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EDITORIAL

Our Dear Colleagues,

We are happy to be with you in the third July issue of our journal. In this issue, we have prepared scientific studies for you as a result of the devoted and careful work of our editorial board and referees. You can find all the details of the articles accepted for publication on our website. I would like to thank the academicians who accepted to be referees and evaluated the articles in our third issue. Finally, I congratulate all the authors whose articles have been published. It is our greatest effort to carry our journal to a good point. Hope to meet you in our next issue

Sincerely Yours,

İzzet BİNGÖL

Editor-in-Chief

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ORIGINAL ARTICLE

REVIEW

CASE REPORT

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Original Article

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Comparison of physical activity, internet addiction, and healthy lifestyle behavior of Turkish University students before and during the early COVID-19 Pandemic

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ABSTRACT

Aims: This study aims to compare the physical activity, internet addiction and healthy lifestyle behaviors of university students before and during the coronavirus pandemic.

Methods: This study, which included university students, was carried out in two stages observational, cross-over, and before-after evaluation. After the physical and sociodemographic characteristics of 335 university students were recorded in the first stage before the pandemic (February-May 2019), The International Physical Activity Questionnaire (IPAQ), the Internet Addiction Scale (IAS) and Healthy Lifestyle Behavior Scale (HLBS) were applied in the study. The second part of the study consists of repeating questionnaires online with 205 students during the pandemic (June 2020).

Results: It was determined that there was a decrease in the levels of vigorous (MD: 28.4; p<0.001) and moderate (MD: 47.7; p<0.001) physical activity of the participants, and an increase in the time they spent sitting (MD: -178.1; p<0.001), internet addiction (MD: 31.7; p<0.001), and HLBS total score (MD: -6.82; p<0.001).

Conclusion: It was observed that the pandemic negatively affected physical activity, internet addiction, and healthy lifestyle behavior. It is essential to determine whether these effects continue after the pandemic and to take precautions accordingly.

Keywords: Physical activity, internet addiction, health behavior, COVID-19 pandemic

INTRODUCTION

In Wuhan, China, COVID-19 infection caused by the novel coronavirus type (SARS-COV-2) was detected in December 2019.[1] The virus, which spread to the whole world, especially Europe and America quickly, was defined as a new coronavirus that had not been detected in humans before on January 7, 2020. On March 11, 2020, the World Health Organization classified it as a pandemic.[2] In Turkey, the first case with a diagnosis of COVID-19 was announced by the Ministry of Health on March 11, 2020.[3] After this date, various measures have been taken by the State of the Republic of Turkey to protect public health and reduce the risk of disease transmission.[4] These measures can be listed as the closure of universities, the transition to online education, travel restrictions, preventing certain age groups from going out on the streets and declaring a weekend curfew. Undoubtedly, this situation causes an increase in the time spent at home and in front of the screen, especially in university students, and may adversely affect the physical activity behaviors, sleep patterns, quality of life and healthy lifestyle behaviors of individuals.[1-3, 5-7]

Many studies in the literature examine problematic internet use, exercise and healthy lifestyle behaviors in university students and adolescents.[8,9] Studies are primarily aimed at determining the relationship between the duration of internet use and depression, stress management, academic achievement or healthy lifestyle behaviors.10 Although these studies reflect pre-pandemic data, there are also studies conducted during the pandemic that examine the effects on internet use, depression, and healthy lifestyle behaviors.[1-11] However, according to our literature review, no study compares the levels of physical activity, internet addiction and healthy lifestyle behaviors before and during the pandemic.

It is thought that the COVID-19 pandemic in young individuals may directly impact physical activity, internet addiction and healthy lifestyle behaviors. However, the effects of COVID-19 on physical activity and internet addiction are uncertain compared to the pre-pandemic period. This study aims to compare the physical activity, internet addiction and

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healthy lifestyle behaviors of young individuals before and during the COVID-19 pandemic.

METHODS

Design

This study was carried out on university students and was carried out as observational, cross-over, before-after evaluation. Volunteer university students aged 19-24, with a body mass index of 18.50-24.99 kg/m^2, without any chronic disease or disability, and who did not use alcohol, drugs or cigarettes were included in the study. Failure to complete the questionnaire, being actively suffering from COVID-19, having a physical or metabolic disease that would prevent physical activity, and having a BMI above 35 were the reasons for exclusion.

Evaluations in the study consisted of two time points. In the first evaluation, face-to-face questionnaires were applied to 335 participants in the pre-pandemic period (February-May 2019), assessing physical activity level, internet addiction, and healthy lifestyle behaviors. The second assessment consisted of repeating the same questionnaires during the pandemic (June 2020). The second evaluation was carried out with 205 of 335 respondents who responded to online questionnaires.

The study was carried out with the permission of the Gazi University Scientific Researches Evaluation and Ethics Committee (Date: 10.11.2020 Decision No: 129778) and the Ministry of Health of the Republic of Turkey (2021-06-10T23-03-50). We obtained an informed consent form from all patients for procedure. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Instruments and Procedures

Sociodemographic Information Form

Sociodemographic data, including gender, age, weight, height, residence during the academic year were gathered using a personalized, self-administered questionnaire.

International Physical Activity Questionnaire - Short Form

The International Physical Activity Questionnaire - Short Form (IPAQ-SF), which has seven questions, was used to measure physical activity. The total weekly physical activity minutes and daily sitting time was determined using the questionnaire.[6] Sağlam et al.[12] performed a validity and reliability analysis of the IPAQ-SF in Turkey in 2010.

Internet Addiction Scale (IAS)

Internet Addiction Scale (IAS) was developed by Young[13] and translated into Turkish by Kesici et al.[14] This scale measures at the way that internet use has affected people's levels of obsessive compulsive behavior, emotional changes, behavioral issues, and overall quality of life.

Higher scores indicate a greater propensity for addiction. The 20 items of the IAS are calibrated scores from 1 to 5, with a total score range of 20 to 100. Three categories of internet user groups are identified in Young's the original design. Internet addicts, possible internet addicts, and non-addicts, in that order, are those whose IAS scores are over 70, between 40 and 69, and below 39.[14]

Healthy Lifestyle Behavior Scale

The healthy lifestyle behaviors scale (HLBS) scale was developed by Walker et al.[15] in 1987 and revised in 1996. The scale measures the health-promoting behaviors of the individual about the healthy lifestyle behavior. The scale includes a total of 52 items that make up the six sub-parameters (Health responsibility, Physical activity, Nutrition, Spiritual development, Interpersonal relationships, Stress management) of HLBS. In this scale, which is a four-point Likert type, the answers given to each item are scored as never "1", sometimes "2", often "3", and regularly "4". Total scores are obtained by summing all the items for the scale. The lowest total score to be taken from the scale was "52", and the highest score was "208".[15] The Turkish validity and reliability study was conducted by Bahar et al.[16] in 2008.

Statistical Analysis

The analysis of the obtained data was performed using the "Statistical Package for Social Sciences" (SPSS) Version 22.0 (SPSS inc. Chicago, II, USA) program. Mean, standard deviation, and mean differences were used for the presentation of continuous variables (quantitative variables) obtained by measurement, and frequency and percentage values were used for the presentation of categorical variables (qualitative variables). Shapiro Wilk test and graphical methods were used to investigate the conformity of quantitative variables to normal distribution. The measurements of the same individuals were different before and during the pandemic was examined with the Wilcoxon test for non-normally distributed variables.

The sample size was calculated using GPower 3.1 program based on the physical activity as the primary outcome measure. Based on similar studies[5,6] the number of participants was determined to be at least 208 with 90% power, 5% type 1 error, and 0.20 effect size.

RESULTS

trength, improving the biomechanics of daily life and sports-specific movements such as walking, running, jumping. If the patient is an athlete, return to sports should be planned after the criterias met.

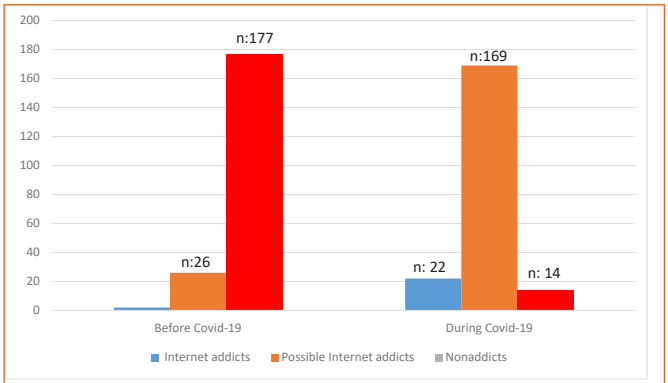
Two hundred five university students with a mean age of 21.7 (SD = 1.7) participated in this study. 66.3% (136) of the participants were female, 33.7% (69) were male, 60% (123) had a garden, etc. while living in a house, 40% (82) lived in an apartment. The remaining demographics are shown in Table 1.

Table 1. Sociodemographic characteristics of the subjects

	Included Subjects (n:205)
Age (years) (X±SD)	21.7±1.7
BMI (kg/m^2) (X±SD)	22.2±3.5
Gender n (%)	
Male	69 (33.7)
Female	136 (66.3)
Year of study n (%)	
First year	31 (15.1)
Second year	38 (18.5)
Third year	78 (38.0)
Fourth year	58 (28.3)
Type of living n (%)	
In a house with a garden or yard	82 (40.0)
In an apartment/a house with no garden or yard	123 (60.0)
Environment n (%)	
Urban	122 (59.5)
Rural	64 (31.2)
Suburban	19 (9.3)

At the first time point, students were in their everyday living and working environments. In contrast, at the second time point, there was a situation where their social and environmental environments were limited due to quarantine and pandemic. Weekly physical activity time as well as weekly sitting time were analyzed and compared at both time points by analyzing the results of the IPAQ questionnaire. Statistics of participants compared to pre-pandemic periods of vigorous (MD: 28.4) and moderate (MD: 47.7) exercise and walking (MD: 325.1) significant decrease was observed. An increase was observed in the daily sitting times (MD: -178.1) (p<0.001) (**Table 2**).

According to the IAS results evaluating internet addiction, it was found that the pandemic statistically significantly increased internet addiction (MD: 31.7) in university students (p<0.001). In addition, it was determined that the number of individuals addicted to the internet increased from 2 to 22, the number of possible addicts increased from 26 to 169. In contrast, the number of non-addicted individuals decreased from 177 to 14 (p<0.05) (**Figure 1**). Finally, the time spent on the internet during the day (MD: 1.46) was also found to increase significantly with the pandemic (p<0.001) (**Table 3**).



* Ki-Square

Figure 1: Change of internet addiction status over time

When HLBS sub-parameters were compared before and during COVID-19, a positive change was observed in health responsibility (MD: 1.88; p<0.001). There was an adverse change in physical activity (MD: -4.9; p<0.001), nutrition (MD: -3.26; p<0.001), spiratual development (MD: -0.96; p: 0.004) and total score (MD: -6.82; p<0.001) and this change was statistically significant (p<0.05). There was a positive change in interpersonal communication (MD: 0.09; p:0.915) and stress management (MD: 0.61; p:0.060), but this did not result in a statistically significant difference (p>0.05) (**Table 4**).

DISCUSSION

The aim of this study was to compare physical activity, internet addiction and healthy life behaviors in university students before and during the pandemic. In general, it was determined that the physical activity time of the students decreased, the time spent sitting increased, they spent more time on the internet, and their healthy life behaviors decreased during the pandemic period compared to the everyday life period.

