. The data was statistically analyzed by SPSS software (SPSS Inc, Chicago, Illinois, USA). Data are expressed as mean±standard deviation for all variables. Univariate correlation (Pearson's) was examined between echocardiographic variables and body surface area and body composition. Statistical difference between the data was obtained in various groups by paired t test. α-level of $p \le 0.05$ and ≤ 0.001 was considered significant and highly significant respectively for all comparisons.

Results

Athletes had larger cardiac dimensions than the non athletes. The mean and standard deviation of all echocardiographic variables of all the subjects are presented in table I. In table I, results of echocardiographic data regarding cardiac structure in endurance-trained athletes are summarized.

The athletes were observed to have less body fat, higher lean mass as compared to the sedentary control group. The mean body surface area and body composition are presented in table II.

The correlation analysis applied to the data showed positive correlation significant between some of the sub variables of echocardiography while some showed no relation with body composition and body surface area. The results of correlation are presented in table III.

Both LVM and LVEDD correlated significantly with various body measures. Lean mass was found to be the common factor correlating with both LVEDD and LVM, thus it was the only independent predictor.

From the table III, it can be seen that the left ventricular end-diastolic dimension significantly correlates with height and Body Mass Index in athletes. The left ventricular mass (LVM) was found to be correlating significantly with BSA, BMI and Lean Mass. The right ventricular dimension was found to be correlating with BMI. Fat mass, sub-variable of body composition, age and weight were found to be having insignificant effect on echocardiographic variables.

Table I. Representation of echocardiographic variables of athletes

Variable	Endurance (N=50)	Control (N=18)
• ARD	28.44±2.44	23.79±0.86*
• RVD	24.46±4.45	22.91±3.03*
• RVT	7.53±1.75	6.63±0.63*
• LA dimension	33.58±2.59	28.05±3.76*
• LVEDD	55.31±2.60	43.88±2.82*
• LVESD	33.07±3.18	28.16±2.40*
• IVS	10.29±1.11	8.27±1.01*
• PWT	9.12±0.89	7.27±0.89*
• LVED Volume	143.23±26.67	103.62±22.85*
• LVES Volume	69.69±17.54	53.66±14.90*
• EF%	67.39±6.83	64.37±5.18*
• FS%	38.22±4.44	34.75±5.11*
• LVM	206.50±24.31	105.38±20.09*
• LVM Index	121.88±11.24	59.50±10.21*
• RWT	0.32±0.03	0.33±0.04

*ARD-Aortic Root Diameter; RVD-Right Ventricular Dimension, RVT-Right Ventricular Thickness; LA-Left Atrium Dimension; LVEDD-Left Ventricular End-Diastolic Dimension; LVESD-Left Ventricular End-Systolic Dimension; IVS-Interventricular Septal Thickness; PWT-Posterior Wall Thickness; Expressed in millimetres (Mm); LVED Volume-Left Ventricular End-Diastolic Volume; LVES Volume-Left Ventricular End-Systolic Volume; Expressed in millilitres (Ml); LVM-Left Ventricular Mass; LVM Index; Expressed in grams (G); RWT-Relative Wall Thickness; Expressed in millimetres (Mm); *Statistically significant.*

Table II. Mean± standard deviation of body surface area and body composition in subjects

Variable	Endurance (N=50)	Control (N=18)
• BSA	1.68±0.10	1.75±0.13
• Body Fat %	16.41±4.41*	26.02±4.69
• Lean body mass	46.41±6.40*	38.39±5.72
• Fat mass	9.66±3.93*	17.45± 5.00

(*Significant at p< 0.05)

Table III. Univariate correlates of echocardiographic variables in trained endurance athletes

Variable	Age (years)	Height (cm)	Weight (kg)	Body surface area (m^2)	Body mass index (kg/ m^2)	Lean body mass (kg)	Fat mass (kg)
ARD	-0.165, 0.25	-0.050, 0.73	0.020, 0.89	0.001, 0.99	0.130, 0.36	0.104, 0.47	-0.193, 0.180
RVD	-0.256, 0.07	0.235, 0.10	-0.152, 0.29	-0.025, 0.86	**-0.379, 0.007***	0.089, 0.53	0.038, 0.79
RVT	-0.201, 0.16	0.088, 0.54	0.147, 0.30	0.179, 0.21	-0.011, 0.93	-0.003, 0.98	0.038, 0.79
LA dimension	0.233, 0.10	0.194, 0.17	0.088, 0.54	0.140, 0.331	-0.060, 0.67	0.117, 0.42	-0.024, 0.86
LVEDD	-0.004, 0.97	**0.55, <0.04***	0.084, 0.56	0.029, 0.84	**0.285, 0.04***	**0.52, 0.001***	0.149, 0.30
LVESD	-0.24, 0.86	0.008, 0.95	0.205, 0.15	0.182, 0.20	0.225, 0.11	-0.127, 0.37	0.149, 0.30
IVS	-0.271, 0.05*	0.273, 0.05	0.068, 0.64	0.109, 0.44	-0.083, 0.56	-0.123, 0.39	0.040, 0.781
PWT	-0.136, 0.34	0.263, 0.06	0.080, 0.58	0.204, 0.15	-0.160, 0.26	0.116, 0.42	0.003, 0.98
LVED Volume	0.178, 0.21	0.229, 0.10	0.164, 0.25	0.166, 0.25	0.044, 0.76	0.071, 0.62	-0.020, 0.89
LVES Volume	0.080, 0.58	0.011, 0.937	0.031, 0.83	-0.021, 0.88	0.065, 0.65	0.114, 0.42	0.103, 0.47
EF%	0.264, 0.06	-0.195, 0.176	-0.134, 0.35	-0.137, 0.34	0.086, 0.54	0.095, 0.51	-0.29, 0.84
FS%	0.037, 0.80	-0.178, 0.21	-0.225, 0.11	-0.239, 0.09	-0.061, 0.67	-0.034, 0.81	-0.001, 0.99
LVM	-0.165, 0.25	0.220, 0.12	0.149. 0.30	**0.51, <0.001****	**0.54, <0.001****	**0.50,<0.001****	0.063, 0.66
LVM Index	-0.137, 0.34	0.181, 0.20	-0.038, 0.79	0.042, 0.77	-0.201, 0.16	-0.065, 0.65	0.033, 0.82
RWT	-0.046, 0.75	**0.383, 0.006***	0.071, 0.62	0.232, 0.10	-0.274, 0.05	0.126, 0.38	0.054, 0.71

R, p values are mentioned. *Correlation is significant at the 0.05 level (2-tailed); **Correlation is significant at the 0.001 level (2-tailed)

Discussion

Athlete's Heart. From table I it could be observed that the study results support the hypothesis that the echocardiographic changes in endurance athletes may be physiologic. All the sub variables of echocardiography showed significant higher readings than the control subjects showing that such changes are present globally in heart in endurance athletes. The left ventricular dimensions and mass was found to be higher in athletes as well as significantly correlating to the body surface and body composition variables as shown in table III. Lean mass, sub variable of body composition was found to be as an independent predictor of the left ventricular mass and end diastolic dimension. This study is among the few studies comparing DEXA with echocardiographic variables. The relationship between heart size and body composition has been previously studied in male endurance athletes but the method used in the study for estimation of Lean Mass (FFM) was skin fold thickness measurement method (17) and underwater hydrostatic weighing method (18). Both the studies showed higher LVM/FFM than controls. But unfortunately these methods are not considered as accurate as DEXA (19) and the two compartment model used may lack validity in athletes due to changes in the total body water and bone mineral content (20). Our study has used the DEXA method which is a very accurate method for estimating body composition and it is suggested that changes observed in athletes are influenced by the Lean mass.

Heart size to body size index. From the results it can be presumed that body size, however, does influence the diameter, mass and wall thickness of the left ventricle and we can therefore not exclude the possibility that part of the differences in heart size may be ascribed to the larger body size of the athletes.

Heart size to body composition. In the present study, no significant relationship was found between echocardiographic variables and fat mass.

The published literature in this area is inconsistent, with some investigators reporting a relationship (21, 22), while others do not (23, 24). Differences in obesity status, distribution of body fat, and technique for the measuring body fat are the most likely explanations underlying the inconsistent findings. Some of the previous researches (4, 5, 25-27) have earlier shown that the left ventricular size is closely related to body size and body composition. Lean mass (Fat Free Mass, FFM) was found to be the only predictor of the LV mass (5). But, the lean mass estimation and accurate measurement is a difficult procedure and not widely available. And hence, BSA is often used to index the echocardiographic variables. But BSA is influenced by Fat Mass, which was found to be inconsistent predictor and did not correlate with the echocardiographic measurements. Height was found to be correlating significantly with LVEDD in the study which is also seen in the previous studies (6, 25, 26) and is also used widely but height derived methods do not predict the heart size. The LV measurements when indexed to BSA and height, differences were observed in the readings for athletes as compared to non athletes (28, 29). If the hypothesis that LVM is influenced and predicted by lean mass, as also evident from results of our study and previous researches; than the matching of athletes on the basis of body size would further emphasize the difference in the echocardiographic variables as both endurance (30) and resistance training (31) increase muscle size and muscle mass and hence the lean mass is increased. As LV measurements (dimension and mass both) were found to be correlating with lean mass, the researches comparing the athletes with non athletes on basis of body size and incongruent lean mass may have led to spurious conclusions. Indexation to height also is misleading as longitudinal changes with increase in training years will be misleading as height is unlikely to change but lean mass will gradually change with increase in training.

Conclusion

This study suggests that the echocardiographic variables and body surface area and composition are correlated with each other. Only the left ventricular dimension and mass showed the significant relationship with the other variables. Thus, the LV dilatation or increase in LV mass as observed in endurance athletes reflect a normal physiologic response to increased lean mass and highlights the importance of accurate assessment of lean to fully estimate the cardiac morphological structure in athletes. The findings are being confirmed in other groups, such as strength trained and combined endurance and strength trained athletes by the author; and if the proposed methodology for indexing LV measurements by lean mass comes out to be positive in all the three groups, than LV indexation can be better be characterised as physiological remodelling and predicted by lean mass.

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Coresponding author
Kulroop Kaur
Sports Medicine Department,
Guru Nanak Dev University
Punjab, India
E-mail: *doctoralifesaver1@gmail.com*

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Comparison of analgesic and anti-inflammatory effects of the classical low laser therapy and multiwave locked system in inflammations of serous bursae

Momanu Alina
Medical Center Fiziomedica, Iasi, Romania

Abstract. *Introduction*. Infrared thermography is a non-invasive physiological test that since 1990 was recognized as a diagnostic tool by the American Academy of Physical Medicine and Rehabilitation. The method is based on the identification and the quantification of coetaneous thermal asymmetry. Several studies were conducted in time, showing thermographic variations in some soft tissue conditions. *Objectives*. This study compares the anti-inflammatory and analgesic effect of classical laser therapy and multi-wave locked system (MLS) laser therapy by following the evolution of differences in temperature between the affected area and the unaffected controlateral area and the evolution of pain measured by visual analog scale (VAS). *Material and method*. I divided the patients in the study into two groups: a group of patients received classic laser therapy and a group of patients received MLS laser therapy. *Results*. In both group, the evolution of studied parameters (pain measured by visual analog scale and thermal gradient) demonstrate the efficiency of laser therapy in treating bursitis, yet the decrease of differences in temperature and of VAS score was steeper in the group under MLS therapy, the dissimilarity between the groups being relevant statistically. *Conclusions*. Laser therapy demonstrate both an analgesic (evidenced by the relieve pain) and anti-inflammatory effect (evidenced by reduction of the thermal gradient) for bursitis affecting superficial bursae and the difference between this two types of laser therapy are statistically significant (MLS therapy has a greater analgesic and anti-inflammatory effect compared with low level laser therapy).

Key words: *bursitis, laser therapy, infrared thermography.*

Introduction

The bursae are anatomic formations that facilitate movement; they may be compared to synovial fluid-filled sacs lined with a membrane made of cuboid cells similar to synovial cells. The bursae rest at the points where muscles and tendons slide across bone, functioning as a gliding surface to reduce friction and ease movement.

