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Effects of 50 Days Ovomet® Supplementation on Biomechanical Parameters and Subjective Pain Perception among Old Institutionalized Patients. A Preliminary Study

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Abstract

According to previous published works, the eggshell membrane has shown a positive effect on the joint pain relief. In this study, several tests were performed to measure the effect of Ovomet® (eggshell membrane) supplementation on the subjective perception and biomechanical variables in institutionalized patients of advanced age before and after 50 days of 300 mg Ovomet® administration. The aim was to demonstrate and verify the protective and regenerative effects of Ovomet® on the joints. To measure this effects some pain perception questionnaires were performed and biomechanical variables such as muscle strength and power in knee extension, linear stiffness of the Achilles tendon (AT) by ultrasound, muscle stiffness by means of sensor in two different manoeuvers were carried out. In conclusion, the daily intake of 300 mg Ovomet® during 50 days showed a positive effect on the linear stiffness of the AT in institutionalized elderly patients showing the usefulness of the echography technique of linear stiffness of the AT to study the factors that increase the protection capacity of the joints.

Keywords Ovomet®; Ageing; Tendonl Linear stiffness; WOMAC; DASH; Biomechanics; Barthel´s index; MINIMENTAL test, Collagen

Introduction

It has recently been recognized that, in addition to changes in muscle-tendon unit, alterations in tendon properties also contribute to muscle weakness and loss of mobility when getting older [1]. In addition, it is well known that the synthesis of constituents of the tissues declines with ageing, for this reason, a balanced diet plays a very important role. The use of nutritional supplements may partly cover or reinforce these needs.

The use of supplementation for joint problems has received much attention in recent years as a preventive therapy or even as a treatment of diseases and joint injuries. The eggshell membrane is one of the food supplements that have had very good results in this sense [2-5]. Eggshell membrane is comprised of a large part of collagen, mainly type I, V and X [6-8]; glycosaminoglycans (hyaluronic acid, chondroitin sulfate and different proteins that are involved in the anti-inflammatory and immune system regulation ability of the eggshell membrane (lysozyme, ovotransferrin, ovocleidin-17 and ovocleidin-116) [8,9]. In addition, the eggshell membrane can be used as a source of sulfur due to the number of disulfide bonds and sulfur amino acids that have been quantified [10]. It is well known that sulfur plays a very important role in nutrition and in maintaining the cartilage matrix [11].

The WOMAC (Western Ontario Osteoarthritis Index and McMaster Universities), DASH (Hand, Shoulder and Hand Disabilities) [12,13] and Visual Analogue Scale (VAS) or Likert with a scale of 0 to 10 are questionnaires that have been used to describe the degree of symptomatic pain in the joints of osteoarthritic people.

The objective measurements of biomechanical variables could become a very important ally in assessing the problems associated with joints.

The stiffness parameter of the tendon is defined as the ability of the tendon to oppose the stretching and tension produced there on, expressed in units of Newton per millimeter of deformation, it can be understood as the force contrary to an external force that is exerted on a joint and protects the internal structure of the tissues; tendon stiffness depends on two fundamental factors: the quality of collagen and the cross-section of the tendon. Ultrasonic techniques developed in recent years have given more information in the study of joints using a series of tests that are used to measure different kinematic variables [14,15].

In the present study, we applied a series of motion tests such as muscle strength and power in knee extension using different weights, muscle stiffness using sensors in two different manoeuvers, a test of “Counter Movement Jump” (CMJ) and Unilateral Drop Jump (UDJ) with a variant, "Heel Rise" HR. We also performed an echography of the AT to measure the tendon linear stiffness.

Materials and Methods

For a double-blind, placebo-controlled, randomized, balanced trial (1:1 ratio), 38 elderly institutionalized participants recruited in the nursing home of Tudela, Spain, (85 ± 5 years, 1.55 ± 8.6 cm, 72.2 ± 12.8 kg and 30.2 ± 4.9 kg/m^2) were selected for the study, 19 of them placebo and 19 with supplementation of one daily capsule of 300 mg of Ovomet® for 50 days.

The study was approved by the ethical committee of animal experimentation and biosafety of the Public University of Navarra with code PI-019/15 of July 30, 2015. The study participants were provided with a consent model with all relevant information about the study, as

well as making clear the fundamental rights of the people who access to the study.