The findings of this study revealed that vigorous and moderate exercise and walking time decreased and sitting time increased with the pandemic in all participants. Ammar et al.[17] reported that, in general, people spent more time at home during the COVID-19 quarantine, leading to an increase in sitting time, a change in lifestyle and a decrease in time spent on physical activity. Conversely, studies show that more time is spent on physical activity.6 This difference in the studies may be due to various factors such as the social environment of the individual, whether the environment in which the individual lives is suitable for exercise (house with a garden, complex with a gym, etc.) and the culture of exercise.[3-18]

In fact, staying at home for long periods of time can lead to sedentary behaviors by increasing sitting and screen time (video games, TV viewing, mobile device use).[7] The negative consequences of the reduction in physical activity observed during the COVID-19 pandemic affect both physical, mental and social health. In addition, low levels of exercise reduce immune competence and regulation, increasing the risk of developing systemic inflammation.[19] Thus, it is inevitable that the risk of chronic diseases will increase, and the individual will become vulnerable to COVID-19. For this reason, it is recommended to maintain a healthy physical activity level during and after the pandemic with simple and easily

Table 2. International Physical Activity Questionnaire – Short Form (IPAQ-SF) scores before and during pandemic.

	Before COVID-19		During COVID-19				
	Mean	SD	Mean	SD	MD	Z	p*
Minutes of vigorous PA	33.9	90.8	5.6	21.5	28.4	-5.584	<0.001
Minutes of moderate PA	50.8	112.1	3.15	12.2	47.7	-7.123	<0.001
Minutes of walking PA	352.8	297.0	27.7	30.4	325.1	-12.359	<0.001
Minutes of daily sitting	478.9	201.7	656.9	195.6	-178.1	-12.365	<0.001

PA: physical activity; MD: Mean Difference; SD: Standard Deviation

Table 3. Internet Addiction Scale (IAS) and daily internet usage time before and during pandemic.

	Before COVID-19		During COVID-19				
	Mean	SD	Mean	SD	MD	Z	p*
Internet Addiction Scale	26.10	13.68	57.81	12.38	31.7	-12.417	<0.001
Daily internet usage time (hour)	3.12	1.65	4.58	1.75	1.46	-11.435	<0.001

MD: Mean Difference; SD: Standard Deviation

Table 4. Scores for the Subscales of Healthy Lifestyle Behavior Scale before and during pandemic.

	Before COVID-19	During COVID-19					
	Mean	SD	Mean	SD	MD	Z	p*
Health responsibility	19.72	3.97	21.60	3.73	1.88	-5.057	<0.001
Physical activity	17.83	4.05	12.93	2.89	-4.9	-12.382	<0.001
Nutrition	19.94	3.44	16.68	3.31	-3.26	-12.483	<0.001
Spiritual development	23.51	3.86	22.54	3.78	-0.96	-2.901	0.004
Interpersonal relationships	24.85	3.58	24.94	3.83	0.09	-0.107	0.915
Stress management	19.20	3.17	19.81	3.53	0.61	-1.878	0.060
Total score	125.38	15.54	118.56	10.34	-6.82	-6.409	<0.001

MD: Mean Difference; SD: Standard Deviation

applicable exercises such as walking, lifting and carrying objects, climbing stairs, standing, etc. that can be done at home. In addition, with the recently developing technology, many e-Health and exercise applications can be used to encourage physical activity through the internet, mobile technologies and television.[20]

Our study determined that the level of internet addiction and the daily time spent on the internet increased with the pandemic. It was also observed that most participants were not addicted to the internet before but developed addiction during COVID-19. Many studies in the literature support our study and show that internet addiction and usage time increase in adolescents and university students during the pandemic and especially during the quarantine period.[18-21] COVID-19 has drastically disrupted the daily lives of people worldwide, while increasing the length of stay at home and the use of digital entertainment during lockdown. Internet addiction became an issue during the lockdown period, becoming a significant problem that could emerge post-pandemic, especially among university students.[22] Although the pandemic is over, the effects of the pandemic on internet addiction should be further studied, and social measures should be taken, as the impact of the pandemic on internet addiction will negatively affect the development of young people.

In our study, we observed a positive increase in health responsibility awareness and a negative decrease in physical activity, nutrition, spiratual development and total score with the pandemic. Improving health depends on a positive change in healthy lifestyle behaviors such as health responsibility, regular and adequate physical activity, good nutrition, self-actualization, interpersonal support and stress management.[23] Studies in the literature reveal that the pandemic has negative effects on healthy living behaviors in general, except for some sub-parameters.[24,25] In Ke et al.[24] no change was observed in health responsibility, nutrition and personal support sub-parameters, while other sub-parameters and total scores decreased with the pandemic. In the study of Ashgar et al.[25] a negative change was observed in all sub-parameters, including the total score. This difference between the studies is thought to be due to various factors such as the age of the participants, the environment they live in, the family's average income, the parents' educational level and cultural differences.[6]

Several limitations of our study should be considered. First, the fact that it was an observational study and all subjects volunteered to participate in the survey may cause bias in participant selection. Secondly, the evaluation of physical activity with a questionnaire, not with objective tests. Finally, the inclusion of individuals who have unknowingly acquired Covid may be a limitation of this study. Performing a real physical activity assessment using an accelerometer would have made the work-out more powerful. This may be useful to provide insight for future research. In addition, as far as we know, the strength of this study was that it was the first study to compare physical activity and internet habit behaviors of university students before and during the pandemic.

CONCLUSION

In this study, it was observed that physical activity, internet usage habits and healthy lifestyle behaviors changed while university students were deprived of their social and social environment due to the physical restrictions applied during the ordinary pandemic period. It was observed that the pandemic caused a decrease in the participants' physical activity level and an increase in the duration of daily sitting and internet use. As a result, more efforts should be made to create strategies that will motivate students to maintain a healthy lifestyle in all aspects (exercise, physical and mental health, etc.) during the pandemic and/or in a similar situation. Particular attention should be paid to participating in physical activity and reducing the duration of sitting and internet use, and social measures should be taken against the risk of this situation occurring after the pandemic.

ETHICAL DECLARATIONS

Referee Evaluation Process: The study was carried out with the permission of the Gazi University Clinical Researches Ethics Committee (Date: 10.11.2020 Decision No: 129778) and (E.129778) and the Ministry of Health of the Republic of Turkey (2021-06-10T23-03-50).

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Original Article

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The correlation between functional movement screen and core stabilization and y balance test in handball players

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ABSTRACT

Aims: The main aim of the study is to put forward correlation between functional movement screen, core endurance and Y balance test assessments in handball players.

Methods: In our study 30 licensed handball player and 30 sedentary young individuals between 18-22 years old took place. Kasari Physical Activity Index was used containing frequency, intensity, time information in order to determine physical activity level of the sedentary group. In all participants, the Illinois Agility Test was used for agility evaluation and the Vertical Jump Test was used for jumping force measurement and flexor endurance, extensor endurance and lateral bridge tests were used for core stabilization evaluation. Dynamic balance was evaluated via Y balance test. Functional movement patterns were evaluated by functional movement screen consisting of 7 subcomponents.

Results: As a result of the evaluations, In the individuals of athletic group, there is identified positive directional correlation between Functional Movement Screen composite score and flexor stability results ($r=0.653$ $p<0.001$), between, Functional Movement Screen composite score and Lateral bridge dominant side scores ($r=0.542$ $p<0.01$), between, FMS composite score and lateral bridge non-dominant side scores ($r=0.374$ $p<0.05$), between, Functional Movement Screen composite score and Extensor endurance scores but when the relationship between Y balance test and Functional Movement Screen was analyzed; no statistically significant relationship was found ($p>0.05$). There was a difference between the results of the Illinois and Vertical Jump Test in the athletic and sedentary groups ($p<0.001$).

Conclusion: While functional movement screen assessments and core stabilization are closely related to each other, these assessments were not found to be associated with Y balance test. Functional movement screen reflects core stabilization but fails to assess dynamic balance.

Keywords: Functional movement, core stability, dynamic balance, handball

INTRODUCTION

Musculoskeletal system injuries are the natural risks of sports. Non-contact injuries account for 20 per cent of sporting injuries that's why, researchers have shown that risk factors of injuries can be determined by identifying abnormal movement patterns, posture asymmetries and balance abnormalities.[1] In the last two decades, sport rehabilitation has shifted from traditional isolated assessment and strengthening to a functional approach that incorporates proprioceptive neuromuscular principles.[2]

Handball is a difficult sport with a high incidence of injury because of fast running, sudden change of direction and throwing movements. Due to the challenging nature of the game handball players experience significant neuromuscular fatigue that may lead to reduced neuromuscular explosive-based performances. Inflammatory responses of the muscle increase with contact in the game and muscle damage is also observed.[3,4] When the incidence of injuries in handball was investigated, it was reported as 0.6 to 4.6 injuries/1000 hours during training and 10.8-73.6 injuries/1000 hours during competitions.[5]

Functional movement is described as movements which that involve many joints and occur in multiple planes.[6] Functional movement components have been defined as flexibility, strength, endurance, proprioception, range of motion and core stability.[7] Functional assessment is used so as to determine the deficiencies in the basic movement models necessary for the realization of sport-specific skills and especially, to identify potential risks of the injuries of

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musculoskeletal system8. Functional movement assessments should be evaluated with holistic assessment methods that evaluate every plan of the emerging movement, taking into account all parameters affecting the quality of the movement.

One of the tests used for functional assessment is functional movement screen. FMS tests are constructed based on basic proprioceptive and kinesthetic awareness principles. Each test is a specific movement that requires the appropriate function of the body's kinetic linkage system.[2] Functional movement screen is a battery of seven movement task tests assessed by visual observation using standardized criteria.[9]

Balance is a result of somatosensory, visual, vestibular, musculoskeletal and central nervous system activation working together10,11. Although balance is thought as a static process, it is a set of dynamic process including many neurological pathways.[10] Y balance test (YBT), which is prepared by modifying the star balance test, is described as a way which is pratic and easy in the name of the assessment of dynamic capacity in order to protect balance. For this reason, this test has found wide application in sports rehabilitation.[12]

The "core", also called the lumbopelvic-hip complex, is a 3-dimensional space with muscular boundaries. These boundaries are: the diaphragm (upper), the abdominal and oblique muscles (front-side), the paraspinal and gluteal muscles (back) and the pelvic, floor and hip girdle (lower). The natural structure of these muscular boundaries creates a corset-like stabilizing effect on the trunk and spine.[13] A weak core region brings about changes in energy transfer, and this also causes the falling of sport performance and risk of injury of weak or underdeveloped muscle group14. Core stabilization tests is used so as to put forward relationship between core stabilization and performance. It is described 35 different tests about core stabilization and is categorized in five different group. These groups are generally, expressed as strength, endurance, flexibility, motor control and function.[15] The basic stability tests commonly used by clinicians are right and left lateral bridge and flexor endurance test16.

Recent studies have focused on assessing functional movement patterns in athletes rather than isolated assessments. Handball also involves many functional movement patterns. The aim of this study was to determine the relationship between functional movement screen and core endurance and Y balance test evaluations in young handball players with objective data.

METHODS

In our study 30 licensed handball player and 30 sedentary young individuals between 18-22 years old took place. Inclusion criteria were being licensed handball player or sedentary volunteer and not having been undergone a surgical operation involving the musculoskeletal system in the last six months. Demographics such as occupation, age, gender, dominant hand, height, body weight, body mass index were obtained in the participant evaluation form.

The ethics committee approval of our study was obtained with the decision of Süleyman Demirel University Faculty of Medicine Clinical Researches Ethics Committee dated 21.12.2020 and numbered 399. Participants were included in the study after consent forms were obtained. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Participants are evaluated with Kasari Physical Activity Index. According to the Kasari score, physical activity level is commented as sedentary between 0-20, poor between 21-40, normal between 41-60, good between 61-80 and perfect between 81-10017,18.