Due to their structure, bursae ***may*** become ***inflamed*** under repetitive movements, excessive pressure or traumatic injury; when such events occur, bursae inflammation manifests by wall congestion, high secretion of viscous liquid and fibrin deposits on the lining membrane. A common cause of bursitis is overuse of a particular body part, especially if that activity is performed awkwardly or with considerable pressure.

Examples of work-related activities that may trigger bursitis include production-line packing and typing. Sports that can cause bursitis include jogging, jumping, overhead throwing, tennis and squash. Repetitive motions cause an increase in the amount of friction present between the bursa and the surrounding tendons or muscles. The bursa becomes irritated, and an inflammatory response occurs.

The areas in which is most commonly to get bursitis are: Elbow – because the elbow is an essential part of many activities, like throwing a ball or swinging a tennis racket, elbow bursitis is one of the most common types of bursitis in teens; Knee – bursitis in the knee can be the result of falling directly on the knee or any activity that requires long periods of kneeling; Hip – bursitis of the hip is often associated with running injuries; Shoulder – bursitis of the shoulder can be the result of something as simple as an awkward fall or as complicated as a rotator cuff injury (the rotator cuff keeps the shoulder secure); Ankle – ankle bursitis can be the result of overboard jumping, running, or walking can get. Just wearing the wrong type of shoes for a particular activity can lead to ankle bursitis.

*Clinical overview***.** The main symptom is local joint pain radiating sometimes to the whole limb. Bursae inflammation involved swelling, especially for the superficial ones, such as olecranon bursae, prerotulian bursae.

The pain felt by the patient may be amplified when certain movements are performed, pressure being exerted on the affected bursae.

Laboratory examinations. The hematological examination and the erythrocyte sedimentation rate (ESR) are normal usually, except for acute bursitis, when they are slightly changed. Yet in septic bursitis the white cell number is much higher and ESR accelerated.

The X-ray exam may show calcium deposits in some bursitis. Musculoskeletal ultrasound may identity fluid in serous bursae, the proliferation of the synovial, the presence of inflammations (Doppler signal) and calcifications.

Clinical forms. Several clinical forms were described from the condition development (acute or chronic) and the topographic standpoints. Acute bursitis is characterized by pain and movement limitation; at an objective examination, swelling and redness are noticed in superficial bursae (prepattelar, olecranon). Chronic bursitis may occur after several episodes of acute bursitis or repeated trauma.

There are numerous forms of bursitis topographically, amongst the most frequently encountered in the clinical practice are: subacromial, subdeltoidian bursitis, olecranon bursitis, Achilles bursitis, bursitis hallux, ischial bursitis, prerotulian bursitis, goose foot bursitis.

Treatment. Rest is a necessary measure indicated in bursitis treatment, irrespective of their seat. Cold applications are useful in acute bursitis, as they relieve pain and swelling. The administration of nonsteroidal anti-inflammatory drugs is dosed in keeping with symptom intensity.

In superficial bursitis, bursal aspiration is indicated. As the fluid restores, repeating aspiration is suggested.

Surgical treatment of bursitis is hardly ever necessary. Bursae excision is preferred. Surgical treatment is indicated when repeated medical treatment yields no result and the bursitis-generated discomfort is severe.

Another treatment method in bursitis is physiotherapy and from the wide range of physical agents to be used, this study tackles the effect of laser therapy.

LASER is an acronym for *Light Amplification by Stimulated Emission of Radiation.* Since this technology was discovered, it continuously enlarged its application scope.

When laser radiation is absorbed by tissues, various types of biological effects are generated - photochemical photothermal, photomechanical, anti-inflammatory, analgesic and biostimulation effects.

The laser energy absorbed by cromophores may produce biochemical changes in the radiated tissue by mechanisms of photoinduction, photodissociation, photosensitivity and photoconversion. Biochemical interaction responds for the anti-inflammatory, anti-edema, pain-killing and biostimulatory effects (1-3). Tissue heating results from the transformation of electromechanical energy into thermal energy which issues from the vibration and the collision of excited atoms. The increase in temperature to 45° determines anabolic, analgesic and anti-inflammatory effects, characteristic of therapeutic lasers.

The interaction between the high energy light impulse and the physical environment generates elastic pressure waves propagating along with the generating impulse; most lasers used in laser therapy cannot produce damaging mechanical effects to tissues; used in physiotherapy have some common biological effects and particular effects depending of the source power and type.

Lasers may influence the inflammation mechanisms at various levels. First, an active hyperemia occurs that washes the inflammatory substances (histamine, bradykinin, cytokine and lymphokine); laser stabilizes the membrane of mast cells (histamine releasers) and stimulates fagocytes, which will remove any noxious agents (1).

Laser stops the action potential at the level of nociceptors by changing the permeability of the axon membrane; then active hyperemia determined by heat and photochemical reactions promote algogen draining, eliminating the feeling of pain; the pulse lasers, mostly the low-frequency ones, act on pain modulation by means of big, myelinized fibers according to the “gate” theory; llaser determines the production of morphinomimetic substances (endorphins and enkephalines) acting as pain-killers (2-4).

Laser increases the ATP production, phenomenon that favors cell energetic processes (5); laser light may promote cell replication and RNA and protein synthesis (e.g. collagen), facilitating reparation processes (6-9).

MLS therapy (Multi-wave Locked System): MLS therapy has several special characteristics: it combines laser emissions with two wavelengths (808 and 905nm), one in the continuous system

(808nm, with a maximum power of 1W), and the other one in a pulsed system (905nm, with a maximum power of 25W).
The advantage of this combination consists in better penetrability and in the possibility of increasing the emitted energy. Therefore, the pulsing system combines the stimulating effect on microcirculation with the advantage of an increased top power, but they have a low average energy, and the combination to a continuous laser wave secures an appropriate energetic intake. The synchronizing of the two wavelengths may transfer the energy towards the cellular layer in a more efficient manner than the emission of a single component. Thus, the MLS impulse has bigger antiphlogistic, bio-stimulating and analgesic effects than a continuous emission or a pulsed one, used separately or in combination, but unsynchronized. Enjoying the advantage of a bigger divergence of the diodes irradiation cones, the multidiode laser may have a spot of big dimensions – 50mm.
Usually, no laser diode has strong anti-inflammatory, antiedemic, and analgesic action, unless for short periods of time. Continuous laser emission has rapid effects on inflammation by means of stimulating blood and lymphatic circulation, inducing extracellular fluid - absorption, nevertheless acts only secondarily on pain, reducing it only after inflammation is reduced. Pulse laser emission has an immediate effect on pain by interfering with the transmission of the painful feeling to the upper nervous centers, but it is less efficient in treating inflammation and edema, these effects occurring only after a long period of application. In the case of the MLS therapy, due to the synchronization emissions, various therapeutic effects, the anti-inflammatory and antiedemic of continuous emission and the analgesic of pulse emission, appear concomitantly and amplify one another. Because of this, MLS therapy may guarantee the efficiency and a short treatment time of numerous disorders of the osteoarticular system and of superficial lesions.
The MLS therapy is non-invasive, painless and may be applied to patients of any age. Scientific studies on the therapeutic effects of light emissions demonstrate that a greater therapeutic effect is obtained if the emission is coherent. One of the most widely accepted hypotheses for explaining this mechanism is that the light/biological membrane interaction generates a coherent bio-laser emission (if the incidental light is coherent), due to the existence of conduction bands in these sub-cellular structures containing free charges.
The MLS pulse wave lengths guarantee the deepest possible action – the range of 600 to 1200 nm is known as the "therapeutic window", as there are no chromophores able to filter the light emission. The wavelengths of the emissions making up the MLS pulse fall into this precise range, meaning that they are able to reach the deepest anatomical structures.
The MLS impulse is a synchronized combination of two unique emission modes, continuous and pulsed, so as to be able to obtain the therapeutic effects belonging to each mode. The continuous emission, in fact, guarantees an intense anti-inflammatory and antiedemic effect, because it is able to stimulate the circulation and lymphatic drainage considerably, and because it is able to interact with the synthesis and degradation of inflammation mediators. The pulsed emission has an effect on pain transmission: the action takes place at the level of the superficial nociceptors and, thanks to the depth of action of the emission used, on the afferent nervous fibers. The rest potential is restored more quickly after the generation of the action potential: this is translated into an increase of the cell and nervous fiber's stimulation threshold and (10) consequently, a reduction in the feeling of pain. Moreover, the contemporary activation of the proprioceptive channels (A-alpha and A-beta fibers), which are subject to greater myelination and therefore able to conduct the nervous stimulus more quickly, induces a pain block on the level of Rolando's gelatinous substance – as indicated by the gate theory – which is replaced by kinesthesia. The analgesic effect obtained is immediate and long lasting
The synchronization of the emissions that make up MLS has an intense and immediate therapeutic effect on both the inflammatory processes and on the painful symptoms accompanying them. This is due the fact that the anti-inflammatory and antiedemic effects of the continuous emission and the analgesic effect of the pulsed emission reinforce each other, thanks to the synchronization of the emissions.
Moreover, the overall way in which energy is supplied through the MLS pulse, together with the net reduction in treatment times, guarantees that there is no risk of addiction. The optic system of the laser head ensures a homogenous distribution

of light and the activation of all photoreceptors of the area.
The aim of this study was to prove the anti-inflammatory and analgesic effects of the classical laser therapy and MLS therapy, shown by the progress of temperature differences between the affected area and the unaffected collateral one, respectively of the VAS score, in inflammations of serous bursae.
In the abarticular conditions, thermography may indicate the local inflammatory and vassomotor reaction by rises in local temperature and/or changes in the thermal skin map, being known that normally the thermal symmetry principle is respected.

Material and method

In this study were admitted 40 patients, with different forms of bursitis (olecranon, prerotulian, retro-calcaneal, bursitis hallux, Baker cyst) and were randomly divided in two groups.
The study inclusion criteria were represented by suggestive symptoms for abarticular rheumatism with onset in less than 3 weeks, presence of changes in the soft part ultrasound (liquid collection, synovial proliferationand calcification).
Exclusion criteria: previous or simultaneous treatment with NSAIDS, local/general cortical therapy, neoplasia, infective skin lesions.
The thermography were performed in a special room, at a thermal comfort temperature (22 – 24°C), without sources of radiant heat (lit by cold light sources), with the determining space thermally isolated by panels. The patients remained in this environment for 15 minutes before starting the investigation, in order to reach thermal equilibrium.
The patients included in the study were examined by soft part ultrasound and digital thermography. Ultrasound exam was performed with a Esaote MyLab 40 ultrasound unit with transducer with a gray-scale frequency of 18MHz and a Doppler frequency of 6,6MHz. In order to obtain thermographic images we used a Flir B335 thermographic camera with an infrared sensor resolution of 320 x 240 pixels, sensitivity of 0.05°C, spectrum 7.5–13µm.
At the moment of presentation (T0) we determined the level of pain by means of the pain visual analogue scale (VAS), the difference in temperature between the painful area and the unaffected symmetrical one through digital infrared thermography, as well as the bursitis structural changes by means of ultrasound, after which the patients were given laser therapy. The patients of two groups received laser therapy with different parameters: for the first group (G1) was used high power MLS laser of 3300mW, and for the second (G2) was used LLLT laser of 100mW. The treatment parameters were those provided by the set programs of the instrument: frequency 900Hz, energy 5 J/cm^2, time 10 minutes for MLS laser therapy, respectively frequency 10Hz, energy 6 J/cm^2, time 5 minute/irradiation point for laser therapy of 100mW. The treatment was applied through contact for the probe of 100mW and as for the probe of 3300mW the scanning was performed from a distance of 20cm.
At the end of ten days of treatment (T1) was determined once again the level of pain and the difference in temperature between the painful area and unaffected contralateral side.
Results were analyzed using the Student T test to determine the statistical relevance of the differences in results in the two groups studied.

Results and discussions

The patients included in the study were divided in two groups, 20 patients in each group, with an average age of 42.5 years for the first group and 44 years for the second one. The members of the groups were 14 men and 6 women in the case of G1group, respectively 12 men and 8 women for G2. The most frequent seats of bursitis were: the knee – prepatellar bursitis and semi-membranous-median gastrocnemius bursitis (Baker cyst). Figures 1 and 2 show the types of bursitis studied in the two groups.

