Original article

The Effect of Type-II Collagen on Y-Balance Performance in Men With Meniscus

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Abstract. In the present study, the effect of hydrolyzed type-II collagen supplementation on Y balance performance was examined within the individuals that have second-degree meniscus damage. 10 experiments with an average age of 46.9 ± 3.61 and 10 control groups with an average age of 47.4 ± 2.12 took part in this study, including 20 male patients in total. Throughout the study, the experimental group patients received hydrolyzed type-II collagen treatment orally on an empty stomach for 10 g/days in the morning for three months. On the other hand, the control group patients did not receive any additional nutritional supplements. As a result of the statistical analysis that is made at the end of the study, there are significant differences that are determined within the Y balance test pre-test and post-test performance values of the experimental group ($p < 0.05$). There were no significant differences in the pre-test and post-test performance values of the control group ($p > 0.05$). As a result, it can be said that collagen type-II supplementation, which is produced by the cartilage matrix in the body and is very important in terms of joint health and cartilage formation, has positive effects on the balance performance of individuals with meniscus damage. Consequently, it can be said that collagen type-II supplementation, which is produced by the cartilage matrix in the body and that is critical in terms of joint health and cartilage formation, has positive effects on the balance performance of individuals with meniscus damage.

Key words: Balance, Collagen, Meniscus

Introduction

The knee joint is the part that carries the weight of the body along with the hips and ankles. Since the knee joint movements take place in multiple planes, the joint is susceptible to injury. Meniscus tears may occur as a result of the injuries (1). Meniscus' are biomechanical structures that are located between the tibia and femur. Within the mechanoreceptors that take part in the meniscus', they establish the postural control (2). The damage in any of these features may cause impairment in the knee biomechanics. Patients generally complain about the pain and balance problems in meniscus pathologies (3). These complaints should be considered in patients under 45 years of age because studies show that patients over the age of 45 generally undergo surgical intervention (4). Due to the knee joint pain, there is a significant decrease in muscle function due to the decrease in the load applied to the knee joint. As a result of this depletion, loss of function is seen in the balance (5). In a meniscus injury, uncontrolled damage occurs in mechanoreceptors. Since this damage creates irregular afferent stimuli in healthy mechanoreceptors, it can be seen in the foot due to the decrease in proprioceptive sensation (6). It has been reported that there is a decrease

in neuromuscular control of the knee joint within the studies that are applied to the patients with meniscectomy (7). Collagen, which is found in the structure of bone, cartilage, fiber, and joints, consists of three alpha chains wrapped on top of each other. Collagen has 30 different types that are named type-I, type-II, type-III, type-IV. This diversity is due to the molecular structure. Type-II collagen, which is the most common type in the body after type-I, is produced by the cartilage matrix. Furthermore, it is vital in joint health and cartilage formation and very effective in joint pain and more advanced joint ailments. type-II collagen is an essential component of joint cartilage and forms the functional unit's axis (8). There are essentialand lots of studies about the knee joint in the literature. However, studies related to meniscus disorders and collagen in the knee joint, which have an important place in terms of life quality, are minimal. This study aims to contribute to science by determining the effect of type-II collagen supplementation on balance performance in men with meniscus damage.

Materials and Methods

20 male volunteers, 10 experimental and 10 control groups have participated in the study. All of the experimental and control groups were composed of individuals who live a sedentary life. The individuals in these groups were formed by individuals with 2nd-degree meniscus damage in their right and left knees. The experimental group patients received hydrolyzed type-II collagen treatment orally on an empty stomach for 10g/days in the morning for three months. On the other hand, the control group patients did not receive any additional nutritional supplements.

Height: The subjects height was measured without shoes while they hold their breath, standing upright on flat ground with their heels and toes adjacent to each other, in a standing position with a sensitivity of 0.01 m stadiometer (SECA, Germany), just like it is required.

Body Weight: The body weights of the subjects were taken at 09:00 in the morning before breakfast. Throughout the weight measurements, the subjects were barefoot and wearing sportswear (tracksuits and t-shirts); plus, it measured with an electronic scale (SECA, Germany) that has a 0.1 kg sensitivity just like it is required.

Body Mass Index Calculation (BMI): The body mass index of the subjects was determined by using the body weight (kg)/height (m)2 formula that the World Health Organization accepts.