Illinois agility test is used for agility assessment in which the athletic's agility abilities are measured in the region which possesses a size of 10×5 m. The completion time of the prepared track was recorded with a stopwatch. In our study, this distance was set as 10 m. The test area was marked with four centre cones spaced 3.3 m apart and four corner cones placed 2.5 m away from the centre cones. The individual started the test lying prone on the ground behind the starting line with arms at the side and head in front. The individual was asked to run as fast as possible and to change direction quickly.[19]

Vertical jump test is used for jumping force measurement, and firstly for this test, the height at which the person turned sideways to the wall and extended his/her arm was marked. Secondly, he/she was asked to jump as high as possible and the height at which he or she jumped was read again on the tape measure. The difference between the first point and the last point was recorded as the jump height. Three trials were performed and the highest value was taken into account.[20]

Core Stabilization Tests: The flexor muscle endurance test is initiated with the subject in a sitting position, with the back leaning against an apparatus angled 60 degrees from the floor. Both knees and hips are flexed to 90 degrees and the support apparatus is withdrawn and the time the person maintains the position is recorded.[21] The extensor muscle endurance test is performed with the upper trunk extended towards the end of the bed on which the test is performed and the pelvis, knees and hips fixed. The time the upper trunk maintains its level is recorded.[21] The lateral bridge test was performed with the individual lying in the full side bridge position (left and right side separately). Individuals supported themselves on one elbow and their feet while lifting their hips off the floor to form a straight line from head to toe. The test was terminated when the individual lost the straight back posture and/or their hips touched the floor.[21]

YBT, which is performed in the standing position on one leg, is a dynamic a test. Participants stood on the footplate in the centre of the Y Balance Test area and then, it was given instruction them that they should maintain a single leg stance while reaching as far as possible with the opposite leg and return to the starting position on the center platform without losing balance. In the test, individuals were asked to reach the maximum distance in 3 directions (anterior, posteromedial and posterolateral), allowing 3 trials for each leg. The maximum reach distance was recorded for each consecutive trial.[22]

FMS consists of seven test component which are used to evaluate various main movement models. Individuals completed one by one deep squat, high stepping, single line lunge, shoulder mobility, straight leg raises, trunk stability push-ups, rotation stability which are the components of the tests battery. Subcomponent tests assess asymmetry by measuring the individual bilaterally. Each component test was scored on an ordinal scale (0 to 3 points), with a maximum score of 3, based on the quality of the movement. Less than 3 points indicated that the individual performed some form of compensation or was unable to complete the entire movement. While individuals were doing these tests,

they were recorded in the video, the final scoring was done by evaluating the images. The scores of the component tests were summed, resulting in a composite score between 0 and 21 points, with a maximum score of.[21-23]

Mean Standard Deviation and Median values were given in descriptive statistics for continuous data, and number and percentage values were given in discrete data. Shapiro-Wilk test was used to examine the conformity of continuous data to normal distribution. In the comparisons of continuous variables between athletic and sedentary groups, the independent samples t test was used for the data fitting the normal distribution and Mann Whitney U test was used for the data not fitting the normal distribution. The relationships between the scales were analyzed with Spearman's correlation coefficient. IBM SPSS Statistics 20.0 program was used in the evaluations and p<0.05 was accepted as the statistical significance limit.

RESULTS

In this study, the correlation between FMS and core stabilization and Y balance test was revealed. The mean age of the athletics participating in the study was 22.06±1.48 years, mean height 182.33±5.89 cm, mean weight 77.23±8.33 kilograms, and mean body mass index 23.21±1.52 kg/m2. The physical characteristics of the athletic and sedentary groups are shown in Table 1.

Table 1. Comparison of physical characteristics of individuals in athlete and sedentary groups

	TOTAL	ATHLETE	SEDENTARY
	$\bar{x}$±SS Median (Min-Max)	$\bar{x}$±SS Median (Min-Max)	$\bar{x}$±SS Median (Min-Max)
AGE	21 (19-25)	21 (21-25)	20 (19-21)
HEIGHT	181.60±6.28	182.33±5.89	180.86±6.66
WEIGHT	79.5 (53-93)	78 (53-93)	80.5 (64-90)
Body-Mass-Index	23.95(18.13-27.02)	23.44(18.13-25.49)	24.43(22.45-27.02)

There was a statistically significant difference between the results of the Illinois and Vertical Jump Test in the athletic and sedentary groups (p<0.001). There was no difference between the results of the Y right and left anterior balance test of the individuals in the athletic and sedentary groups (p>0.05). There was a statistically significant difference between the Y right-posteriolateral and Y right-posteromedial reaching distances of the individuals in the athletic and sedentary groups (p<0.001). A statistically significant difference was found between the Y left-posteriolateral and Y left-posteromedial reach distances of the athlete and sedentary groups (p<0.001) (Table 2).

There was a difference between the results of flexor muscle endurance test, lateral bridge tests, extensor muscle endurance test of the individuals in the athletic and sedentary groups (Table 2).

When the total score and subcomponents of functional movement screen in athletic and sedentary groups were analyzed, a significant difference was found in all subcomponents except deep squat and stability push-up (p<0.001) (Table 3).

In individuals of athletic group, it was not found correlation between FMS points and Y balance test. (p>0.05) (Table 4). In individuals of athletic group, a positive correlation between FMS scores and flexor endurance results (r=0.653 p<0.001), FMS scores and Lateral bridge dominant side scores (r=0.542 p<0.01), FMS scores and lateral bridge nondominant side scores (r=0.374 p<0.05), FMS scores and extensor endurance scores (r=0.511 p<0.01) was found. (Table 4).

DISCUSSION

IIn our study, while there is found significant correlation between FMS and core stabilization, no relationship is found between FMS and YBT. Though functional movement screen is a test battery that evaluates many parameters, it is considered to be insufficient in the overall assessment of athletic performance.

Athletics have different requirements in each age group. The maturation and growth process basically brings anthropometric and then psychological changes. Sportive assessment and programs should be made according to age groups by taking these changes into consideration. Exercise programs, which are applied without paying attention the difference of age group, decrease effectiveness. This condition is more common in amateur and regional teams24. When elite and amateur level handball players are compared, it is revealed that elite level players have better agility, aerobic capacity and lower limb muscle strength20. This suggests that

Table 2. Comparison of Illinois, Vertical Jump, Y Balance Test results of athletes and sedentary groups

	TOTAL	ATHLETE	SEDENTARY		
	$\bar{x}$±SS Median (Min-Max)	$\bar{x}$±SS Median (Min-Max)	$\bar{x}$±SS Median (Min-Max)	Test Statistic	p
İllinois	24.76±6.13	19.26±1.17	30.26±3.54	t=-16.127	<0.001*
Vertical Jump	28.66±6.04	33.67±3.32	23.66±3.37	t=11.576	<0.001*
YBT right-anterior	79.98±11.91	82.39±9.83	77.52±13.42	t=1.586	0.118
YBT right-posteriolateral	95.02±15.84	105.16±10.85	84.88±13.42	t=6.433	<0.001*
YBT right-posterio medial	91.17±15.85	101.96±9.48	80.38±13.44	t=7.182	<0.001*
YBT right-anterior	79.03±11.66	80.57±10.31	77.48±12.85	t=1.026	0.309
YBT left-posteriolateral	90.87±14.25	101.53±10.26	80.22±8.54	t=8.738	<0.001*
Y left-postero medial	88.44±15.33	98.92±10.04	77.96±12.26	t=7.241	<0.001*
Flexor endurance	91.15 (68.7-128)	99.1 (86.3-128.1)	79.5 (68.7-91.5)	U=6.5	<0.001
Lateral bridge Dominant	22.4 (19.5-40.8)	24.5 (20.2-40.8)	22 (19.5-28.3)	U=216.0	<0.001
Lateral bridge nondominant	21.2 (17.3-37.4)	22.3 (18.2-37.4)	20.9 (17.3-26.2)	U=287.5	0.016
Extensor endurance	94.28±31.36	124.17±10.18	64.39±7.06	t=26.428	<0.001

U: Mann Whitney U test t: Student t test (Independent samples t test)
*: The p value is less than 0.05 in the Independent-sample t Test and Mann Whitney U Test
Abbreviations: YBT, Y balance test

Table 3. Comparison of FMS scores of individuals in athlete and sedentary groups

	TOTAL	ATHLETE	SEDENTARY		
	$\bar{x}$±SS Median (Min-Max)	$\bar{x}$±SS Median (Min-Max)	$\bar{x}$±SS Median (Min-Max)	Test Statistic	p
Deep Squat	2 (1-3)	2 (1-3)	2 (2-3)	U=400.5	0.387
Right High step	3 (1-3)	3 (2-3)	2 (1-3)	U=295.0	0.009*
Left High step	2 (1-3)	3 (2-3)	2 (1-3)	U=287.5	0.007*
Right Single line lunge	2 (1-3)	2 (1-3)	2 (1-3)	U=258.5	0.001*
Left Single line lunge	2 (1-3)	2 (1-3)	2 (1-2)	U=302.0	0.009*
Right shoulder mobility	3 (2-3)	3 (2-3)	2.5 (2-3)	U=270.0	0.001*
Left shoulder mobility	3 (2-3)	3 (2-3)	2 (2-3)	U=240.0	<0.001*
Right straight leg raise	3 (2-3)	3 (2-3)	2 (2-3)	U=135.0	<0.001*
Left straight leg raise	3 (1-3)	3 (2-3)	2 (1-3)	U=103.5	<0.001*
Stability push-ups	3 (2-3)	3 (2-3)	2.5 (2-3)	U=345.0	0.065
Right rotation stabilization	2 (1-3)	2 (1-3)	2 (1-2)	U=292.0	0.003*
Left rotation stabilization	2 (1-3)	2 (1-3)	1.5 (1-2)	U=315.0	0.020
FMS Compozit Score	16 (12-19)	18 (15-19)	15 (12-17)	U=47.5	<0.001*

U: Mann Whitney U test t: Student t test (Independent samples t test)
*: The p value is less than 0.05 in the Independent-sample t Test and Mann Whitney U Test
Abbreviations: FMS, functional movement screen

Table 4. Relationships between FMS scores and Y balance test and Core stabilization scores in the athlete group

	FMS Composit	
	r*	p
YBT right-anterior	0.211	0.264
YBT right-posteriolateral	0.119	0.531
YBT right-posteriomedial	0.132	0.487
YBT left-anterior	0.198	0.295
YBT left-posteriolateral	0.009	0.963
YBT left-posteriomedial	0.020	0.916
Flexor endurance	0.653	<0.001*
Lateral bridge Dominant	0.542	0.002*
Lateral bridge nondominant	0.374	0.044
Extansor endurance	0.511	0.004*

* Spearman's Correlation Coefficient
*: The p value is less than 0.05 in the Spearman's Correlation
Abbreviations: FMS, functional movement screen; YBT, Y balance test

biomechanical assessment is more essential in young amateur players.

Usual typical procedures are inadequate in order to evaluate the physical requirements of young persons objectively. The tests, which include core stability and functionality in addition, are more successful. Compensatory movements in the basic movement patterns have been identified as an important risk factor of injury in athletics. FMS is an effective test battery that reveals the weakness of movement patterns.[25] In a meta-analysis examining injury mechanisms with FMS, a composite score of less than 14 points and the presence of asymmetry were found to be an injury risk. Its sensitivity was found to be high in predicting non-traumatic (non-contact) injuries in athletics.[26] The injury evaluation of team sports and precaution programs should be dynamic a process in other words the process should consist of continuous re-evaluation.[22] Identifying the deficiencies and asymmetries in the functional movement patterns of young athletics before entering professional life can enable the athletic to reach functional competence by selecting the appropriate rehabilitation program.

In the beginning of the season, young handball players, who are evaluated with FMS, do not experience injury during the season after locomotor exercises for the determined body asymmetries.[22] Regular FMS assessment in training programs will have an important place in injury prevention by revealing risk factors.