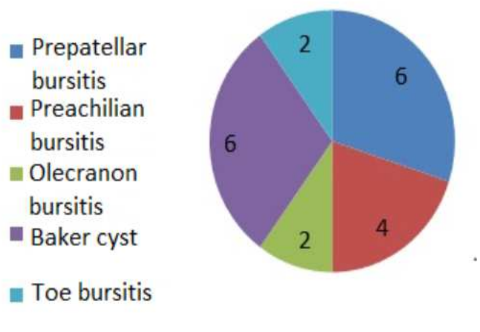

Figure 1. Distribution on types of conditions in group G1

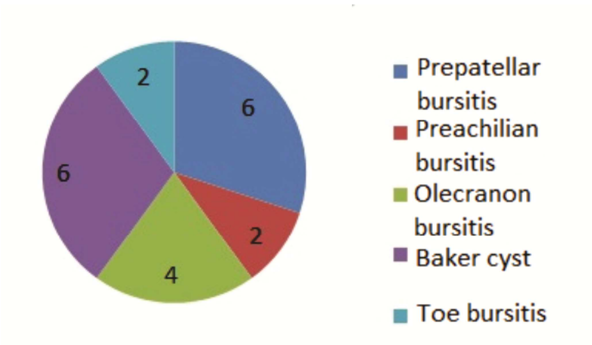

Figure 2. Distribution on types of condition in group G2

The following images exemplify the untrasound and thermographic aspects of the studied conditions. The thermographs were made before treatment and at the end of treatment (fig 3-6).

The mean value of initial VAS for the spontaneous pain for the two groups was 6.5 and 6.1. In both groups the value decreased during and at the end of the treatment, the slightest VAS (1.5) being recorded in the group that followed MLS M6 laser treatment after 30 days from the end of the treatment.

The differences registered between G1 and G2 were statistically significant for the three recording times ($p<0,05$).

As for the pain felt when palpating, the same trend was noticed: progressive decrease of VAS score in both groups from 7.1 to 1.9 in the case of the group that underwent MLS laser therapy and from 6.85 to 2.95 in the second group. Differences were statistically relevant at the three assessment times (fig 7 and 8).

The temperature gradient decreased from a mean value of 3.91°C to 0.79°C in G1 and from 3.73°C to 1.59°C in G2 (fig 9).

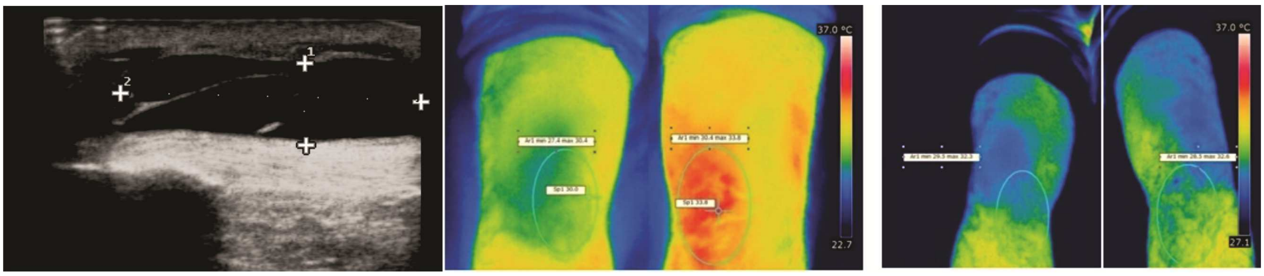

Figure 3. Prepatellar bursitis ultrasound and thermography before and after treatment (decrease of ΔT from 3,8°C to 0,3°C)

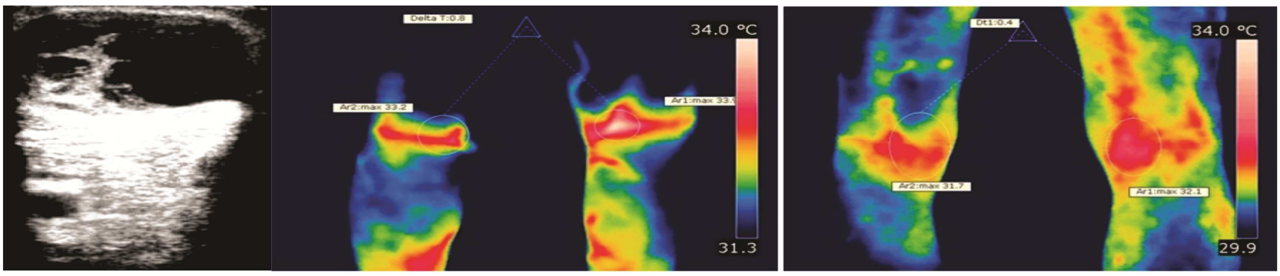

Figure 4. Baker cyst ultrasound and thermography before and after treatment (ΔT decrease from 0.8 to 0.4°C)

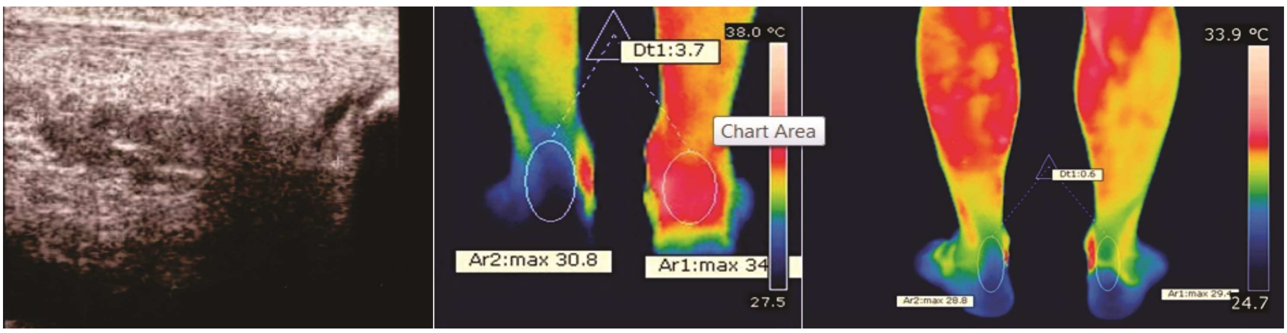

Figure 5. Preachillean bursitisultrasound and thermography before and after treatment (ΔT decreasefrom 3.7 to 0.6°C)

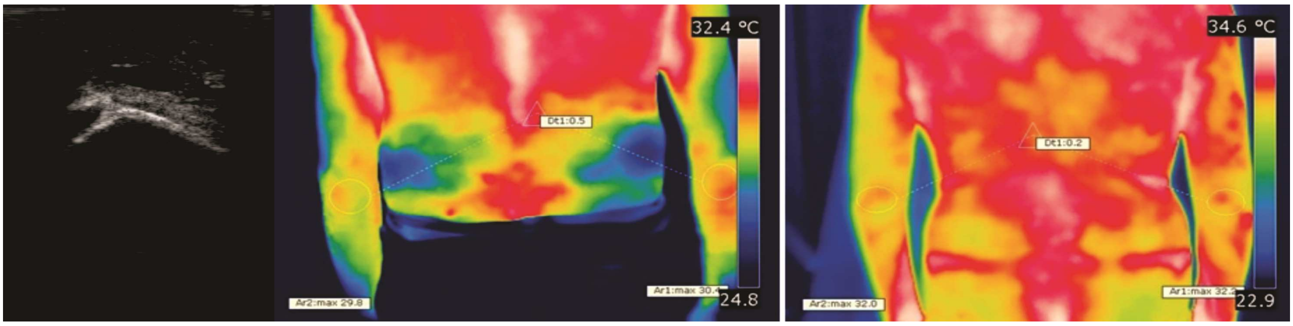

Figure 6. Olecranon bursitis ultrasound and thermography before and after treatment (ΔT decrease from 0.5 to 0.2°C)

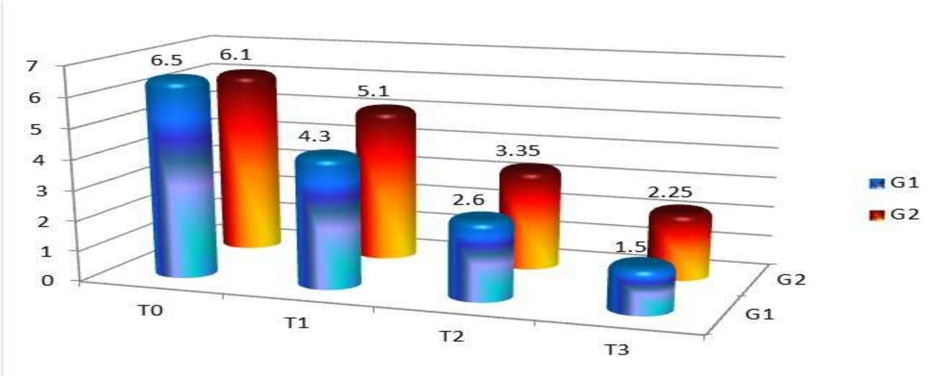

Figure 7. Comparative analysis of the mean VAS score (spontaneous pain) in the two studied groups

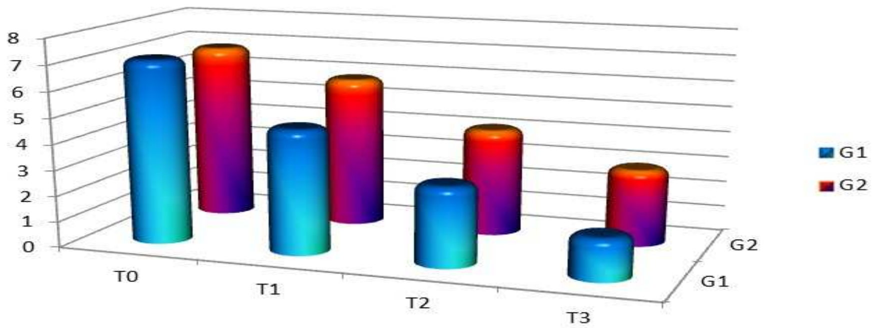

Figure 8. Comparative assessment of the mean VAS score (pain when palpating) in the two studied groups

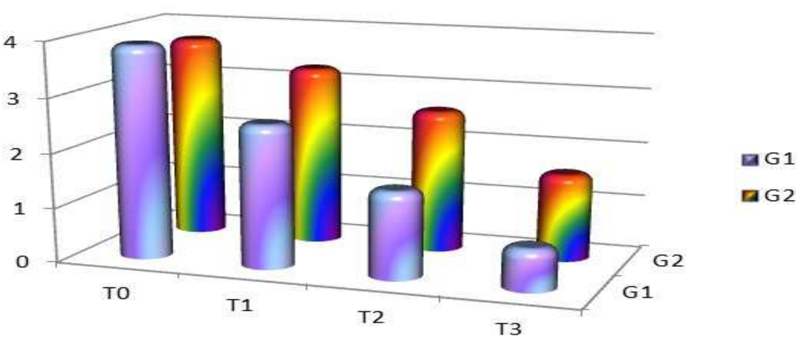

Figure 9. Comparative analysis of the mean temperature gradient of the affected area and the controlateral unaffected area of the two studied groups

Conclusions

In inflammatory conditions involving serous bursae, laser therapy (in combination with electrotherapy and ultrasound therapy) is efficient both in relieving pain (VAS score diminishing as early as the 5th therapy session) and in reducing the inflammation by reducing local temperature.

Between the two types of laser used in this study, there are differences in wavelength: laser of 100mW with a wavelength of 830nm, MLS laser combines two wavelengths 808 and 905nm, emission type (continuous for the wave length of 808, pulse for 830 and 905nm), peak power (100m, respectively 3300mW).

These differences may account for the different efficiency of the two types of equipment in treating bursitis.

In bursitis the efficiency of the MLS therapy is higher compared to one-wavelength laser therapy, the differences being significant after 5 therapy sessions and the best after 10 sessions.