Y Balance Test: The "Y Balance Test" platform was used to measure dynamic postural control. Each participant's leg length was recorded by measuring bilaterally in centimeters from the anterior superior iliac point to the distal part of the medial malleolus in the supine position. Measurements were made with bare feet in three directions. Anterior reach was tested as the distance between the toe of the participant in the center and the distance between the posteromedial and the posterolateral from the heel of the foot. During the test, the participants were asked to keep their hands on the iliac while their heels on the floor and asked to touch on the farthest point with the reaching foot's toe. Before the measurement, the experienced researcher made a brief demonstration about how to apply the test, and the participants were allowed to experiment in all directions at least six times (9). After the test was completed, each participant was given a two-minute rest time and then three stretches in each direction. During the measurement, transferring their body weight to the reclining foot, separating the heel of the standing foot from the floor, or separating their hands from the hips were considered errors, and the measurement was repeated after the participant was verbally informed. All reach distances are recorded in centimeters. After the data were obtained, in order to take away the leg length advantage, the formula "best reaching distance/leg length) x100" for each direction was normalized that was received (10). The total score (TOP) value was calculated using the normalized ANT, PL, and PM scores.

Statistical Analysis: Statistical package program (SPSS 22 IBM) was used in the analysis of the data in the study. Descriptive statistics were used to determine the mean and standard deviation values. Normality analysis of the groups was done using the Shapiro-Wilk test, and it was found that the groups showed a normal distribution. While comparing the pre-test and post-test values within the groups, a paired-samples

t-test is used. On the other hand, the independent samples t-test is used to compare the groups with each other. The level of significance was evaluated according to the "p <0.05" level.

Results

When Table 1 is examined, it is observed that the mean values of age, height, weight, and body mass index of the control and experimental groups.

In Table 2, when the pre-test scores of the Y balance test performance values of the experimental and control groups were compared, no statistically significant difference is found in all values (p> 0.05).

In Table 3, when the post-test scores of the Y balance test performance values of the experimental and control groups were compared, statistically significant differencesare found in all values (p <0.05).

Table 1. Descriptive statistical values for the subjects

Variables	Experimental Group Mean ± SD	Control Group Mean ± SD
Age (year)	46.9± 3.61	47.4± 2.12
Height (cm)	169.1± 4.91	170.2± 4.09
Weight (kg)	72.77± 4.11	73.01± 3.87
BMI (kg/m2)	25.45± 2.09	25.20± 2.01

In Table 4, when the pre-test and post-test scores of the Y balance test performance values of the experimental group were compared, there are statistically significant differences found in all values (p <0.05).

In Table 5, when the pre-test and post-test scores of the Y balance test performance values of the control group were compared, there is no statistically significant difference found in all values (p> 0.05).

Discussion and Conclusion

Meniscus lesions are a common illness. These lesions cause the rupture of specific tissues in the knee due to uncontrolled rotation and excessive strain. The recovery of meniscus damage is only possible with physical therapy, sports, and other natural treatment approaches. However, if the damage is severe, surgical methods are applied too. In our study, type-II collagen's effect on the meniscus and balanced performance applied to the meniscus-damaged patients is examined. In our study, the experimental group patients received hydrolyzed type-II collagen treatment orally on an empty stomach for 10g/days. According to clinical studies, to see the benefit of collagen hydrolyzate's positive effects, it is necessary to consume at the recommended daily dosage (10 g/days) regularly. It has been experimentally determined that this amount of collagen hydrolyzate intake has beneficial effects on

Table 2. Statistical values for the Y balance performance pre-test scores of the subjects

Variables	Experimental Group (Mean ± SD)	Control Group (Mean ± SD)	F	P
Anterior Right Leg	45.38±1.27	46.66±2.33		
Anterior Left Leg	43.65±2.43	44.73±1.94		
Anterior Average (cm)	44.51±2.77	45.69±2.59	0.398	0.743
Posteriomedial Right Leg	71.47±2.56	75.38±3.75		
Posteriomedial Left Leg	73.55±3.78	73.64±2.52		
Posteriomedial Average (cm)	72.51±2.64	74.51±2.66	0.465	0.606
Posteriolateral Right Leg	63.39±3.12	65.31±2.49		
Posteriolateral Left Leg	65.41±2.29	67.91±1.82		
Posteriolateral Average (cm)	64.40±2.19	66.61±2.65	0.409	0.722
Total Average Y Balance Test	60.47±2.79	62.26±2.87	0.423	0.687

*p<0.05 significance level.

Table 3. Statistical values for the Y balance performance post-test scores of the subjects

Variables	Experimental Group (Mean ± SD)	Control Group (Mean ± SD)	F	P
Anterior Right Leg	53.30±2.19	45.88±2.45		
Anterior Left Leg	52.87±3.19	46.25±2.09		
Anterior Average (cm)	53.08±3.51	46.06±2.11	3.903	0.008*
Posteriomedial Right Leg	80.89±3.37	74.99±3.01		
Posteriomedial Left Leg	81.49±3.22	74.75±2.65		
Posteriomedial Average (cm)	81.19±2.33	74.87±2.27	2.132	0.034*
Posteriolateral Right Leg	70.85±3.28	65.35±2.81		
Posteriolateral Left Leg	72.18±2.95	65.78±2.44		
Posteriolateral Average (cm)	71.51±3.22	65.56±2.61	2.199	0.031*
Total Average Y Balance Test	68.59±2.45	62.16±2.71	2.471	0.018*

*p<0.05 significance level.