To evaluate the response to the treatment, a battery of evaluations were performed according to the WOMAC, DASH and VAS questionnaires before and after the intervention. In addition, a psychic evaluation of the patients was performed using a MINIMENTAL test, a brief psychosomatic scale to evaluate the cognitive status of people. For functional assessment of the basic activities of daily living, one of the most widely used tests in this population segment (third age) is Barthel's Index, which measures the functional capacity of patients.

The kinematic parameters like linear stiffness of the AT by echography, muscle stiffness utilizing sensors in two different manoeuvres and muscle strength and power in extension of knees were measured.

For the test with sensors in two different manoeuvres a "heel rise" HR test was performed, which consists of the subject starting the test standing and being asked to lift the heel, remaining for 3 s and measuring the different phases of the movement; with this test the duration times of the different phases are extracted and the accelerations, the linear velocity in vertical axis of each individual, the vertical force (acceleration x mass of the subject) and the vertical mechanical power are calculated. The SQ (squat) test was another test that was used to measure parameters similar to the HR test, this being another type of movement manoeuver where the subject from the "standing" position sits in the chair and then rise until it stands erect again. For the AT linear stiffness, the displacement of the tendon was measured in the ultrasound.

All tests were performed before and after supplementation in the study period.

Statistical analysis

Data of the equipment were analysed using SPSS 21.0 program.

Statistical analysis was designed to evaluate the data of the subjective rating scale, MTJ displacement and TA strength would followed a normal distribution by Shapiro Wilks test ($n<30$). In the case of normal distribution, the statistical comparison was performed using the paired Student's T test to study the effects of supplementation. If some of the variables would not have a normal distribution, the Wilcoxon non-parametric statistical test is performed. If $p<0.05$ significant differences are assumed.

Results and Discussion

The evaluation of the WOMAC questionnaire revealed a reduction of 40% (from 8.4 ± 4.2 to 5.0 ± 4.6, P=0.04 post treatment) in the group supplemented with Ovomet® while in the placebo group was 28% (from 5.7 ± 3.4 to 4.1 ± 4.3, P=0.09 at the end of the study); with the Barthel's Index, the number of subjects who improved with supplementation (n=5) was slightly higher than the number of placebo individuals who showed improvement, (n=3) although no statistical differences were observed between placebo and Ovomet® conditions before the study. The results of DASH and VAS showed inconsistent results between placebo and supplemented groups and among the same group; a MINIMENTAL test obtained was an average of 26. The subjective tests of pain, joint and functional stiffness did not offer very reliable results for the group studied.

In the experimental work performed (kinematic variables), results were obtained with little reproducibility in the different measurements.

The linear stiffness of the AT by echography showed quite promising results since the supplemented group experienced an increase from 4.79 N/mm to 7.01 N/mm representing a 46.5% of increase post treatment (n=5) compared to a slight decrease in the linear stiffness in the placebo group (from 6.81 N/mm to 6.64 N/mm resulting in 2.43% (n=3)). This result seems to indicate that this test can be very useful for measuring effects of joints supplementation or another method for the treatment of joints problems such as physiotherapy or exercise. Our results indicate an increase in linear stiffness of AT in the elderly with the administration of Ovomet®, when the normal behavior is the decrease of this parameter with ageing [16-18], the opposite of what happens during the passage from childhood to adulthood (5 to 12 years) [19,20], which report an increase in linear stiffness of the AT as a consequence of weight gain and increased loads in tendon.

Intrinsic factors such as the quality of collagen as well as the cross-section of tendons decrease over time in the aging process [21-24], although there is controversy about this, others have suggested that with the advanced age the tendon is shown stronger and more rigid [25], the truth is that with our work the control group experienced a slight decrease in tendon linear stiffness. There are little studies that have done research on the effect of food supplementation on the tendon biomechanics; however a study with rats concluded that a supplementation of 3% of glycine and lysine added to the diet increased the stiffness of the tendon of the rats tail significantly compared to a control group fed with a standard diet [26].

Conclusion

Of all biomechanical tests performed the measurement of the linear stiffness of AT has shown a useful tool to study the influence of supplementation in the joints , demonstrating that the supplementation of Ovomet® in patients of advanced age could increase the linear stiffness of the AT showing a positive influence on the joints.

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