Laser therapy demonstrate both an analgesic (evidenced by the relieve pain) and anti-inflammatory effect (evidenced by reduction of the thermal gradient) for bursitis affecting superficial bursae, which makes this method an alternative therapy without adverse effects for local corticosteroid, more especially if the bursitis is caused by mechanical and not inflammatory factors.

Because of strong and rapidly installed analgesic and anti-inflammatory effects, MSL therapy may be a reliable therapeutic alternative especially for people who may need a more complete and prompt recovery, such as performance athletes.

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Coresponding author
Momanu Alina
Fiziomedica Medical Center, Iasi, Romania
Phone: 0749-125550
E-mail*: malyna.2004@yahoo.com*

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Prevalence of low back pain and fatigue levels in Indian athletes

Singh Amrinder, Sandhu Gursumeet, Sandhu Jaspal Singh
Faculty of Sports Medicine and Physiotherapy, Guru Nanak Dev University, Amritsar, Punjab, India

Abstract. The purpose of this study was to evaluate the prevalence of low back pain and fatigue levels in Indian athletes. *Material and Method*. 300 athletes participated in this study of which 123 (41%) were national level athletes and the remaining 177 (59%) were university level athletes, playing for the last 6 years. Equal number of athletes (n =75) were include in this study from each game i.e. handball, basketball, weightlifters, hockey. The JOABEQ, OSW, CIS-20 questionnaires were used in this study to measure the fatigue level and evaluates the prevalence of LBP. *Results.* The prevalence of low back pain is more in weightlifters and hockey players as compared to handball and basketball. The fatigue levels were significantly increased in all the four groups. There was a significant positive correlation between JOABPEQ, OSW and CIS-20 ($p \leq 0.05$). *Conclusion*. This study concludes that high prevalence of low back pain in weightlifters and hockey players is due to their hard training and high bending movement at trunk and weak back muscles group which increases the chances of LBP and injury as compared to handball and basketball players.
Key words: *low back pain, fatigue, questionnaires.*

Introduction

As sporting activities are becoming competitive day by day it imposes a lot of stress on backbone which leads to increase in low back injuries. Low back pain is one of the most common health problem faced by athletes**.** Low back pain is defined as an episode of pain or discomfort that interrupted normal daily activities and/or required treatment or consultation in the lower back. It is ranked first as a cause of disability and inability to work, and expected to affect up to 90% of the world’s population at some point in their lives (1). Low back pain has long been recognized as an almost universal problem in the adult population, with an estimated yearly prevalence of 15% to 20% and a lifetime prevalence of up to 80% (2).

Low back pain is an extremely common entity in the general population. Athletes are no different in their affliction for suffering low back pain and injuries, particularly in sports that carry specific low back demands. The natural history of low back pain in athletes is most probably no different. The very nature of athletic preparation requires mechanical overload. Athletic manoeuvres produce significant compressive forces directed at the lumbar spine (3). A trade off is likely to exist between athletic demands and injury , with greater duration of training, training intensity and a lack of relative rest occurring at the expense of tissue overload and ongoing injury. This may explain why some athletes tend to have more persistent, chronic and recurrent low back symptoms, frequently associated with early degenerative joint disease. Although most low back pain in both the athletic and non-athletic population is non-specific and mechanical in nature, athletes are often at special risk of more serious causes of back pain that are often sport specific in their aetiology. This is a result of the repetitive mechanical loading and often specific and unique motion imposed on the spines of athletes through various sporting requirements in training and competition (4,5).

Lower back pain is a heterogeneous condition, which may contribute to variation in reported prevalence. In the absence of ‘a gold standard to evaluate low back pain’, questionnaires are considered reliable measurement tools for the assessment of this condition (1).

Fatigue represents the decline in muscle tension or force capacity with repeated stimulation or during a given time period. It occurs when the exercise continuous to the point that compromises the content of liver and muscle glycogen. Endurance athletes commonly refer to this sensation of fatigue as “bonking” or “hitting the wall (6).

There is no standard way to assess fatigue. Fatigue can be measured objectively as well as subjectively. Objective fatigue measures focus on physiological processes or performance such as reaction time or number of errors. Subjective ways to assess fatigue include diary studies, interviews, and questionnaires, questionnaires are used in large scale studies because of their shortness and self report format (7).

There has been no such study documented on Indian athletes till date to evaluate the prevalence of low back pain and assess the fatigue level, In this study four groups comparison of different sports that are hockey, weightlifters, handball, basketball has been done. The aim of the present study was to throw light upon the association between low back pain and fatigue level and associated risk factors for an injury to occur in athletes and if there is any specific sport, in which LBP is most common. This may in future help in prevention of the low back injury in athletes specifically which are caused due to muscle imbalance or overuse in athletes.

Material and Method

Current study was descriptive-practical design. 300 athletes participated in this study of which 123 (41%) were national level athletes and rest 177 (59%) played at university level, playing for last 6 years. Equal number of athletes i.e. n=75 were include in this study from each game, handball, basketball, weightlifters, hockey. The Oswestry Low Back Pain Disability (JOABEQ), Oswestry Low Back Pain Disability (OSW), Checklist Individual Strength-20 (CIS-20) questionnaires were used in this study to measure the fatigue level and evaluate the prevalence of LBP in Indian athletes, were chosen by randomly between the age of 18-30 years.

The subjects were suffering from low back pain from last 6 months, female 39.3% (n=18), male 60.6% (n=182) and 300 questionnaires were filled in by the athletes and the results are based on the analyses of these 300 questionnaires.

OSW questionnaire consists of 10 items addressing different aspects of function. Each item is scored from 0 to 5, with higher values representing greater disability. The total score is multiplied by 2 and expressed as percentage. In Modified OSW sex life question was replaced with question related to fluctuations in pain intensity.

JOABPEQ questionnaire contains 25 valued questions. The examiner then calculates 5 functional scores for corresponding domains according to the provided calculating formulas. The range of the score for each domain is from 0 to 100, with higher scores indicating a better condition.

CIS questionnaire was used to measure fatigue levels, it consists of 20 statements for which the person has to indicate on a 7 point scale to what extent the particular statement applies to him or her. CIS total score is calculated. Higher scores indicate a higher degree of fatigue, more concentration problems, reduced motivation, and less physical activity.

Statistical Analysis. All data were analyzed by using ANOVA and Tukey’s Post Hoc Test. Statistical significance was set at $p \leq 0.05$.

Results

The self reported data of participants in this study were: athletes from four different sports group (n=75) - handball (23.3±3.21yrs), basketball (22.4±2.23yrs), weightlifters (24.4±2.51yrs), hockey (24.7±2.64yrs); height (inches) - handball (67.9±3.03), basketball (69.0±3.46), weightlifters (67.9±3.40), hockey (69.1 ± 2.91); weight (kg) - handball (67.2±11.0), basketball (72.3±14.5), weightlifters (79.4±12.5), hockey (72.8± 11.1); female 39.3% (n=118), male 60.6% (n=182).

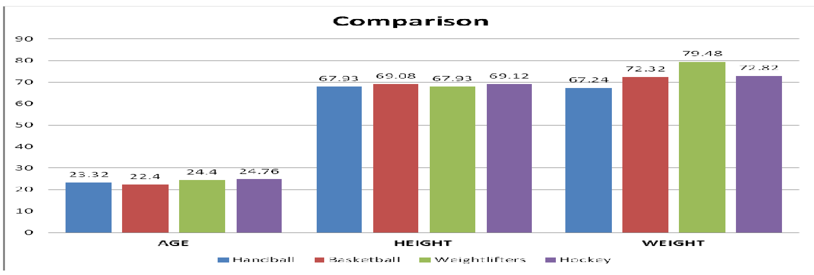

Figure 1. The characteristics of study groups **Hb-handball, b-basketball, w-weightlifters, ho- hockey*

Results of JOA Back Pain Questionnaire. The self reported prevalence of lower back pain is different in the study groups according with JOABPE scale, weightlifters and hockey has high prevalence of low back pain, handball and basketball has least prevalence. The 5 subscales of JOABPEQ scale were significantly correlated. In all five subscales range of the score for each domain is from 0 to 100, with higher scores indicating a better condition.

Table I. The prevalence of low back pain in the research groups of athletes according with JOABPE scale

	JOABPEQ subscale	No.	Handball	Basketball	weightlifter	Hockey
1	Low back pain	75	32.0±22.8	42.4±30.5	29.4±21.4	31.9±27.1
2	Lumbar function	75	51.6±27.4	41.4±26.0	36.6±30.5	36.4±28.9
3	Walking ability	75	57.7±30.1	63.8±29.6	47.8±31.6	39.1±27.1
4	Social life function	75	50.2±23.9	54.6±19.6	36.5±16.0	47.3±23.2
5	Mental health	75	58.6±22.0	57.3±14.7	31.1±13.5	56.4±18.8

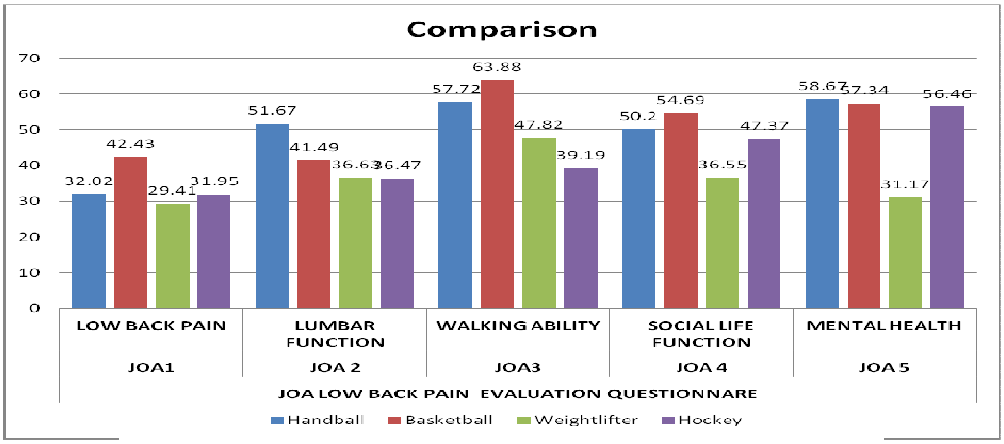

Figure 2. Comparison among the five subscales of JOABPE in research groups

JOABPE scale shows high prevalence of low back pain in weightlifters (table I) which shows weightlifters face high difficulty in low back pain (mean=29.4; SD=21.4), decrease in mental health (mean=31.1; SD=13.5), impaired social life (mean= 36.5; SD = 16.0), difficulty in lumbar function (mean=36.6; SD=30.5), and least walking ability (mean= 47.8; SD=31.6).

After the weightlifters, hockey players show high prevalence in low back pain which face high difficulties in low back pain (mean=31.9; SD=27.1), difficulty in lumbar function (mean=36.4; SD=28.9) and walking ability (mean=39.1; SD=29.3), decrease in social life function (mean=47.3; SD=23.2) and less effect on mental health (mean = 56.4; SD=18.8).

Handball players show less prevalence in low back pain. They face high low back pain (mean=32.0; SD=22.8), impaired of social life function (mean=50.2; SD=23.9), difficulty in lumbar function (mean=51.6; SD=27.4), problem in walking ability (mean=57.7; SD=30.1) and least, problem in mental health (mean=8.6; SD=22.0).

Basketball players show very less prevalence of low back pain, a less degree of low back pain as compare to above four groups (mean=42.4; S=30.5), difficulty in lumbar functions (mean=41.4; SD=26.0), impaired social life function (mean=54.6; SD=19.6), problem in mental health (mean=57.3; SD=14.7) and problem in walking ability (mean= 63.8; SD=29.6).

Results of OSW Questionnaire

OSW scale was significantly correlated with (JOABPE scale) and results of OSW questionnaire were much similar to (JOABPE). Results are shown in figure 3. Hockey players and weightlifters show a high revalence of low back pain which represent severe disability. Pain remains the main problem in this group but activities of daily living are affected (8).

Handball and basketball were less prevalent. The handball group for low back pain with (36.2 ± 16.1) has a moderate disability. Athletes experience more pain and difficulty with sitting, lifting and standing. Basketball has least prevalent group for low back pain as compare to others with moderate disability, but less then handball. Result of OSW scale was significant.