Table 4. Comparison of experimental group Y balance performance pre-test and post-test scores.

Variables	Pre-Test (Mean ± SD)	Post-Test (Mean ± SD)	F	P
Anterior Right Leg	45.38±1.27	53.30±2.19		
Anterior Left Leg	43.65±2.43	52.87±3.19		
Anterior Average (cm)	44.51±2.77	53.08±3.51	4.903	0.001*
Posteriomedial Right Leg	71.47±2.56	80.89±3.37		
Posteriomedial Left Leg	73.55±3.78	81.49±3.22		
Posteriomedial Average (cm)	72.51±2.64	81.19±2.33	2.032	0.039*
Posteriolateral Right Leg	63.39±3.12	70.85±3.28		
Posteriolateral Left Leg	65.41±2.29	72.18±2.95		
Posteriolateral Average (cm)	64.40±2.19	71.51±3.22	2.509	0.016*
Total Average Y Balance Test	60.47±2.79	68.59±2.45	4.113	0.001*

*p<0.05 significance level.

Table 5. Comparison of control group Y balance performance pre-test and post-test scores.

Variables	Pre-Test (Mean ± SD)	Post-Test (Mean ± SD)	F	P
Anterior Right Leg	46.66±2.33	45.88±2.45		
Anterior Left Leg	44.73±1.94	46.25±2.09		
Anterior Average (cm)	45.69±2.59	46.06±2.11	0.181	1.313
Posteriomedial Right Leg	75.38±3.75	74.99±3.01		
Posteriomedial Left Leg	73.64±2.52	74.75±2.65		
Posteriomedial Average (cm)	74.51±2.66	74.87±2.27	0.101	1.998
Posteriolateral Right Leg	65.31±2.49	65.35±2.81		
Posteriolateral Left Leg	67.91±1.82	65.78±2.44		
Posteriolateral Average (cm)	66.61±2.65	65.56±2.61	0.132	1.512
Total Average Y Balance Test	62.26±2.87	62.16±2.71	0.176	1.197

*p<0.05 significance level.

joint, bone, and skin health (11) and that collagen synthesis increases as a result of the increase in the concentration of hydroxyproline in the blood (12).

Our study determined that hydrolyzed collagen type-II treatment applied for three months to individuals with 2nd-degree meniscus damage had positive effects on Y balance performance, and there were statistically significant differences between pre-test and post-test performance values. Besides, no statistically significant difference is found in the Y balance test pre-test and post-test performance values of the control group.

When the studies are in the literature are examined; in a study of middle-aged patients with meniscus damage, the effect of meniscus lesions on muscle strength functions in the knee joint has been examined, and pre-operative isokinetic muscle strength values of patients with meniscus damage and isokinetic muscle strength values of individuals without meniscus damage were compared. According to the data that is obtained, it is concluded that the extension muscle strength in the knees of individuals with meniscus damage was significantly lower compared to knees without meniscus damage (13). In a study about patients with meniscectomy that is conducted by Akima and Furukowa (14), it is reported that the quadriceps femoris muscle was weaker compared to the healthy side, and this weakness was mainly at the thigh level. In another study that is conducted on 20 patients who have partial medial meniscectomy, the dynamic balance of the subjects are examined, and it is found that the operated extremity balance was weaker than the healthy side. It has been reported that the reason for this weakness, which lasts for a year, can be caused by damaged mechanoreceptors that are injured due to the meniscus (15).

In Al-Dadah's study on 100 people, isolated patients with meniscopathy and a healthy group were evaluated for their proprioceptive functions (6). A significant proprioceptive deficit was found in the knee with meniscal tear compared to the healthy control group and healthy knee. In the study about balance, Cho et al. (16) reported that the cause of postural balance problems might be due to the decrease in lower extremity muscle strength. It is thought that the decrease in muscle strength causes the center of gravity to stay in front of the axis of the ankle joint, and this causes balance problems. Also, it is thought that the increase in muscle strength will change the center of gravity towards the ankle's axis and positively affect the balance performance.

In conclusion, we can say that collagen type-II treatment, which is one of the vital building blocks of joint cartilage, has positive effects on balance performance in individuals with meniscus damage and can be considered an auxiliary treatment method when the individual exercise.

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