The demographic qualities of athletics and sedentary groups, who participated in the study, show similarity. The athletic group indicated better performance than the sedentary group in both vertical jump distance and agility test times. The fact that the athletic group had a training period of at least 4 days per week can be considered as the main reason for this difference. When the reaching distances of athletic university students and sedentary university students in the Y balance test were compared, athletic students showed better performance in all directions.[27] The athletics in our study demonstrated better performance in posteromedial and posterolateral directions compared to sedentary individuals, while no significant difference was found in the anterior direction. The Y balance test requires good knee stabilization and quadriceps muscle strength during anterior reaching.[28] We think that our young athletics are open to improvement in terms of structures that provide knee stabilization.

There was founded different average datas in the studies which are done for functional movement screen. In a study of 209 young individuals who did sports for at least 30 minutes 2 days a week, the mean composite score was calculated as 15.7 points.[29] In a study with healthy adults, 622 individuals participated and the mean composite score was found to be 14.1430. In our study, the mean composite score was calculated as 17.56. Young individuals had higher composite scores than adult ones, age factor and the fact that young people had better biomechanical alignment might be effective in this situation. So as for the use of FMS to become widespread, normative values by age groups should be clearer.

Functional movements substantially are used during both daily and sport activity. Core stabilization and dynamic balance are factors, which determine the quality of functional movements. Postural stability is an essential a component of functional movement. Lumbar stability is closely related to performance in overhead shooting athletics. Proximal stabilization through the abdominal fascial system has a direct effect on upper limb stability31. Handball players with higher core power and endurance, they have better shooting performance and are less likely to suffer upper limb injuries.[30]

FMS all alone may be insufficient to predict the performance therefore it is recommended to be used in combination with other tests. Core stability plays an essential a role in the elicitation of functional movement.[33] Many studies in the literature have supported our findings by showing that core stabilization and functional movement screen results are related. Even if players have good coordination, reduced core stabilization ability will affect their functional movement patterns. Core stabilization plays an important role in the transfer of force to the terminal segments in both basic and functional movement.

Since handball is defined as a sport, which requires so much effort, it increases the risks and it becomes clear that the assessment should be made with a holistic approach. In handball, the finding of asymmetry between the extremities as a result of the y balance test negatively affects the vertical jump strength of the athletes.[34] Y balance test performance is directly affected by trunk and lower extremity kinematics. Dynamic postural control depends on trunk and limb alignment.[35] No strength correlations were discovered when relations between Y balance test and FMS were examined. Reach distances in the Y balance test and FMS composite scores were analyzed in a study of 78 individuals and no significant relationship was found. FMS is often used to identify weaknesses, asymmetries and compensatory movement patterns that can be corrected through exercise training. It is difficult to capture all aspects of dynamic postural control with one component of the FMS.[36] In our study, no significant correlation was found between Y balance test and FMS composite score. Functional movement screen is insufficient in the assessment of dynamic balance. Because ıt belongs to a evaluation scale on protecting the biomechanical movements performed in the subcomponents of FMS, it better reflects static balance.

In a study evaluating the relationship between the Y balance test and the subcomponents of the FMS test battery, no significant relationship was found between the Y balance test and the subcomponents of the FMS test battery.[37] FMS is insufficient to assess dynamic balance. In the evaluation of functional movement patterns, dynamic balance tests should be included in addition to FMS.

The fact that our study is the first application of FMS in amateur handball players in the 18-25 age group stands out as the strength of our study. The limitations of our study are that only male athletes were included, and a power analysis to determine the sample size could not be performed because a similar study had not been published before.

CONCLUSION

When the relationship between FMS and Y balance test was analyzed; no relationship was found. When the relationship between FMS and core stabilization was examined; a significant relationship was found between the FMS composite score and the endurance tests used for core stabilization. Positive correlation was found between FMS scores and flexor stability, lateral bridge dominant, lateral bridge non-dominate, extensor endurance test results in the athletic group.

Since handball consists of too much functional pattern, evaluation should make by taking this into account. During the assessment, risk factors and biomechanical mechanisms that may pose a risk should be identified. In addition to the classical injury risks described in the literature, individual functional risk factors should also be described. Neurodynamic and biomechanical malalignment of the trunk and lower limbs can lead to pathologies that may prevent functional movement. Reduced postural control will make it difficult to maintain the centre of gravity within the surface of the support under dynamic and static conditions and increase the risk of injury. The application of functional movement assessment with core stabilization and balance assessments will reveal biomechanical or neuromuscular pathologies.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Süleyman Demirel University Faculty of Medicine Clinical Researches Ethics Committee (Date: 21.12.2020, Decision No: 399).

Informed Consent: All patients signed and free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Investigation of the instant effect of Kinesio Taping on the rectus femoris muscle on pain and functional disability in knee osteoarthritis patients

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ABSTRACT

Aims: The aim of this study is to determine the instant effect of kinesio taping applied to the rectus femoris muscle on pain and functional disability in patients with knee osteoarthritis

Methods: Forty individuals diagnosed with osteoarthritis were included in the study and were divided into two groups as Kinesio tape (KT) and placebo groups. Kinesio taping was applied to both rectus femoris of the participants for 30 minutes with the facilitation technique in the intervention group and without tension in the placebo group. We assessed participants for pain and functional disability Western Ontario and McMaster Osteoarthritis Index (WOMAC).

Results: Demographic and clinical characteristics of the groups before these interventions were similar ($p > 0.05$). WOMAC pain, WOMAC function and WOMAC total score improved significantly for the KT group between pre-post taping results ($p<0,05$). There was no significant difference between the pre-post taping in WOMAC stiffness section ($p>0,05$).

Conclusion: It was concluded that KT applied bilaterally to the rectus femoris did not affect stiffness in patients with knee OA, but instantly improved pain and functional disability.

Keywords: Kinesio tape, knee osteoarthritis, pain; functional disability

INTRODUCTION

Osteoarthritis (OA) is a chronic, multifactorial and degenerative disease that occurs mainly in cartilage, subchondral bone, synovium and muscles. It is characterized by joint space narrowing, articular cartilage defect, subchondral bone destruction, and synovial membrane thickening.[1] The joint is the most affected part of the body in knee OA, and the number of patients with knee OA has increased in parallel with the aging of the population and remains a major health challenge.[2]

Knee OA patients experience inflammation, pain, stiffness, muscle atrophy and functional disability, and these findings lead to a decrease in quality of life.[3] The aim of conservative treatment in knee osteoarthritis is to minimize pain, limit functional disorders and improve physical function in patients. Current knee OA treatments aim to alleviate these symptoms through a variety of methods, including pharmacological, non-pharmacological, surgical and non-surgical interventions.[4] Among non-pharmacological modalities, kinesio taping has gained popularity in recent years. Cost-effective interventions with minimal side effects are therefore encouraged, previous studies recommending the use of therapeutic taping techniques/interventions as a practical solution in knee OA.[5]

Kinesio taping has been proven to be a short-term intervention for knee pain in cases of knee OA by correcting the misaligned knee joint and reducing the load on the inflamed soft tissue. It causes quadriceps muscle weakness, stiffness in the knee joint, decreased ROM in the joint, pain and functional disability in knee OA patients. Often, the pain and physical impairments/injuries associated with knee OA are caused by quadriceps weakness, benefiting from taping.[6]

Kinesio taping is a method that is frequently applied to affect different physical problems. It has been reported that kinesiology taping application provides improvement in pain, limitation of joint movement, muscle strength activation and proprioceptive changes.[7] Facilitation taping, which is one of the kinesiological taping techniques, is a technique that affects the golgi tendon organ, stimulates the muscle to which it is applied and contributes to the function of the muscle.[8]

It has been reported that kinesiology taping has significant effects on pain, physical performance, muscle strength and range of motion in knee OA patients 6. In another study in

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which kinesiology taping was applied, better proprioceptive sensitivity was found, as well as improvements in pain and joint range of motion in knee OA patients.[9] There are studies in the literature examining the long or short-term effects of kinesiology taping on pain, physical performance, and active range of motion in knee OA patients. Significant improvements were noted in some of them compared to the placebo group.[10-12] while in some, no significant difference was found.[13]

Although previous studies have shown that Kinesio Taping is effective in knee disease, there is still no reliable evidence and the effect of Kinesio Taping on knee OA is still controversial. Studies examining the immediate effect of kinesiology taping in knee OA, which are less emphasized than the long or short-term effects, have examined the effects on pain, function, range of motion, balance, proprioception, but the studies are insufficient and the evidence for the method to be applied and the duration of KT application is insufficient. Therefore, the aim of our study is to determine the immediate effect of kinesiology taping on the rectus femoris muscle on pain, stiffness, and functional disability in patients with knee osteoarthritis.

METHODS

This study was carried out in the Physical Therapy and Rehabilitation Unit of Kırıkkale University Faculty of Medicine between October 2021 and February 2022. Our study was approved by Kırıkkale University Non-invasive Researches Ethics Committee with the decision number 2021.09.12 on 16.09.2021. An informed consent form was signed by all patients participating in the study. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Forty individuals diagnosed with stage 2 or 3 bilateral knee OA, according to Kellgren-Lawrence grading who applied to Kırıkkale University Faculty of Medicine Physical Therapy Outpatient Clinic, were included in the study. Individuals aged 45-65 years, with independent ambulation, grade 2 or 3 bilateral knee osteoarthritis according to the Kellgren and Lawrence Classification, and who did not use nonsteroidal anti-inflammatory drugs in the last 5 days were included in the study.[14-15] Patients with a history of surgery in the lower extremities, neuromuscular disease, vestibular pathology, congenital problems that may affect independent walking in the lower extremity, difficulties in communication and cooperation, who received physiotherapy or injection into the joint in the last 6 months, or who regularly exercise were excluded from the study.[14-16] All individuals were evaluated before taping and 30 minutes after taping. Age, height, weight, body mass index (BMI) of the individuals participating in the study were questioned and recorded. While facilitation taping was applied to the Rectus femoris muscle of the individuals in the intervention group for 30 minutes, placebo taping was applied to the Rectus Femoris muscle of the individuals in the placebo group for 30 minutes.

Pain and functional disability were evaluated with the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) before and immediately after kinesio taping or placebo taping was applied to individuals included in both groups. Kinesio and placebo taping was performed by a certified physiotherapist trained in this field. The same physiotherapist performed all the measurements, so that there was no difference between the measurements.

Taping Application

Tape (Kinesio Tex Tape) 5 cm wide and 0.5 mm thick was used in both groups. Facilitation taping technique was applied according to the Kenzo Kase application in the KT group, and sham tape was applied in the placebo group. The rectus femoris muscle was taped according to the "kinesiology taping guide" book published by Kenzo Kase .[17]

Before taping, individuals were seated and rested for 10 minutes. If all individuals had hair in the area to be taped, this area was freed from hair. Then this area was cleaned with alcohol and the taping was started. Superior Y technique was applied to all individuals. The tape, which was cut by measuring the patient's length, was divided into two at one end and given a 'Y' shape. Kinesio and placebo taping were applied to both rectus femoris muscles in all patients. The tape remained for 30 minutes in all individuals .[18] Individuals waited in sitting position until the second evaluation after taping. Facilitation taping was applied to the Rectus Femoris muscle of the patients included in the KT group. For facilitation taping, individuals were positioned in the supine position with their legs hanging from the bed from their knees. The kinesiology tape was fixed 10 cm below the origin of the rectus femoris without any tension. Then, 35-50% tension was given to the band, and it was descended to the patella. After this point, the banding was terminated in such a way that the Y-shaped band wraps the patella medially and laterally without any tension .[17]

The individuals included in the placebo group, on the other hand, were placed on the Rectus Femoris muscle without any tension while lying in the supine position.

Outcome Measure

Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC): It is a 24-item scale consisting of three subsections: pain, stiffness, and physical function. It was created to evaluate patients with hip and knee OA. The questions in each section can be given a minimum of 0 and a maximum of 4 points.