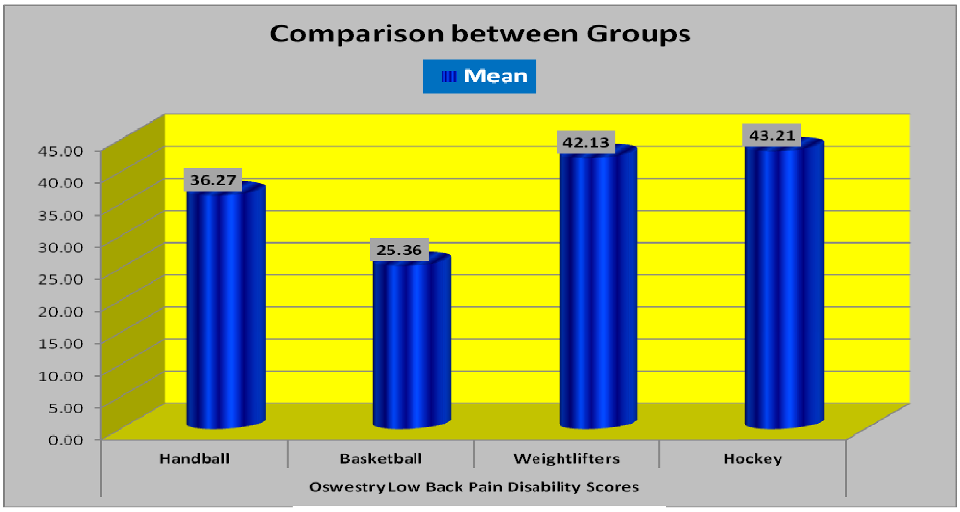

Figure 3. OSW scores of study groups

Results of CIS-20 Questionnaire

CIS -20 is fatigue assessment scale which results in this research was elevated CIS-20 scores (elevated in fatigue level) in all four groups (handball, basketball, weightlifters and hockey), but weightlifters have severely elevated CIS-20 scores than other three groups, this result in that athletes with low back pain were also show high fatigue level. Increase in elevation of subjective fatigue, decrease in concentration, which shows in figure 4. CIS-20 has 4 subscales which were significantly correlated. Scores of the CIS-20 in the weightlifters groups were compared with other 3 groups of athletes with the low back pain. The mean scores of weightlifters with low back pain were for subjective fatigue 40.53, reduction in activity 11.67, reduction in motivation 13.04, reduction in concentration 22.07, and for CIS total 87.31. These scores were higher than the scores of handball, basketball, and hockey group.

Increased subjective fatigue was reported in weightlifters and other three groups. Higher scores indicate a higher degree of fatigue, more concentration problems, reduced motivation, and less physical activity.

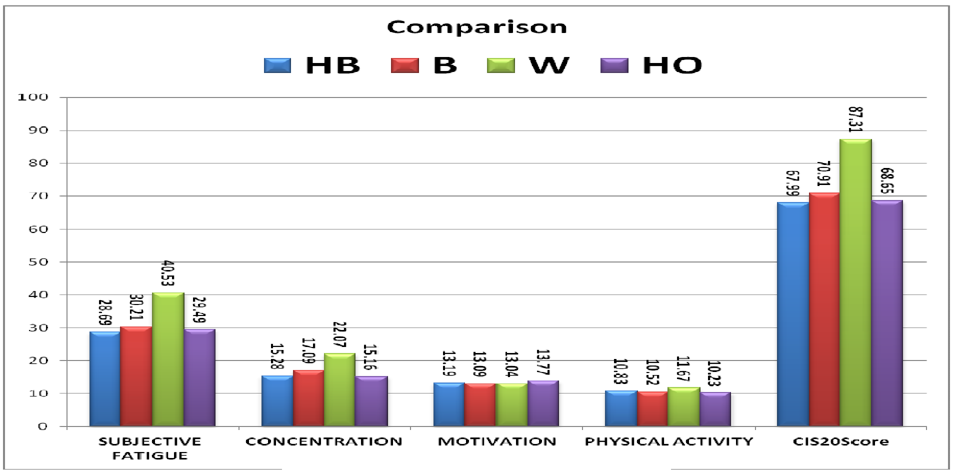

Figure 4. CIS-20 scores of study groups

Discussion and Conclusion

The aim of present study was to evaluate the prevalence of low back pain, in athletes of four different sports groups and assess the level of fatigue in prevalent athletes. The current study found a high prevalence of low back pain in weightlifters and hockey athletes and both groups had significantly elevated the level of fatigue in weightlifters and slightly elevation in hockey group with low back pain.

JOABPE and OSW scales show high prevalence of low back pain in weightlifters and hockey players, least prevalence in handball and basketball athletes. The five subscales of JOABPE scale are significantly correlated to each other, and also significantly correlated with OSW scale. Scores of most of the categories in the weightlifters and hockey players were worse than those in other two groups. In this findings weightlifters and hockey group has high low back pain problems, but weightlifters face depression and decrease in mental health and social life function problems that was high as compared to other three groups, weightlifters group reported that due to their previous low back pain injury or by present injury they have to house bound most of the time and take less or very rare part in social activities like going in parties or to meet someone outside. Weightlifters and hockey group face lumbar function problems like bending, twisting movements and Problem in walking abilities due to low back pain is also worse than handball and basketball group (9, 10).

Findings in the literature vary regarding the impact of activity and exercise, but studies on elite athletes and sports involving hyperflexion and extension have reported higher prevalence of lower back pain (11). Positive correlation have also been found between occupational activities (lifting and loading) and lower back pain. A study proposed a U-shaped association with lower back pain. A simple association between low activity levels and lower back pain may be an inappropriate claim, as lower back pain may be more an effect than a cause of sedentary lifestyle (12). Athletes, however, have suffered lower back pain due to long duration of training, or extremity of flexion and/or load in the lumbar region (1). The current study findings supported the previous study that showed high prevalence of low back pain in weightlifters and hockey players due to their hard training and high bending movement at trunk and weak back muscles group cause increase the chances of injury and prevalence in these two groups, weightlifters and hockey, then other two groups, handball and basketball (13, 14).

In current study, CIS-20 questionnaire was used to assess the level of fatigue in four groups that had low back pain, the current findings show elevation in subjective fatigue in all four groups of low back pain but at weightlifters subjective fatigue is severely elevated. No gold standard exists for fatigue. Therefore, we will never be able to prove the validity of instruments measuring fatigue. In the absence of a gold standard, direct comparisons of methods of measuring fatigue with related and existing measures are needed (7). CIS-20 scale had significantly correlated with other low back pain scales used in this current study

High level of subjective fatigue in weightlifters may be due to high threshold and long time intense training of these athletes in which heavy external loads (loading and lifting of heavy weights), cause severe increase in subjective fatigue and decrease in concentration and other three groups show less fatigue because they has less hard training and bending twisting movement then weightlifters (15, 16). But all four athlete groups show elevation in subjective fatigue that prove athletes with low back pain has also elevation in fatigue level.

Limitation of the study. This study could have been carried on a larger sample size to include more athletes playing different sports to assess the fatigue levels in them.

Implication of this study. The study estimating the prevalence of low back pain in athletes and monitoring the fatigue levels gives a solid data and indications that the athletes with increased risk of injury should be given optimal rest and recovery phases during the training sessions

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Coresponding author
Singh Amrinder
Faculty of Sports Medicine and Physiotherapy,
Guru Nanak Dev University, Amritsar, Punjab, India
E-mail: *amrindersportsmed@gmail.com*

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Cognitive benefits of aerobic exercise in patients with Cushing's syndrome

Rucsandra Dănciulescu Miulescu[1,2], Denisa Margină[1], Roxana Corina Sfetea[1], Diana Păun[1,3], Cătălina Poiană[1,3,] Elena Taina Avramescu[4]
[1]*Carol Davila University of Medicine and Pharmacy, Bucharest, Romania*
[2]*N.C.Paulescu National Institute of Diabetes, Nutrition and Metabolic Diseases, Bucharest, Romania*
[3]*C.I.Parhon National Institute of Endocrinology, Bucharest, Romania*
[4]*University of Craiova, Faculty of Physical Education and Sport, Craiova, Romania*

Abstract. *Objectives.* Previous research has shown that Cushing's syndrome has been linked with higher incidence of cognitive impairment. The beneficial effects of exercise on cognitive function have been demonstrated in clinical studies. This study will test the hypothesis that aerobic exercise leads to improved cognitive function in patients with Cushing's syndrome. *Material and Method.* 16 patients with Cushing's syndrome (10 with iatrogenic syndrome, 2 with adrenal and 4 with pituitary adenoma) and mild or moderate cognitive impairment were recruited for this study. The mental state examination were evaluated by Folstein test-30-point questionnaire test that is used to screen for cognitive impairment. Training consisted of exercise (such as cycling or fast walking) 5days/week for approximately 30 min/day. The efficacy were evaluated at six months of aerobic exercise treatment. *Results.* The subjects were between 42 and 58 years age and an evolution of the Cushing's syndrome between 2 and 6 years. Patients were screened initially with a questionnaire detailing their medical history, concomitant medications, smoking status, alcohol consumption. Baseline score of the Folstein test were 20±2.1 points. 10 patients present mild (19-24 poinnts) and 6 patients moderate (10-18 points) cognitive impairment. At the end of six months, the mean score of the Folstein test was improved (20,3±2.1 vs 21.4±3.3, $p<0.05$).*Conclusion.* In our study the Folstein score can be corrected significantly by aerobic exercise in patients with Cushing's syndrome.
Key words: *cognition aspects, Cushing's syndrome, aerobic exercise.*

Introduction

Cushing's syndrome describes the signs and symptoms associated with prolonged exposure to high levels of cortisol. Previous studies reported that patients with Cushing's syndrome have significantly higher social, psychological, and neurocognitive dysfunction than control participants (1-3). Chronic exposure to excess glucocorticoids may be associated with psychiatric and psychological disturbances and presence of depressive symptoms can be an early manifestation of Cushing's syndrome (4). In Consensus on the management of Cushing's syndrome published in 2003 in the Journal of Clinical Endocrinology and Metabolism, Arnaldi G and coll. reported that "Adults with hypercortisolism have also impaired cognitive function associated with reversible apparent loss of brain volume. Cognitive deficits are often specific to the medial temporal lobe declarative memory system. Adult patients studied 1 yr after surgical cure show improvement in mood but no change in cognitive function, with a concomitant increased, but not normalization, of brain volume" (1). The beneficial effects of exercise on cognitive function have been demonstrated in clinical studies (5-7). This study will test the hypothesis that aerobic exercise leads to improved cognitive function in patients with Cushing's syndrome.

Materials and Method

We evaluated 16 patients with Cushing's syndrome (10 with iatrogenic syndrome, 2 with adrenal and 4 with pituitary adenoma) and mild or moderate cognitive impairment. The mental state examination were evaluated by Folstein test-30-point questionnaire test that is used to screen for cognitive impairment (8). The Folstein test includes questions in a number of areas: the time and place of the test, repeating lists of words, arithmetic, language use and comprehension, and basic motor skills. Any score ≥25 points indicates a normal cognition, scores ≤ 9 points indicate severe cognitive impairment, score between 10-18 points and 19-24 points indicates moderate or mild cognitive impairment. Training consisted of exercise (such as cycling or fast walking) 5days/week, at 50-60%VO_2max intensity, 30 min/day. The efficacy was evaluated at six months of aerobic exercise treatment. The study protocol and informed consent were approved by the Institutional Ethics Committee. All subjects provided written informed consent before participating in this study.

Statistical analysis. Data are presented as mean±SD. Clinical characteristics were compared using the t Student Test. Pearson's moment-product correlation coefficients were calculated to evaluate correlations between variables. Significance was defined at the 0.05 level of confidence. All calculations were performed using the Statistical Package for Social Sciences Software (SPSS) version 15.

Results

The subjects were between 42 and 58 years age with an evolution of the Cushing's syndrome between 2 and 6 years.

Patients were screened initially with a questionnaire detailing their medical history, concomitant medications, smoking status, alcohol consumption.

Baseline score of the Folstein test were 20±2.1 points. 10 patients (62.5%) present mild (19-24 points) and 6 patients (37.5%) moderate (10-18 points) cognitive impairment.

At the end of six months, the mean score of the Folstein test was improved (20.3±2.1 *vs* 21.4±3.3, $p<0.05$). The mean score of the Folstein test, before and after six months of aerobic exercise is shown in figure 1. Favorable effects of aerobic exercise were apparent for orientation to time (3.4±0.2 *vs* 4.1±0.2 points) and the attention and calculation (4.1±0.1 *vs* 4.7±0.3 points) (fig. 2, 3).

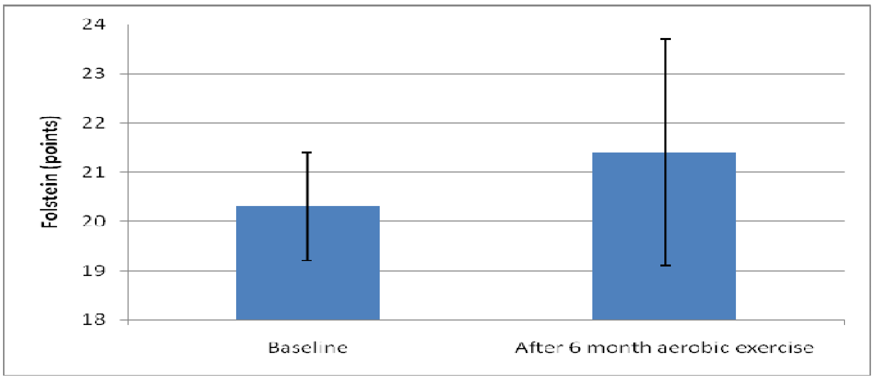

Figure 1. Changes in the Folstein test before and after 6 months of aerobic exercise in patients with Cushing's syndrome

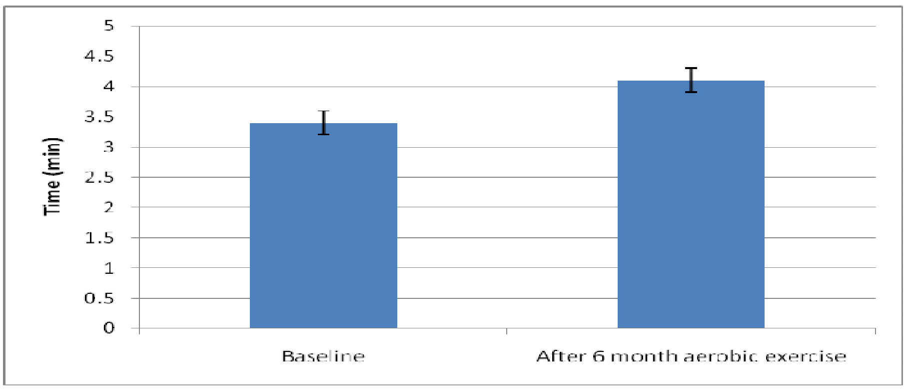

Figure 2. Changes in the orientation to time before and after 6 months of aerobic exercise in patients with Cushing's syndrome

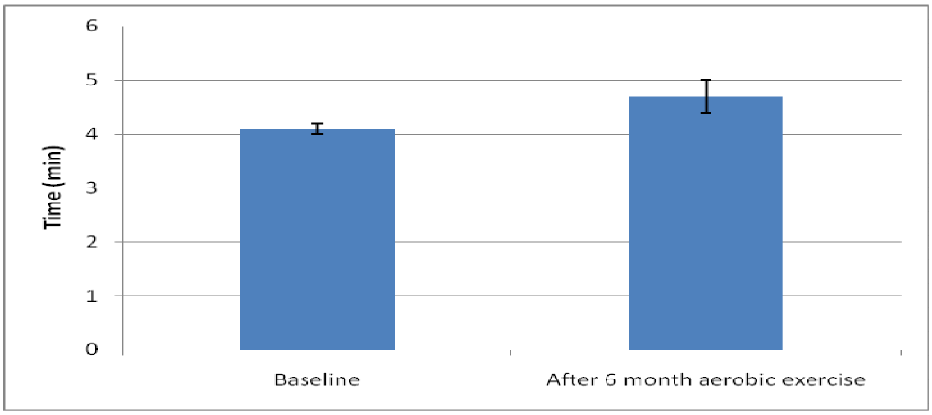

Figure 3. Changes in the attention and calculation before and after 6 months of aerobic exercise

Discussion

Previous studies have shown that higher cortisol concentrations is associated with cognitive impairment. The most sensitive brain areas sensitive to the impact of glucocorticoid are the hippocampus and prefrontal cortex; the hippocampus is involved in learning and memory consolidation and prefrontal cortex in executive functioning, emotion regulation (9). The prolonged exposure to cortisol leads to a reduction in hippocampal neurogenesis, hippocampal atrophy and memory impairment (10,11).

There is evidence that physical activity can prevent chronic diseases, and promote health (12, 13). Physical activity can increase neurogenesis and neurotrophic factor production that suppress oxyradical production, and inhibit apoptotic cascades (13). Aerobic exercise benefits on cognitive function have been demonstrated in clinical studies with older adults (14, 15).

Previous cross-sectional and prospective imaging have shown that aerobic exercise in healthy older adults is associated with reduced age-related atrophy and increased perfusion in regions involved in executive control and memory (16, 17).

One of the limitations of this study could be the small number of patients.

Conclusion

In our study the Folstein score can be corrected significantly byaerobic exercise in patients with Cushing's syndrome. Six months of intervention was sufficient to improve cognitive performance without adverse effects associated with pharmaceutical therapies and the cost.

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Correspondent author
Rucsandra Danciulescu Miulescu
Carol Davila University of Medicine and Pharmacy
Bucharest, Romania
Phone: +40748134500
E-mail: *rucsandra_m@yahoo.com*

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Comparison of the effects of retro walking and stretching on balance and flexibility

Dinesh Chand , Shibili Nuhmani , Shaji John
[1]*Department of Rehabilitation Sciences Hamdard University, New Delhi, India*
[3]*Associate professor, College of Applied Medical Science, King Saud University, Riyadh, KSA*

Abstract. *Introduction*. There is no study done to compare the effects of passive static stretching and retro walking on hamstring length and on balance. Objective of this study was to study the efficacy of retro walking vs. passive static stretching on hamstring tightness and balance in young collegiate students. *Material and Method*. 30 collegiate students, male and female, were the subjects of this research. 15 subjects received retro-walking (Group 1), 15 received passive static stretching (Group 2) during for 6 weeks, with frequency of 3 days per week. Length of the hamstring muscle, static balance and dynamic balance were the outcome measures of the study. Hamstring length were measured by measuring active knee extension. Static balance was measured by standing stork test while dynamic balance was measured by Star Excursion balance test. *Results*. All the two groups i.e. retro-walking and passive static stretching has yielded significant improvements on the length of hamstring muscle (p=0.000) the outcome after training for 6 weeks. Retro-walking also significantly increased balance performance both static and dynamic (p=0.000) but passive static stretching showed no significant improvement on static balance, however, 4 out of 8 directions of SEBT (for dynamic balance assessment) showed significant improvement. *Conclusions*. Retro-walking and passive static stretching both increased hamstring length significantly among young collegiate students otherwise asymptomatic individuals. Retro-walking significantly increased both static and dynamic balance. There was no significant effect of passive static stretching on static balance improvement and also on dynamic balance in four out of eight directions studied by SEBT test.
Key words: *passive static stretching, muscle tightness, balance*.

Introduction

Humans generally learn to walk and run in a forward direction with little difficulty. This is inherently logical since our field of view is in the forward direction. The ability to move backwards is necessary for normal daily activities and allows the body to be positioned to accommodate various tasks. Athletic trainers and coaches have used backward running (BR) drills to increase the athlete's coordination and endurance. In recent years, BR has been popularized in the lay literature as a means to improve muscular balance, increase forward running performance, rest injured muscles and prevent boredom.

Threlkeld et al (1) examined both the kinetics and kinematics of backward running in 10 subjects and concluded that backward running may provide a clinically useful means of increasing knee extensor strength, while minimizing harmful joint stress in the process. Similarly, Flynn and Soutas (1995) suggested that backward running could decrease patellofemoral joint reaction forces and decrease eccentric loading of the patellar tendon, both of which may be beneficial in patients with patellofemoral dysfunction (2).

Another benefit of retro motion includes practice and training of skills used in specific sports. Many court and field sports, such as basketball, American football and soccer all incorporate backward running during competition.

Performing the activity during training may allow one to improve performance and/or reduce potential for injury. Acute musculoskeletal injuries can lead to a myriad of secondary problems during recovery and rehabilitation.

The length of hamstring muscle is considered to play an important role in both the effectiveness and the efficiency of basic movements, such as walking and running.

Clinical observations have suggested that short hamstrings are associated with various problems, including specific disorders of the lumbar spine, general dysfunction syndromes of the low back, and sports-related injuries (3). Lack of flexibility as the cause of strains, sprains, and overuse injuries in sports is a widely held belief. Consequently, there is no study done to compare the effects of passive static stretching and retrowalking on hamstring length and on balance, thus the purpose of this study is to determine the efficiency of retrowalking vs static passive stretching on hamstring length and balance.

Material and Method

A sample, consisting total of 30 individuals was selected for the study. It consisted of 15 male & 15 female participants, with age=23.93±0.96yrs, height=168.73±8.6cm,weight=59.53±7.61kg, limb length=90.53±5.75cm.

They were recruited according to the inclusion and exclusion criteria. Inclusion criteria included healthy young male or female of age group 20-25 with normal BMI value and ROM of knee flexors (hamstring) of an inability to achieve 160^0 of active knee extension.

Chosen subjects were randomly allocated to two groups having 15 subjects each both males and females. Group A - retro-walking group (RWG) and Group B - passive static stretching (PSS).

For RWG to provide an opportunity to acclimate to backward walking on a treadmill, all subjects completed three supervised 10 minutes practice sessions at 0^0 of inclination (4). On the day of data collection, the treadmill was adjusted to produce a speed of 4km/h and 0^0 inclination (4).

Prior to collecting data, the subjects also completed a 1 minute accommodation period. The testing phase consists of a 6 minute period of walking 3 times a week for 6 weeks (5).

For passive static stretching (PSS) group was given to both the lower extremities of the subjects in supine lying over the bed, with a stretch hold duration of 30 seconds (6), 4 times per session with 10 sec rest between each repetition, 3 times per week for 6 weeks (7-9).

Results

Between Group Difference Comparison of Dependent Variables

T-test for between group comparison was applied to the difference between pre-test and post test readings between the groups, to determine whether any significant difference existed among the each variable between the two groups (Table 1).

The comparison of the difference of pre-test and post- test reading of each variable, using t-test, at significant level of significance p=0.05, statistically significant difference was found between the scores of all the variables between two groups.

Variables	Group 1 (Mean ± S.D)	Group 2 (Mean ± S.D)	t-value	*p*-value
Hamstring length	9.33 ± 2.74	6.86 ± 2.41	2.613	0.014
Standing Stork Test	13.00 ± 4.60	0.73 ± 1.41	9.872	0.000
Anterior reach distance	4.43 ± 3.17	0.73 ± 0.88	4.344	0.000
Antero-lateral reach distance	4.16 ± 1.29	0.23 ± 0.86	9.809	0.000
Postero-Lateral reach distance	3.40 ± 1.16	0.50 ± 1.14	6.854	0.000
Posterior reach distance	3.77 ± 1.33	0.26 ± 1.36	7.111	0.000
Postero-medial reach distance	3.83 ± 0.81	0.40 ± 1.10	9.677	0.000
Medial reach distance	4.66 ± 2.68	1.20 ± 0.84	4.774	0.000
Antero medial reach distance	4.06 ± 0.88	1.13 ± 1.04	8.310	0.000

Table 1. The difference comparison of dependent variables between the study groups

Hamstring length. The post- test score was significantly different from the pre-test for hamstring length (Figure 1) in group 1(p=0.000) as well as in group 2 (p=0.000), however mean improvement of group 1 (mean difference=9.33) was more than the mean improvement of group 2 (mean difference=6.86).