The highest score was 20 for the pain subsection, 8 for the stiffness subsection, and 68 for the physical function subsection. Turkish validity and reliability study was conducted by Tüzün et al.[19]

Statistical analysis

Data analysis was performed using SPSS 23.0 (SPSS Inc., Chicago, Illinois, USA). As descriptive statistics, appropriate measures such as frequency and percentage for qualitative variables, mean, standard deviation and median for quantitative variables were given. The Shapiro-Wilk normality test was used to determine whether the distribution of quantitative variables conformed to the normal distribution. In cases where the parametric test assumptions were met, whether there was a difference between the intervention and control groups in terms of the 1st and 2nd measurement values was examined with One-Way Analysis of Variance in Repeated Measurements. The level of significance in the analyzes was taken as 0.05. If the parametric test assumptions were not met, comparisons between independent groups were made with the Mann-Whitney U Test, and comparisons between dependent groups were made with the Wilcoxon Test. The formula $r = Z/\sqrt{n}$ was used for the effect size of the data not normally distributed ($r = 0.10$ small effect, $r = 0.30$ moderate effect, $r = 0.5$ large effect). The formula d= Mean_difference / SD_ difference (Cohen's d was used for the effect size of normally

distributed data (d = 0.2-0.50 small effect, d = 0.50-0.80 moderate effect, d = 0.8 large effect. Post-hoc power analysis was performed to determine the strength of the present study. For post-hoc power analysis, G Power program (version 3.0.10 Universit€at Dusseldorf, D € usseldorf, € Germany) was used. In post-hoc power analysis, the alpha statistical significance was 5% and the confidence interval was 95%, and the power of the study (1-b) was 72%. The primary outcome was the WOMAC total score.

RESULTS

Forty individuals with a mean age of 55.93±5.44 years and diagnosed with stage 2 or 3 bilateral knee OA according to Kellgren-Lawrence grading were included in this study. The mean age of the intervention group was 55.65±4.44 years, and the mean age of the placebo group was 56.20±6.40 years. No statistically significant difference was observed between the two groups in terms of age, height, weight and BMI (p>0.05) (Table 1).

Table 1. Comparison of demographic features of the groups

Variables	KT Group Mean±SD	Placebo Group Mean±SD	p value
Age (year)	55.65±4.44	56.20±6.40	0.754
Height (cm)	155.93±36.96	154.68±36.72	0.512
Body Weight (kg)	86.18±14.87	83.45±10.54	0.738
Body mass indeks (kg/m^2)	31.98±6.04	31.57±4.14	0.583

SD: Standard Deviation;,KT: Kinesio tape; cm: centimeter, kg: kilogram, %: percentage n: participants BMI: Body Mass Index, *p<0.05

WOMAC results measured before taping were found to be statistically similar (p>0.05). When the WOMAC results of the patients before and after taping was compared, there was a significant decrease in the WOMAC pain (p=0.001, z=15.221), WOMAC function (p=0.012, z=7.036), WOMAC total score (p=0.003, z=-2.934) after taping in KT group. However, WOMAC stiffness results 30 minutes after taping was not statistically significant in either KT or placebo groups (p>0.05) (Table 2).

Compared with the placebo group, there was no statistically significant difference was found between the changes in the WOMAC pain, WOMAC stiffness, WOMAC function, WOMAC total scores (p>0.05). The mean change in WOMAC pain was -1.37 for the KT group and -0.73 for the placebo group (p =0.157). The median change WOMAC stiffness was 0.00 for the KT group and the placebo group (p =0.547). The mean change WOMAC function was 2.21 for the KT group and -0.99 for the placebo group (p =0.157). The median change in WOMAC total score was -3.65 for the KT group and 0.00 for the placebo group (p =0.056) (Table 3).

DISCUSSION

In our study in which we examined the instantaneous effect of kinesio taping applied to the rectus femoris muscle on rectus pain and functional disability in knee OA patients, an instant decrease was observed in the WOMAC total score in the intervention group compared to the placebo group after a single session of kinesio taping. There was an immediate decrease in WOMAC pain and function scores after taping in both the KT and placebo groups.

Both groups included in our study showed homogeneous distribution in terms of age, BMI, gender distribution,

Table 2. Results of WOMAC in KT and placebo taping groups

Variables	Pre-taping Median (Min-Max) Mean±SD	Post-taping Median (Min-Max) Mean±SD	P[1]	z	
WOMAC pain (score)	KT Group	12.67±4.47	11.30±5.23	0.001*	15.221
	Placebo Group	12.50±3.64	11.77±3.92	0.064	14.567
p[2]	0.369	0.678			
	(z=-0.906)	(z=-0.433)			
WOMAC stiffness (score)	KT Group	3.45 (1.03-13.62)	3.38 (0.06-17.14)	0.823	-0.224
	Placebo Group	3.69 (1.36-42.57)	3.80 (1.05-37.46)	0.794	-0.261
p[2]	0.914	0.240			
	(f=0.012)	(f=1.426)			
WOMAC function (score)	KT Group	42.71±13.44	40.50±15.14	0.012*	7.036
	Plascebo Group	37.55±11.97	36.56±12.23	0.097	6.047
p[2]	0.280	0.318			
	(f=1.202)	(f=1.202)			
WOMAC total (score)	KT Group	64.06 (18.75-87.50)	56.77 (6.66-87.50)	0.003*	-2.934
	Placebo Group	56.25 (16.66-79.16)	53.64 (16.66-79.16)	0.091	-1.690
p[2]	0.231	0.758			
	(z=-1.204)	(z=-0.311)			

[1]compare variables within tests (Pre-versus Post taping).
[2]compare variablesbetween groups (KT group versus Placebo group).
*Statistical significance is set at p<0.05.
z: Wilcoxon signed-rank test
F: One-way analysis of variance test
KT: Kinesio Taping, WOMAC:Western Ontario and McMaster Universities Osteoarthritis Index SD: standart deviation, n: participants, Min:Minimum, Max:maximum

Table 3. Change in WOMAC in KT and placebo taping groups

Variables	KT Group	Placebo Group		
	Median (Min-Max) Mean ±SD	Median (Min-Max) Mean ±SD	p values	Effect size
Change in WOMAC_pain	-1.37± 1.65	-0.73± 1.76	0.157	0.38
Change in WOMAC_stiffness	0.00 (-5.21-0.00)	0.00 (-1.04-0.00)	0.547	0.47
Change in WOMAC _function	-2.21± 4.62	-0.99± 2.78	0.157	0.32
Change in WOMAC_ total score	-3.65 (-60.00-0.00)	0.00 (-13.54-2.09)	0.056	0.60

KT: Kinesio Taping, WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index SD: standart deviation, n: participants, Min:Minimum,Max:maximum
*Statistical significance is set at p<0.05.

and educational status. Muscle activation and the sense of proprioception of the knee joint decrease with age.[20,21] Therefore, it is important to include individuals in the similar age range in the study. High BMI negatively affects muscle activation, physical performance, and proprioception.[22] Therefore, it is important to include individuals with similar BMI in a study on these variables. It is known that women have lower muscle activation, physical performance, and therefore worse proprioception than men.[23] Therefore, it was important that the gender distribution of the individuals in our study was homogeneous between the groups.

Articular cartilage can be damaged by normal wear and abnormal mechanical loading, resulting in abnormal cellular activities in the cartilage and synovium, resulting in stiffness, loss of range of motion. Joint function is an important parameter to evaluate the effectiveness of treatment in knee OA, and WOMAC is one of the most commonly used functional and disability scores [24] For this reason, WOMAC was used to evaluate pain and functional disability in the current study. Kinesio Taping can be an inexpensive and convenient option aimed at reducing symptoms and improving function. Intra-articular aseptic inflammation can be reduced using Kinesio Taping. One meta-analysis noted that Kinesio Taping recorded improvements in WOMAC outcomes over placebo taping. However, in this meta-analysis, the follow-up period of the interventions was stated to be variable between 3 days and 3 months for both the banding and control groups with the WOMAC outcome measures 5

In a review study, it was stated that although KT was effective in the treatment of knee OA in most studies, there were very few studies that did not report its beneficial effect on knee OA 6 For example, the study by Wageck et al.[25] reported that KT had no beneficial effect on any of the outcomes evaluated for people with knee osteoarthritis. This is probably due to the short time (4 days) participants had KT, which may not be long enough to confer any real benefit in knee osteoarthritis. Conversely, trials by Rahlf et al.[15] noted a discrepancy with Wageck's claim that KT had beneficial effects on short-term (three days in a row) pain relief, reducing joint stiffness, and increasing knee function. The reason for this difference; Wageck et al.[13] stated that the follow-up time may be due to the taping technique (administration of placebo of tension-free CT for the control group). In these studies, in addition to the method of measuring pain directly, two questionnaires (Lysholm and WOMAC) containing questions about pain were also used, and the score was analyzed from the WOMAC questionnaire from the pain domain. The study of Koçyiğit et al.[11] reported that there is inconclusive evidence that KT has a beneficial effect over placebo taping in knee osteoarthritis. It has been stated that the reason for this may be that the Lequesne index is not sufficiently sensitive and responsive to document changes in a short time period and there is no untreated control group.

In a study examining the instantaneous effect of kinesio taping applied to knee OA patients on WOMAC results, an instant improvement was obtained in the WOMAC total score in the intervention group compared to the placebo group 26. In our study, we also achieved an immediate positive improvement in the WOMAC total score in the intervention group with kinesio taping compared to the placebo group.

Pinherio et al.[27] concluded that the change in the WOMAC results of a single session of kinesiology taping applied to knee OA patients in the intervention group was not different from the placebo group. We also obtained a similar result for WOMAC pain and function in our study. In the sub-section of detention, no significant improvement was observed in either group. We think that this is due to the short implementation time in our study. Studies examining the immediate effect of KT taping on WOMAC pain and functional disability are limited in the literature, so there is a need for more studies examining both long-term and short-term effects.

There are views that KT increases local blood flow by increasing the interstitial space due to the area-reshaping lifting effect as a result of the folds formed on the skin28. Therefore, some studies have demonstrated that KT application affected lymphatic and blood circulation with its impact on the subcutaneous cavity, decreased pain and inflammation and accelerated healing, and positively affected functional disability.[9-29] However, data on which taping method are more effective is insufficient. For these reasons, in our study, we aimed to investigate the instant effect (30 minutes) of KT on pain and functional disability. As a result of this study, we obtained positive results on pain and functional disability after 30 minutes KT taping.

There are some limitations to this study that should be emphasized. First, all participants were recruited from a single center, which makes it difficult to generalize the results. Secondly, the fact that the tape we applied to the placebo group was the same as the kinesiology tape we applied to the intervention group may have affected the results of the placebo group. The WOMAC questionnaire is a questionnaire that should be administered at least two days apart. In our study, in which we evaluated the instantaneous effect of kinesiology taping, the 30-minute interval between the WOMAC questionnaire applied before and after taping may have affected the results. Third, the long-term effects of our 30-minute KT application were not examined. Long-term effects such as 24 hours, 72 hours and 1 month later could also be examined.

CONCLUSION

In conclusion, positive changes were detected in the WOMAC total score 30 minutes after KT application in patients with knee OA. We think that this result will contribute to the literature lacking information on the immediate effect of kinesiology taping on knee OA patients. In line with these results, we think that kinesiology taping can be used as a complementary treatment to instantly increase the effectiveness of knee OA rehabilitation as an easily applicable method due to its positive effect on functional disability.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Kırıkkale University Non-invasive Researches Ethics Committee (Date: 16.09.2021, Decision No: 2021.09.12).

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Analysis of publications on surgical gloves

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ABSTRACT

Aims: This bibliometric analysis aimed to examine the trends and characteristics of publications related to surgical gloves. The study analyzed articles retrieved from the Elsevier Scopus database, focusing on topics such as the history of glove usage, the importance of sterility, glove punctures, and advancements in glove designs.