Standing Stork Test (STORK). The pre-test score was significant difference (Figure 2) from the pre-test score in group 1 (p=0.000) but not in group 2 (p=0.065), however mean improvement in group 1 (mean difference=13.00) was more than that of group 2 (mean difference=0.73).

Star Excursion test

Anterior reach distance. The post-test score of anterior reach distance (Figure 3) was signify-cantly different from the pre-test scores of group 1 (p=0.000) as well as group 2 (p=0.006), however mean improvement in group 1 (mean difference=4.43) was more than that of group 2 (mean difference=0.73).

Antero-lateral reach distance. The post-test score of antero-lateral reach distance (Figure 4) was significantly different from the pre-test score for group 1 (p=0.000) as well as for group 2 (p=0.022), however mean improvement in group 1 (mean difference=4.16) was more than the group 2 (mean difference= 0.23).

Lateral reach distance. The post-test score of lateral reach distance (Figure 5) was significantly different from the pre-test score for group 1 (p=0.000) but not for group 2 (p=0.313), and mean improvement in group 1 (mean difference=4.16) was more than the group 2 (mean difference= 0.23).

Postero-Lateral reach distance. The post-test score of postero-lateral reach distance (Figure 6) was significantly different from the pre-test score for group 1 (p=0.000) but not for group 2 (p=0.114), and mean improvement in group 1 (mean difference=3.40) was more than the group 2 (mean difference=0.50).

Posterior reach distance. The post-test score of posrerior reach distance (Figure 7) was significantly different from the pre-test score for group 1 (p=0.000) but not for group 2 (p=0.461), and mean improvement in group 1 (mean difference=3.76) was more than the group 2 (mean difference=0.26).

Postero-medial reach distance. The post-test score of postero-medial reach distance (Figure 8) was significantly different from the pre-test score for group 1 (p=0.000) but not for group 2 (p=0.183), and mean improvement in group 1 (mean difference=3.83) was more than the group 2 (mean difference=0.40).

Medial reach distance. The post-test score of medial reach distance (Figure 9) was significantly different from the pre-test score for group 1 (p=0.000) as well as for group 2 (p=0.000), however mean improvement in group 1 (mean difference=4.66) was more than the group 2 (mean difference=1.20).

Antero medial reach distance. The post-test score of antero-medial reach distance (Figure 10) was significantly different from the pre-test score for group 1 (p=0.000) as well as for group 2 (p=0.001), however mean improvement in group 1 (mean difference=4.06) was more than the group 2 (mean difference=1.13).

Between group difference comparison of variable. Between group difference comparison hamstring length revealed that there was a significant difference between retro walking group (9.33±2.74) and passive stretching group (6.86±2.41). The p value was found significant. Between group comparison of standing stork test also revealed that there was a significant difference between both groups. It was also found that there was a significant difference in star excursion test in all the 8 directions.

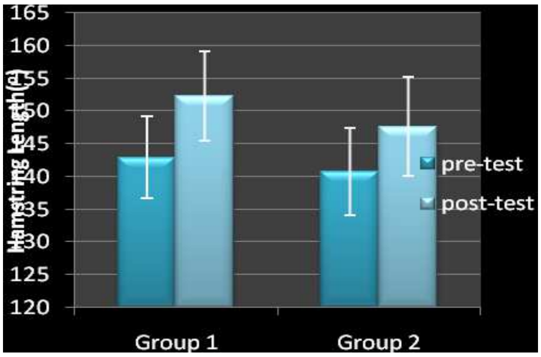

Figure 1. Comparison of hamstring length

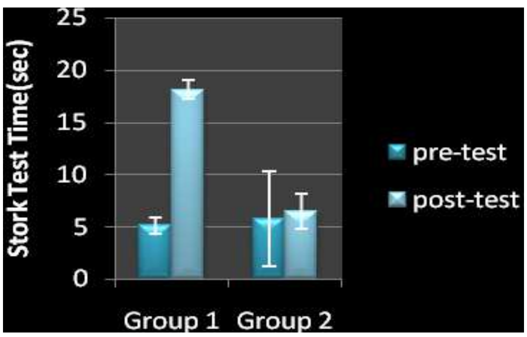

Figure 2. Within group comparison of Standing stork test

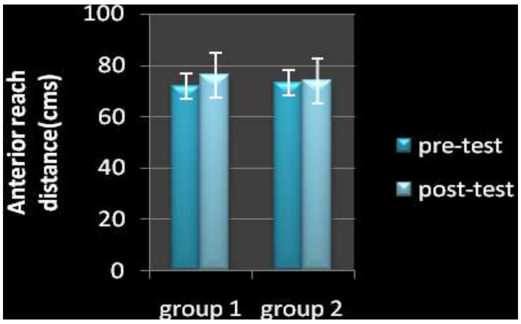

Figure 3. Within group comparison of anterior reach distance

Figure 4. Within group comparison of antero-lateral reach distance

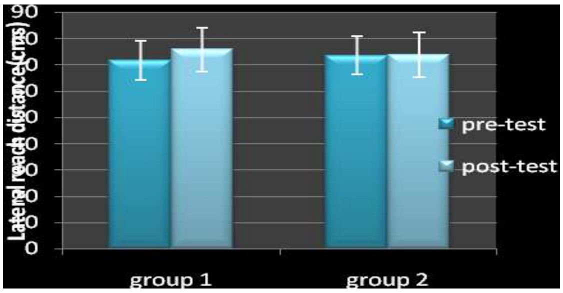

Figure 5. Within group comparison of lateral reach distance

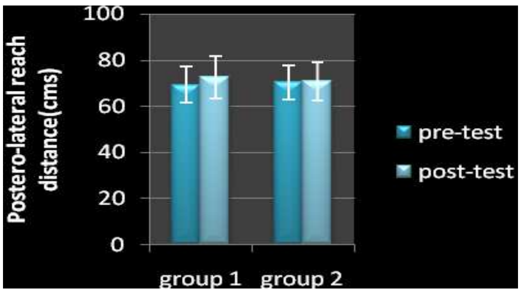

Figure 6. Within group comparison of postero-lateral reach distance

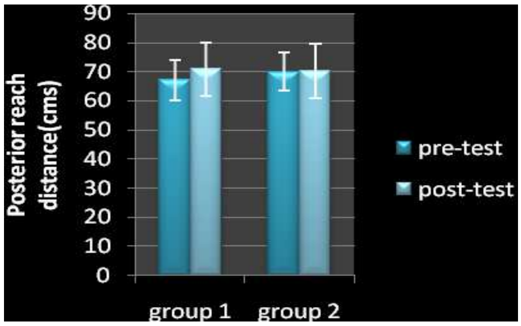

Figure 7. Within group comparison of posterior reach distance

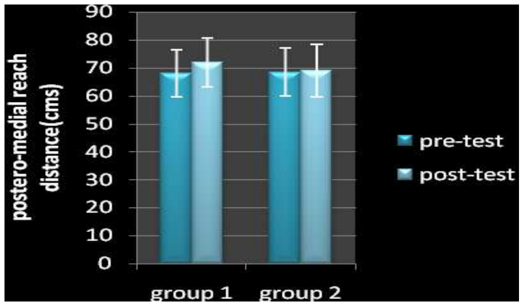

Figure 8. Within group comparison of postero-medial reach distance

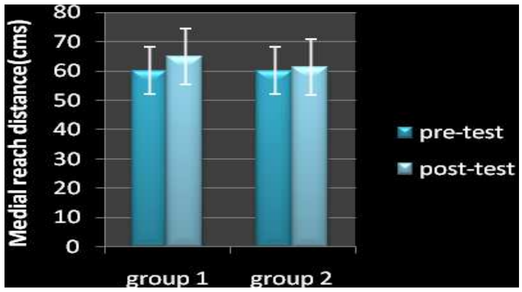

Figure 9. Within group comparison of medial reach distance

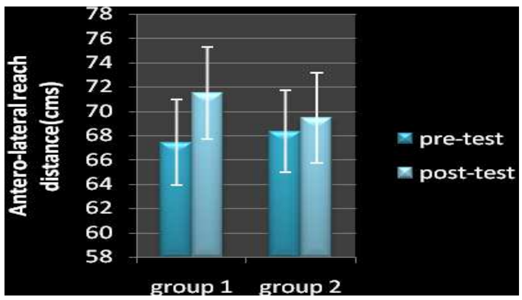

Figure 10. Within group comparison of antero-medial reach distance

Discussion

Both retro walking group and passive static stretching group showed significant improvement in hamstring length between the two data recording sessions.

A study done by Whitley et al. (2009) shows retro locomotion may be a practical means to improve flexibility of the low back and hamstrings as evidenced by improved SR (sit and reach) scores (10). Another study done by Nanda Kumar TR and Muddasir Ashraf (2009) showed a decrease in the angles for the hip and the knee and an increase in the angle for the ankle joint after backward walking treadmill training (11). This could explain the gain in hamstring length as well.

Improvement by the retro walking in hamstring length can be explained by reduced range of motion at the hip joint with greater flexion and lesser extension and a combination of maximum knee extension with hip flexion. Daniel J. Cipriani et al (1995) showed an increased activity of rectus femoris muscle as during backward walking, the normal eccentric contraction of the rectus femoris is replaced by a concentric contraction (4). Due to this increase in concentric activity of rectus femoris, hamstring may be loaded under eccentric stretch and could be a reason in the gains of the hamstring length.

Improvement by the passive static stretch in hamstring length can be explained by the changes in viscoelastic properties of human tendon structures, which states that stretching decreases the viscosity of tendon structures but increases the elasticity (12). The effects of both neuro-physiologic and biomechanical mechanisms. The neurophysiological component is explained by the inhibition of muscles exposed to stretching. Inhibition decreases the activity of the contractile component and results in an increased extensibility of the muscles and an increase in ROM of the joint. The biomechanical component is described by the properties of muscles tissue undergoing stretch. Elastic behavior refers to the property of a structure to elongate when a force is applied, and to return to its original length when force is taken away. Viscous behavior refers to property of a structure to elongate when a force is applied, but where the elongation is dependent on rate change. Hence, it appears that the elongation of a muscle is determined by the exerted force and force rate[13].When a structure is stretched to a fixed length either once or repeatedly in cyclic succession, the acting force at that length will decrease over time.

Creep is the behavior of structures under a fixed force when the force is either held or reached successively in cyclic manner (13).

Previous studies also have shown similar improvement in hamstring length by stretching. Klaus Wiemann and Knut Hahn (1997) has attributed the gains in hamstring length to an increase of subject’s tolerance to stretching strains (11). They have also conclude that getting used to stretching strains seems also to be responsible for the observation that subjects believe they have gained longer or more relaxed muscles after a stretching programme (15). Volkert C. De Weijer et al (2003) had shown significant increase in the hamstring length after passive static stretching (16). Richard L. Gasdosik (1991) showed a concomitant increase in hamstring length after static stretching and demonstrated lengthening adaptations to stretching regimen (3). Meroni Roberto et al (2010) have shown increase in hamstring length in active and static stretching techniques although the active stretching produced the greater gain in the AKER test, and the gain was almost completely maintained 4 weeks after the end of the training, which was not seen with the passive stretching group (17). William D Bandy et al (1994) also have shown increase in hamstring length with a stretch duration of 30 sec (6).