Methods: The data in this study were obtained by searching the Elsevier Scopus database. The search was selected from records containing the keywords in the title "surgical gloves" and a single day was chosen for the sake of being unbiased. In this study, only the articles were analyzed and the online library and digital resources of Çanakkale Onsekiz Mart University were used. Scopus' visuals were used for visualization after data analysis.

Results: A total of 568 publications were included in the analysis, consisting of articles, letters, reviews, and other study documents. The majority of articles were written in English, and the top three countries in terms of publication output were the United States, United Kingdom, and Germany. Medical journals accounted for the largest share of publications, followed by nursing journals. Notably, there was a rising trend in the number of studies on glove punctures and advancements in glove designs. Richard F. Edlich from the University of Virginia School of Medicine emerged as the most productive author, and the Association of periOperative Registered Nurses (AORN) Journal was the most prolific journal in this field.

Conclusion: Today, studies on surgical gloves; focuses on latex glove allergy and surgical site infections. These studies: It is important for the prevention of infection during surgery in the future and the prevention of infectious diseases in healthcare workers.

Keywords: Surgical gloves, bibliometric analysis, sterility, glove punctures, latex allergy gloves

INTRODUCTION

Gloves have been utilized in surgical procedures for about 100 years.1 The end of the 1800s saw a widespread adoption of gloves. Gloves were mostly worn during this time to safeguard the surgical crew from infected patients. However, following the 1900s, the focus on the use of sterile gloves and the goal of employing surgical gloves changed from preventing microbiological contamination of the surgical field to protecting the surgical field from contamination.[2,3]

Surgical gloves offer reliable protection as long as they are not punctured. The surgical team runs the danger of contracting infections like hepatitis B and AIDS that are spread percutaneously when gloves are punctured during surgery.1 The requirement to safeguard the surgical team from diseases that can be transmitted through blood and body fluids during surgery has been highlighted by the rising prevalence of diseases including Hepatitis B, Hepatitis C, and HIV/AIDS that can be contracted through blood and bodily fluids.[3,4]

The risk of transmission via glove punctures, which are common during surgery, has been addressed in recent years. Studies have looked into the effects of employing double gloves rather than single gloves on glove puncture, and new glove designs have been created for procedures involving the frequent use of sharp instruments.[3-5] The length of the surgery and the frequency of glove punctures are related, according to some writers, who indicate that longer surgeries result in more punctures.[6,7]

We wanted to look at how all of these developments affected the scientific literature in our study.

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METHODS

Bibliometric data analysis method was used in this study. The data in this study were obtained by a search conducted on the Elsevier Scopus database. The journals indexed in the Elsevier Scopus database were included. The Scopus database covers peer-reviewed journals in different disciplines (health sciences, social sciences, life sciences, physical sciences, etc.).

In this study data was retrieved from the beginning of records until October 19.2021 containing the keywords in the title "surgical gloves" typed into the search box of the basic research. Only articles were analyzed.

The searches were performed on a single day October 19, 2021, to avoid bias since the database is still open and has daily updates. The graphics of the Scopus were used for visualization and also to create graphics Microsoft Office 2010 program was used. The articles were sorted by the countries, authors, journals, affiliations, publication date, and most productive journals on surgical gloves and citation analyses of this journals also analysed. Canakkale On Sekiz March University's online library and digital resources were used to access information.

Ethics Approval

Since this was not human or animal study, approval from the ethical committee was not requested. The study was conducted in accordance with the Declaration of Helsinki revised in the year 2013.

Statistical Analysis

In the study, all the data were given in percentages, numbers, and bar charts.

RESULTS

Five hundred sixty-eight publications met inclusion criteria. 441(75.25%) of them articles, 70(11.94%) of them letters, 31(8.03%) of them reviews and 32 other study documents (27 note, 8 conference paper, 4 short survey, 3 editorial and 2 erratum). Only articles (n=441) were analyzed. The first article was published in the year 1940 The article numbers by years were given in **Figure 1**.

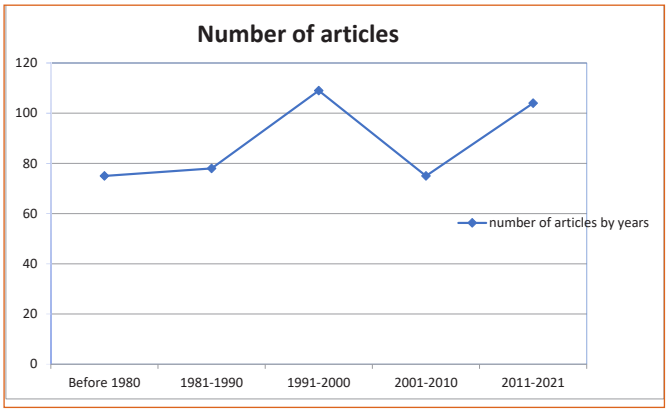

Figure 1. Articles by years.

Most of the articles were written in English (n=369, 83.67%). Also German, French, Japanese, Spanish, Italian, Portuguese, Russian, Dutch and Hungarian were top preferred languages.

The majority of articles (n=108, 24.48%) were produced by authors from institutions based in the United States of America (USA), while United Kingdom and German were among the top three countries. Japan, Austria, France, Italy, Australia, Brazil and Canada were also in the top ten countries. Turkey and India ranked 11th.

58 (13.15%) of the articles were published in open access (AE) (Open Access) journals (23 Gold, 2 Hybrid gold, 24 bronze and 35 green OA journals). The most frequent keywords were 'Gloves, Surgical' (n=314), 'article (n=313), 'surgical glove' (n=303). Most of the articles were in the area of medicine [n=373(84.58%)] and nursing [n =27(6.12%)]. Also 21 in different science areas such as engineering, environmental science and veterinary. 420 (92.23%) of the publications were not funded by any institution.

Top 3 funding sponsors were National Institutes of Health [n =6], The United States Department of Health and Human Services [n =6] and Centers for Disease Control and Prevention (CDC) [n =4].

Most of the publications were from University of Virginia (USA) [n =20], University Medicine Greifswald (Germany) [n=9], Medical University of Vienna (Austria) [n=8] and Medical College of Wisconsin (USA) [n=6]. The publications were from over than 100 affiliations but number of publicaitons were lower than [5].

Richard F. Edlich from University of Virginia School of Medicin (Charlottesville, USA) was the most productive author.

Most productive journals on surgical gloves and citation analyses

The highest number of articles were published in the journals of the Association of periOperative Registered Nurses (AORN) Journal [n =9, 2.04%], Contact Dermatitis [n=8, 1.81%] and Journal of Hospital Infection [n=7, 1.58%].

The citations numbers by years of the most publishing 10 journals on surgical gloves have been rising by years. The citations numbers by years of the most publishing 10 journals on surgical gloves were given in **Figure 2**.

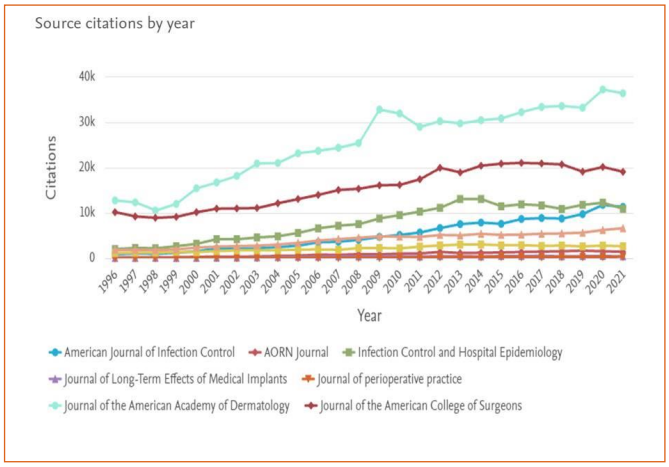

Figure 2. The citations numbers by years of the most publishing 10 journals on surgical gloves.

121 of the articles were not cited yet. Susan M. Tarlo from Toronto Western Hospital University of Toronto (Canada) was the most cited author (**Table 1**).

DISCUSSION

Scopus delivers the broadest coverage of any interdisciplinary abstract and citation database. Covering 240 disciplines, researchers, instructors, librarians and students who rely on Scopus are confident that the odds of missing key publications are greatly reduced. That's why we chose scopus.

Table 1. Citing analysis of the top cited 15 documents.

First Author, Year	Source	Number of citations	Title	Open access
Tarlo et al, 1990	The Journal of Allergy and Clinical Immunology	277	Occupational asthma caused by latex in a surgical glove manufacturing plant	No
Turjanmaa et al,1988	Contact Dermatitis	181	Comparison of diagnostic methods in latex surgical glove contact urticaria	No
Carrillo et al, 1986	Contact Dermatitis	148	Contact urticaria and rhinitis from latex surgical gloves	
Beezhold&Beck, 1992	Archives of Surgery	133	Surgical Glove Powders Bind Latex Antigens	No
Brough et al, 1988	British Journal of Surgery	127	Surgical glove perforations	No
Misteli et al,2009	Archives of Surgery	121	Surgical glove perforation and the risk of surgical site infection	Yes
Dxodds et al,1988	British Journal of Surgery	113	Surgical glove perforation	No
Gerber, et al,1989	Anesthesiology	110	Severe intraoperative anaphylaxis to surgical gloves: Latex allergy, an unfamiliar condition	No
Förström, L.1980	Contact Dermatitis	88	Contact urticaria from latex surgical gloves	No
Partecke et al,2009	Infection Control and Hospital Epidemiology	77	Incidence of microperforation for surgical gloves depends on duration of wear	No
Dalgleish&Malkovsky,1988	British Journal of Surgery	65	Surgical gloves as a mechanical barrier against human immunodeficiency viruses	No
Harnoß, et al,2010	American Journal of Infection Control	64	Concentration of bacteria passing through puncture holes in surgical gloves	No
Wright, et al,1991	JAMA: The Journal of the American Medical Association	63	Mechanisms of Glove Tears and Sharp Injuries Among Surgical Personnel	No
McLeod, G.G.,1989	Journal of Bone and Joint Surgery - Series B	58	Needlestick injuries at operations for trauma. Are surgical gloves an effective barrier?	No
Alenius H, 1991	International Archives of Allergy and Immunology	56	Surgical latex glove allergy: Characterization of rubber protein allergens by immunoblotting	No

According to the results of the bibliometric analysis we conducted with 441 articles, an increase in studies related to surgical gloves was observed between 1990 and 2000, as well as between 2011 and 2021. This indicates the importance that authors have placed on the topic of surgical gloves in terms of sterility. The studies, which initially began with Willian et al. in 1940, have been increasing over time.[8] Based on these data, we predict that there may be an increase in the number of publications in the future. In recent years, there has been a growing number of studies on glove punctures, which are commonly encountered in surgeries, as they contribute to both surgeon and patient mortality and morbidity.[9] The effects of using double gloves on glove punctures have been investigated, and new glove designs have been developed for procedures involving glove punctures.[4,9,10] While sterility is crucial in surgery, multicenter multidisciplinary studies are necessary to evaluate the effectiveness of gloves and develop new preventive measures.

In our study, the articles were predominantly written in English. When looking at the countries represented in the studies, the top three were the USA, United Kingdom, and Germany, in that order. Turkey ranked 11th along with India. We believe that new studies conducted in our country can create awareness and help prevent morbidity and mortality associated with this issue. In their study, Harnoss et al. reported that the microperforation rate of the outer layer was approximately 15%, and approximately 82% of perforations went unnoticed by the surgical team, depending on the duration of glove usage.11 We believe that this issue can be addressed by using more durable gloves or implementing procedures such as changing gloves at regular intervals.

In the articles, medical journals accounted for 84.58%, while nursing journals represented only 6.12%. We believe that there should be an increase in studies related to this topic in nursing journals and the nursing field. Nurses are involved in surgeries, and it is essential for healthcare personnel, including auxiliary staff, to pay attention to sterility before, during, and after the procedure. Considering that surgery is a team effort, maximum importance should be given to sterility by all healthcare personnel. Furthermore, the study examined articles from a total of 21 different scientific fields, including engineering, veterinary science, and environmental sciences.

Most of the publications originated from the University of Virginia, specifically from the University of Virginia School of Medicine in Charlottesville, USA. Richard F. Edlich, affiliated with the University of Virginia, was the most prolific author in this field. Richard F. Edlich, who specialized in plastic surgery, has published hundreds of articles and book chapters throughout his career, focusing

on burn care, wound healing, surgical instrument design, and rehabilitation.[12-14]

The Association of periOperative Registered Nurses (AORN) Journal stands out as the journal with the highest number of publications, with 9 articles. Contact Dermatitis and Journal of Hospital Infection share the top three positions. We believe that the efforts of surgical specialty journals in conducting studies in this area will be significant.

The study by Tarlo et al. (2019) on latex-induced occupational asthma in a surgical glove manufacturing factory appears to be the most cited publication in our research. Tarlo et al. reported in their study that latex should be considered as one of the causes of occupational asthma.[15] When looking at the top three publications on the list, it is notable that they are related to allergic side effects caused by latex gloves.[16-17] As a result, when examining the study data, the increasing number of citations in the Journal of the American Academy of Dermatology stands out.

CONCLUSION

There has been an increasing trend in surgical gloves in recent years. In particular, studies have been conducted on latex glove allergy and surgical site infections. Multidisciplinary studies to be carried out in the future are important, especially in terms of preventing infection during surgery and preventing possible transmission to healthcare workers.

ETHICAL DECLARATIONS

Ethics Committee Approval: Since this was not human or animal study, approval from the ethical committee was not requested.

Informed Consent: Since this was not human or animal study, informed consent was not obtained.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Journal of Orthopedics Research and Rehabilitation

Case Report

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Physiotherapy outcomes following latissimus dorsi tendon transfer in a patient with massive rotator cuff tear: a case report

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ABSTRACT

This study aims to evaluate the early-term rehabilitation outcomes of a 63-year-old female patient who underwent latissimus dorsi transfer following a massive rotator cuff tear. Rotator cuff tears typically occur in individuals over middle age due to degenerative causes, while in younger individuals and athletes, they can be a result of trauma. These tears can lead to symptoms such as pain, muscle weakness, and limited range of motion. While conservative treatments are generally effective, surgical intervention may be necessary in some cases. Latissimus dorsi tendon transfer is a surgical procedure used to restore active external rotation of the shoulder in massive tears. This method provides an alternative treatment option. This study presents the early-term rehabilitation outcomes of the patient.

Keywords: Latissimus dorsi tendon transfer, shoulder rehabilitation, shoulder surgery, rehabilitation program, rotator cuff tear

INTRODUCTION

Rotator cuff tear (RCT) is a common problem in the shoulder joint, typically seen in individuals over middle age due to degenerative changes, while in younger individuals it can occur as a result of trauma or repetitive movements, and it can also be observed in athletes. Rotator cuff injuries can be caused by mechanical factors such as heavy lifting or repetitive motions, as well as genetic factors such as aging and gender. Following these injuries, patients may experience pain, muscle weakness, and limited range of motion.[1]

RCT can be treated with various conservative methods including physical therapy, corticosteroid injections, Platelet Rich Plasma, and nonsteroidal anti-inflammatory drugs. However, surgical intervention may be required in cases of massive RCT. [2] The surgical approach can vary depending on the type and size of the tear, the patient's age, and activity level.[3] Surgical methods may include arthroscopic debridement, lower trapezius and pectoralis major transfers, arthroscopic complete repair, reverse shoulder arthroplasty, and also the consideration of latissimus dorsi tendon transfer (LDTT).

LDTT is used as a surgical procedure for massive, irreparable RCT to restore active external rotation of the shoulder. The latissimus dorsi muscle is detached from the crest of the lesser tuberosity and transferred to the greater tuberosity, losing its internal rotation function and exhibiting external rotation capability.[4] The latissimus dorsi tendon becomes a large, well-vascularized tendon that applies an external rotational moment and allows for more effective movement of the deltoid muscle[5]. As a result, it provides an alternative method for the treatment of rotator cuff tears. However, complications such as hematoma, anchor pull-out, and nerve damage may occur after latissimus dorsi transfer. Therefore, it may not be a suitable treatment option for every patient.[4]

Upon reviewing the literature, an adequate number of studies focusing on the postoperative rehabilitation of patients who underwent LDTT was not found. This study presents the early outcomes of a patient who underwent LDTT and participated in a physiotherapy and rehabilitation program.

CASE REPORT

A 63-year-old female patient with a RCT admitted to the Orthopedics Clinic at Kırşehir Ahi Evran University Education and Research Hospital. The patient was diagnosed

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as RCT with magnetic resonance imaging and clinically continuity test by a orthopedic specialist specialized in shoulder (ÇB).

Surgery Procedure

For LDTT, the procedure begins with an initial glenohumeral arthroscopy. This involves using standard anterior, lateral, and posterior portals to examine the joint for arthritis, biceps lesions, and subscapularis tendon tears. If a subscapularis tear is present, it is repaired, while biceps tenotomy or tenodesis is performed for tendon degeneration or instability. The size and extent of the RCT and the mobility of the torn cuff are assessed. If the RCT is confirmed to be irreparable with full involvement and retraction of the supraspinatus and infraspinatus, and remains immobile even after thorough arthroscopic release, a limited subacromial decompression is performed. This aims to create a smooth acromial undersurface and debride the lateral aspect of the greater tuberosity to prepare a suitable surface for graft-bone healing. After completing the arthroscopy, the focus shifts to graft harvesting. The shoulder is placed in maximum abduction and the elbow in 90 degrees of flexion. A 5-cm longitudinal incision is made over the posterior axillary crease to approach the latissimus dorsi muscle through blunt dissection. Any soft tissue adhesions between the teres major and latissimus dorsi are released. The latissimus dorsi muscle is then dissected sharply from its insertion on the humerus, ensuring maximum tendon excursion. Care is taken to protect the pedicle of the muscle located at the ventral aspect. The fascia lata autograft, commonly used to augment latissimus dorsi tendon transfers, is harvested through an 8-cm longitudinal incision on the lateral aspect of the thigh. An 8x4-cm fascia lata graft is obtained, folded over to create a double-layered 4x4-cm autograft, and tubularized. It is then fixed around the end of the latissimus dorsi tendon using nonabsorbable no. 1 sutures. Once the augmented tendon is ready for transfer, a curved hemostat is inserted through the anterior arthroscopy portal, and a blunt dissection is performed to create a plane between the teres minor and posterior deltoid muscle. Tactile feedback from the index finger through the axillary incision is used for guidance. The sutures on the leading edge of the tendon are retrieved through the anterior portal along the developed plane, with arthroscopic visualization from the lateral portal. With the arm at 30 degrees of abduction and external rotation, the transfer is achieved by fixing the augmented tendon over the lateral and anterior aspects of the greater tuberosity using two knotless anchors (Footprint Ultra PK; Smith & Nephew, Andover, MA, USA), applying optimal tension.[6]

Rehabilitation

A total of 6-weeks (five days, per a week) physiotherapy program following immobilization bandage (**Figure 1**) was applied to the patient. 20 minutes of cold application, 20 minutes of conventional TENS (transcutaneous electrical nerve stimulation) therapy within the frequency range of 60-120 Hz, soft tissue massage for the deltoid and biceps muscles (3 minutes), mobilization exercises for the scapula and glenohumeral joint (Grade A-B), standing exercises involving towel sliding against a wall and wall dusting, assisted bilateral shoulder elevation up to 120° using a wand, progressive abduction angles with external rotation after the 9th week, internal rotation during abduction, horizontal adduction, and functional internal rotation exercises (placing the hand on the lower back or higher), strengthening training in supine and lateral positions with elbow flexion to maintain rotator cuff/deltoid balance, finger ladder exercises, strengthening exercises in the "Full Can" position with a 0.5 kg weight for thumb elevation, closed kinetic chain exercises in a static quadruped position, isometric exercises for the periscapular muscles, deltoid, and trapezius, posterior capsule stretching, kinesiotaping (**Figure 1**).

Figure 1. Immobilisation bandage

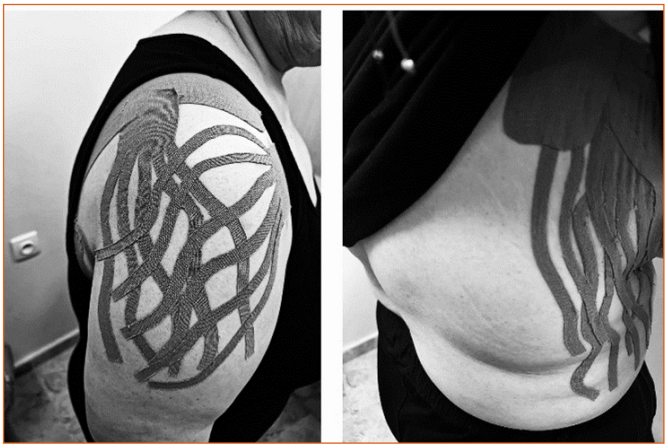

Figure 2. Kinesiotaping for shoulder edema

Outcome measurements

Patient was assessed by surgeon for both pre- and post-rehabilitation periods. Following reliable test and culturally adapted scales were used for assesment.

- Universal Goniometer for range of motion (**Table 1**).
- Visual Analog Scale for pain assessment (**Table 2**).
- Disabilities of the Arm, Shoulder, and Hand questionnaire and Revised Oxford Shoulder Score for upper extremity functionality (**Table 2**).

DISCUSSION

The aim of this case presentation was to examine the early rehabilitation outcomes in terms of pain and functionality in a patient who underwent LDTT. The results obtained indicate that the physiotherapy program following LDTT in patients with massive rotator cuff tears has a positive contribution,

Figure 3. Shoulder ROM exercises (abduction in side-lying position, flexion-abduction in supine position) B. Wand Exercises (flexion and abduction directions) C. Pendulum exercise, biceps brachii strengthening

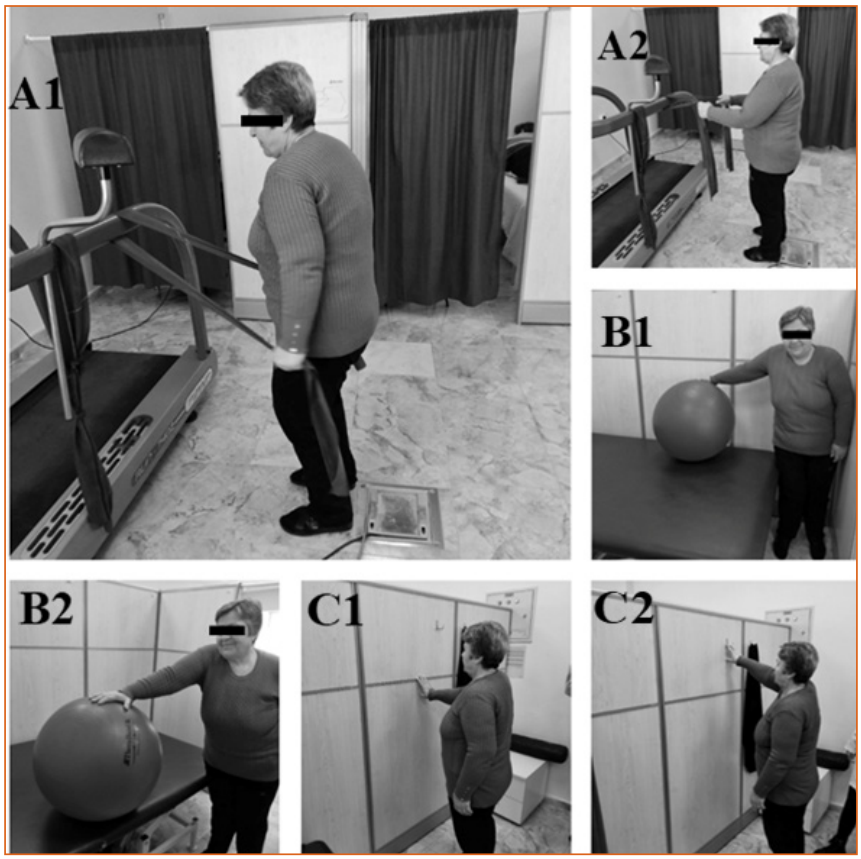

Figure 4. A1-A2: Resistance shoulder strengthening with elastic band, B1-B2: Lying activities with ball, C1-C2: Wall climbing exercise.