Retro walking group showed significant improvement in balance, but there were no significant improvement found in passive static stretching group in the measures of static balance. However, gains in four out of eight studied directions of SEBT test to measure dynamic balance have revealed significant improvement. In retro walking group this can be explained through enhanced proprioceptive input and better static posture control through muscles around ankle. The plantar surface of the foot plays significant role in providing sensory input in CNS for balance and posture control. Three mechano-receptors (Merkel’s disc, Pacinian corpuscles, Meissner complex) send somatosensory input to the brain by sensing pressure and stretching motions in tissues which surrounds them. Input that come from bottom of the foot in particular are of great importance as they indicate movement of the body over the base of support (BOS). Thus weight bearing exercises such as retro walking can stimulate joint mechanoreceptors leading to increased proprioception input which can be the

reason for the increase in balance in retro walking group.
Improvement in the static balance of the retro walking group may be because of the fact that with retro walking gastrocnemius is loaded more. A study done Daniel J. Cipriani et al (1995) had shown increase in the EMG activity of gastrocnemius muscle (4). As in our study the measurement tool to assess the static balance (stork test) has a important component of heel off the ground in final position done by the activity of gastrocnemius and various other muscles around ankle, the gain in static balance could be because of the above stated reason that is by retro walking there is increase in activity of gastrocnemius and other muscles around ankle thus a more stable ankle.
The gains in dynamic balance in our study can be explained by the reason that there is increase in static balance is achieved around ankle and thus in dynamic balance assessment by SEBT which require stability around ankle on stance limb can be the reason of increase in the reach distance by the other limb. Further, as there is increase in length of the hamstring muscle found by Whitley, Chet R. Dufek, Janet S. (2009), this could also be the possible reason in increase in the reach distance which is a sign of increase in the dynamic balance (10).
However retro walking is itself a dynamic activity and stress the dynamic control over the body during retro walking, this could also be the reason in gains in the dynamic balance readings found in retro walking group. As in passive static stretching there is no significant improvement found in static balance findings and in only four out of eight directions in SEBT test.
Our findings correlates with various previously done studies which states that there is no significant difference of static stretching on balance or acute effects of stretching showed adverse effects on balance.
Study done by David G. Behm et al (2004) had shown that static stretching with a stretch duration of 45 seconds adversely affects the balance and gave reasons that changes in muscle tendon unit (MTU) stiffness might be expected to affect the transmission of forces, the rate of force transmission and the rate at which changes in muscle length or tension are detected (18). A more slack parallel and series elastic component could increase the electromechanical delay by slowing the period between myofilament cross bridge kinetics and the exertion of tension by the MTU on the skeletal system. In addition, the detection and monitoring of the muscle tension by the Golgi tendon organs (GTO) would be delayed since a more compliant tendon would not transmit the tension information to the GTO as rapidly as a stiffer MTU.
Furthermore, increases in MTU length and decreases in MTU stiffness could also alter the perception of the intrafusal stretch receptors and thus perturb the afferent responses to both changes in muscle length, rate of length change, and tension (GTO).
Therefore, stretch-induced changes in muscle compliance might affect both the muscle afferent input to the CNS and muscle output for counteracting unexpected perturbations to balance.
Pablo B. Costa (2009) had shown no significance improvement in the balance scales after passive stretching of 45 seconds (19). However, they had also shown that a stretching duration of 15 seconds hold may improve balance performance by decreasing postural instability. Thomas Little et al (2006) had shown no detrimental effects of static stretching of duration of 30s on performance measures (20).
Further, the improvement in dynamic balance in four out of eight directions (anterior, antero-lateral, antero-medial and medial) can be explained as the increase in reach distance can be because of the reason that as there is increase in hamstring length it could affect the reach distance in these mentioned directions and thus increase in the reach directions in these directions readings had been observed.

Conclusion

In our study both retro-walking and passive static stretching increased hamstring length significantly among young collegiate students. Retro-walking significantly increased both static and dynamic balance. There was no significant effect of passive static stretching on static balance improvement & also on dynamic balance in four out of eight directions studied by SEBT test.
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Corresponding author
Shibili Nuhmani
Department of Rehabilitation Sciences
Hamdard Institute of Medical Sciences
Hamdard University, New Delhi
E-mail: *vakeri@gmail.com*

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Stress fracture of the tip of the olecranon in a professional discus thrower
(case report)

Ionescu Anca Mirela[1], Anghelescu Dan[2], Anghelescu Marian[1]
[1]*National Institute of Sports Medicine, Bucharest, Romania*
[2]*Medsport Clinic, Bucharest, Romania*

Abstract. A 24 year old male, professional discus thrower presented in our orthopedic service with four months history of posterior elbow joint pain and mild impairment in function. He described a "snap" in his right elbow during a regular practice. The standard X-ray showed no particular lesions. The treatment was short physical rest and oral NSAID. He continued to train but with a decrease in performance. Four months later, after the competition season ended, he returned with persistent pain in elbow joint but still with no impairment in elbow function or range of motion (ROM). An MRI was performed which showed an aspect of comminutive fracture of the tip of the olecranon incompletely consolidated and a CT (computed tomographic) scan was necessary to confirm the diagnosis.
The choice for the surgical technique was a challenge because of the particularity of the high functional demands of the patient. The option was an olecranon osteotomy with excision of the small comminuted fragments in the olecranon fossa and osteosynthesis of the olecranon using tension band. The second day after surgery the patient began ROM and was integrated in a specific rehabilitation program. At 9 month the tension band has been surgically removed and he began a regular training program once the wound close. This case report suggests that a tip of the olecranon fracture must be taken in consideration as differential diagnosis in professional throwing athletes and not to be overlooked. It also suggests that olecranon osteotomy with excision of the fragments can be a viable surgical option.
Kay words: *olecranon, stress fracture, throwing athlete, osteotomy*.

Introduction
Stress olecranon fractures are a rare condition of the professional athlete (1-5).
There are three types of stress olecranon fracture type 1 - fracture of the tip of the olecranon, type 2 – fracture of the growthplate in skeletally immature patients and type 3 - transverse or oblique fracture of the distal third of the olecranon (2). The fracture's types are caused by impingement of the tip in the olecranon fossa at the end of the extension movement. We report a case of a fracture of the tip of the olecranon that occurred at a professional discus thrower.

Case report
A 24-year-old male competing discus thrower presented with a four month history of posterior elbow pain. He described the onset as sudden, during a regular practice, when he heard a "snap" followed by pain in the elbow joint (2).
The X-rays of the elbow joint were done after three days and showed no particular changes. At first it was thought to be a mild tendinitis of the triceps.
After a small time of physical rest, oral theerapy with NSAID and muscle relaxants, the patient started to train and compete.
He described a moderate discomfort in throwing with decrease in velocity and distance and also described an early release of the discus because the full extension of the elbow was painful.
After the competition season ended, the patient came to our attention and complete elbow joint physical examination was performed.
The hypertrophy of the muscles around the elbow joint was obvious at inspection, the skin was normal and no soft spots were observed. There was moderate pain on the olecranon and in the olecranial fossa with the elbow flexed at 45 degrees. No tenderness on the epicondyles or on the elements of the cubital fossa was found.
ROM was normal, but with moderate pain in full extension. Full blood count, biochemistry, C reactive protein and erythrocyte sedimentation rate were all within normal range.
Plain X ray examination showing an abnormal tip of the olecranon at 6 month post-injury (figure 1).

A magnetic resonance imaging (MRI) was performed that showed an abnormal image at the tip of the olecranon suggestive for a fracture and with no other significant pathological changes around the elbow joint. Finally, a CT scan examination was done that described a comminuted fracture of the tip of the olecranon (figure 2).

Figure 1. Plain X-ray examination of the olecranon at 6 month post-injury

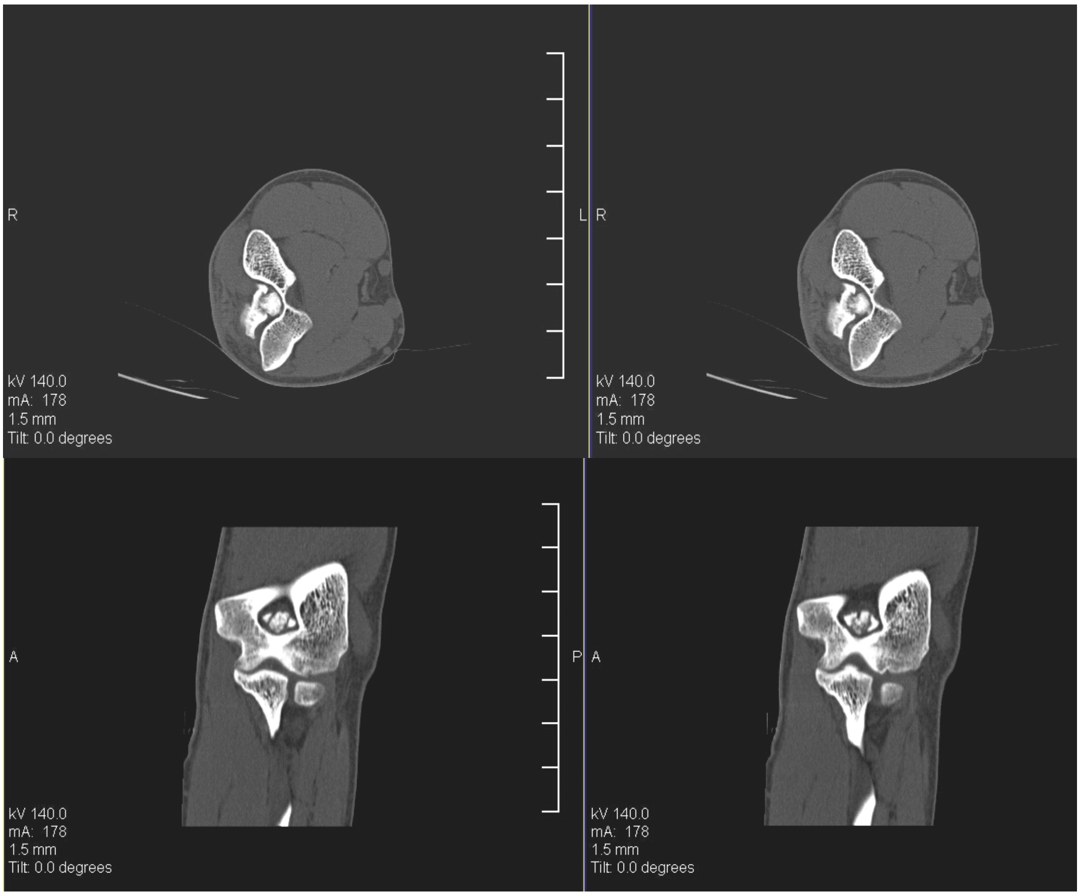

Figure 2. CT scan examination of the olecranon

The decision was taken for a surgical excision of this fractured osteophyte (3).
Through a standard 5cm posterior incision, the olecranon was exposed and a transverse osteotomy was done. We exposed the tip of the olecranon and found the comminutive fractured osteophyte and excised it. The osteosynthesys of the olecranon was done using two kirschner wires (4) following the principles of the tension band.
The following day passive ROM was begun with active ROM at day 3. Sutures had been removed after 14 days and a specific rehabilitation programme (6) was started after 3 weeks.
The rehabilitationwas performed in our center for 3 weeks, when the patient began progressive loading and close chain exercises. The full extension was recovered after 3 weeks.
The metal material was removed after 9 months, after X-ray and follow up showed consolidation of olecranon.
After 6 weeks the athlete returned progressively to usual training. He has no more pain at full extension of the elbow, he claims he is pain free when training and has improved his distance and speed similar to the pre-injury level.

Figure 3. X-ray olecranon examination at 6 weeks postoperative osteotomy and osteosynthesis using tension band

Discussion
Stress fractures of the olecranon in throwing athletes are sometimes difficult conditions to diagnose and treat(7). Physical findings are poor and not revelatory and usually X-rays are normal.
CT scans and MRI exam usually make the diagnosis clear. Our option was an osteotomy of the olecranon with excision of the small comminuted fragments and osteosynthesis by tension band because of the particularity of the joint capsule and because this approach offered us the best visualisation in the olecranon fossa for excising all the fragments (8,9).
The disadvantage is the burden of the osteothomy that must heal properly and the need for reintervention for extracting the metalic material.
Another advantage is that rehabilitation can begin early in postoperatory period and there is a small incidence in joint stiffness and pain after using this technique.
Taking into account the satisfaction of the patient at 6 month after the material was extracted and his improvement in symptoms and performance, we consider that this technique can be an option in treating stress fractures of the tip of the olecranon.

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Coresponding author
Anca Mirela Ionescu
National Institute of Sports Medicine
Bucharest, Romania
E-mail: *anca_mirela_ionescu@yahoo.com*

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