Table 1. Shoulder joint ROM measurements								
ROM (°)	Initial Assessment				Final Assessment			
	Active		Passive		Active		Passive	
	Right	Left	Right	Left	Right	Left	Right	Left
Flexion	20	170	132	180	160	170	170	180
Abduction	35	180	90	180	70	180	120	180
External Rotation	32	90	20	90	65	90	60	90
Internal Rotation	60	90	40	90	80	90	65	90

ROM: Range of motion

Table 2. Evaluation Parameters		
Method	Before Treatment	After Treatment
VAS		
Rest	3	0
Activity	8	5
DASH (0-100 points)	76,66	58,33
ROSS (0-45 points)	42	25

VAS: Visual Analog Scale, DASH: Disabilities of the Arm, Shoulder and Hand, ROSS: Revize Oxford Omuz Skoru

particularly in terms of shoulder external rotation. These findings are consistent with other studies in the literature. Gerber et al.[7] found in their study that LDTT was effective in reducing the limitation of active external rotation in patients with massive rotator cuff tears. Additionally, Irlenbusch et al.[8] observed that a comprehensive physiotherapy program applied after LDTT in patients with rotator cuff tears resulted in increased shoulder range of motion and muscle strength in the shoulder girdle. Strengthening exercises and range of motion exercises can assist in strengthening the shoulder muscles and improving range of motion. However, the success of the physiotherapy program depends on the patient's correct execution of exercises and their motivation.[9]

CONCLUSION

LDTT appears to be an effective treatment option for patients with massive rotator cuff tears, and when combined with a physiotherapy program, it leads to improvements in range of motion and strengthening. This study demonstrates that LDTT and a physiotherapy program can be effective choices in the treatment of patients with massive rotator cuff tears.

ETHICAL DECLARATIONS

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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Case Report

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Grade 2 chondrosarcoma of the middle phalanx of the third digit: a rare presentation

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ABSTRACT

Chondrosarcoma is the most frequently seen primary malignant tumour of the hand. It is seen most often in the proximal phalanges and metacarpals, and middle phalanx involvement is rarely seen. An 80-year-old female presented at our clinic with the complaints of pain and a massive mass in the middle phalanx. On the direct radiograph, there was seen to be an expansile, permeative mass, creating a destructive, periosteal reaction with total involvement of the middle phalanx. Amputation was performed at the level of the proximal phalanx. Curettage and grafting were not considered in this case as the lesion was causing destruction and expansion in the middle phalanx. This is one of the few cases in literature of a grade 2 (intermediate) chondrosarcoma in the middle phalanx. In this case presentation, the diagnosis and treatment of middle phalanx chondrosarcoma was explained in the light of current literature.

Keywords: Bone tumour, digital chondrosarcoma, hand, middle phalanx, pathology

INTRODUCTION

Chondrosarcoma, which is produced from cartilage, is the second most frequently seen primary malignant tumour after osteogenic sarcoma.[1,2] Although it is most common in the shoulder, knee, and pelvic region, it is the most frequently seen primary malignant tumour of the hand.[3] These tumours are seen most often in the 5th and 6th decades of life, at equal rates in males and females.[3,4] Chondrosarcoma are separated into 3 main histological grades as low (grade 1), intermediate (grade 2), and high (grade 3).[1] The majority of chondrosarcoma are evaluated as low grade.

As these tumours are resistant to chemotherapy and radiotherapy, surgical treatment is applied irrespective of localisation 4. Curettage and resection or extremity amputation are among the tre atment options. Recurrence rates with curettage treatment of the lesion are higher compared to other treatments.[5] These tumours can metastasize but metastases are not often seen.[6,7]

Approximately 50% of chondrosarcomas of the hand affect the phalangeal bone 3. From a scan of literature, approximately sixty articles were found related to phalangeal chondrosarcoma, and of these very few included the middle phalanx. In this case presentation, the clinical presentation of middle phalanx chondrosarcoma, which is seen extremely rarely in literature, was discussed in the light of current literature.

CASE REPORT

An 80-year-old female presented with complaints of swelling, slight redness, and pain in the third finger of the left hand. The complaints had started one year ago and had worsened in the last 6 months. The patient had decided to seek medical help as there had started to be limited movement in the adjacent fingers. It was learned that 10 years previously, the patient had presented at another centre with the complaints of pain and minimal swelling. The patient had been told it was a benign mass, and curettage and grafting had been applied. Unfortunately, the previous tests, operation report and pathological diagnosis were unavailable. The patient had not received any medical treatment. On presentation at our clinic there was massive swelling and redness in the middle phalanx of the third finger on the left hand. With palpation, there was sensitivity in the middle phalanx. The active and passive joint range of movements were limited and painful in the proximal and distal phalanges of the left-hand 3rd finger, and there was an amount of restricted movement in the proximal and distal interphalangeal joints of the 2nd and 4th fingers of the left hand. On the direct radiograph taken, there was seen to be an expansile, permeative mass, creating a destructive, periosteal reaction with total involvement of the middle phalanx (**Figure 1**).

Finger amputation and metacarpal ray resection was recommended to the patient for better functional results. The patient did not accept metacarpal resection so was given full information about the surgical details, and future functional

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Figure 1. An expansile, permeative mass, creating a destructive, periosteal reaction was seen

status and cosmetic appearance, and informed consent was provided. The amputation was performed at the proximal phalanx level proximal of the tumoral tissue (Figure 2).

Figure 2. The amputation was performed at the proximal phalanx level proximal of the tumoral tissue

The amputated part was sent to the Pathology Department of our institution. In the pathological examination, the tumour was seen to be formed of nodules in a permeative pattern, which had occurred from scattered chondrocytes on a chondroid base (Figure 3). No tumoral tissue was observed in the surgical margin sections. These characteristics were evaluated as grade 2 chondrosarcoma. When the patient was discharged it was explained that she must move the adjacent joints. In the examination at 2 weeks postoperatively, the grip was full and there were no wound site problems (Figure 4). The patient is now in the second postoperative year and has no active complaints.

DISCUSSION

This case, which summarises the diagnosis and treatment of an 80-year-old patient, is one of the very few reports in literature of middle phalanx chondrosarcoma.

Chondrosarcoma is the most common primary malignant tumour of the hand and constitutes 4% of all hand malignancies.[8,9] It arises most from the proximal phalanx and metacarpal in the hand 5. Involvement of the middle and distal phalanges is extremely rare.[10] In current literature, treatment is applied surgically with curettage or excision.[11] As the tumour was destructive, permeative and expansile in character in the current case, ray amputation was recommended. However, as the patient did not wish the metacarpal to be removed, amputation was made proximal of the tumoral tissue.

The radiological characteristics of chondrosarcoma are cortical destruction, massive soft tissue swelling and extension, and a permeative pattern Chondrosarcomas generally emerge after the 5th decade of life and are slow-growing tumours.[12] Curettage and bone grafting, which are finger salvage procedures, are preferable to amputation because they cause late metastases.[6] When there is thumb involvement, salvage procedures are preferred as there will be significant function loss.[4] However, recurrence rates are 22%-62.5% because of local aggressive structures and close postoperative follow up is required. [5]

Mankin et al reported that as digital chondrosarcomas have a more benign course than other chondrosarcomas, finger-sparing surgical approaches should be considered.[13] However, in the current case, as the mass on the finger was both destructive and expansive, and there had been previous surgical treatment, ray amputation was recommended. Despite the recommendation for ray amputation, which has a better functional outcome and lower recurrence rates, the patient refused this treatment. Therefore, finger amputation was made proximal of the tumoral tissue.

Chondrosarcomas can generally be classified as primary or secondary. There may be malignant transformation in Ollier disease and Maffucci syndrome, and in multiple

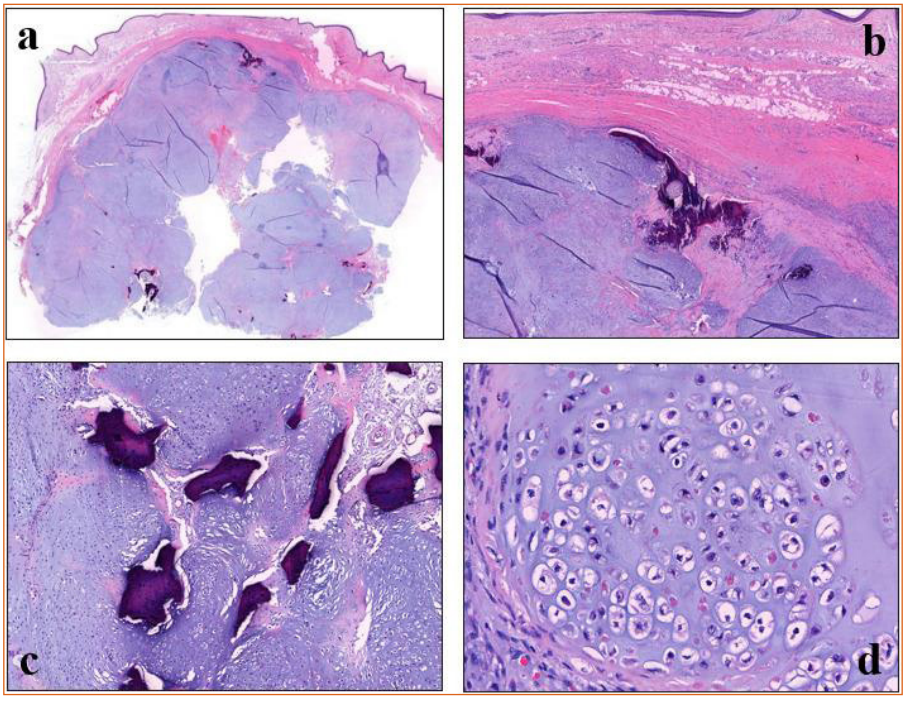

Figure 3. Tumour shows nodular or diffuse organization showing chondroid matrix formation b) Tumour has penetrated the soft tissue by infiltrating the bone cortex c) Permeation of intertrabecular spaces d) Tumour consists of atypical chondrocytes with increased cellularity and prominent nuclei

Figure 4 The patient's hand in the second week postoperatively

hereditary exostoses. Most secondary chondrosarcomas have been shown to originate from osteochondromas. The risk of malignant transformation in Ollier disease and Maffucci syndrome is 25% and 100%, respectively.[14,15] Cases have also been reported of transformation to chondrosarcoma from solitary enchondroma, synovial chondromatosis and chondromyxoid fibroma.[10] As the previous tests and data of the current case were not available it was not possible to determine whether this was a primary lesion or whether it had transformed from a benign lesion.

CONCLUSION

This is one of the rarely reported cases in literature of a middle phalanx grade 2 chondrosarcoma. The diagnosis and treatment of middle phalanx chondrosarcoma of this clinical case have been explained in the light of current literature.

ETHICAL DECLARATIONS

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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