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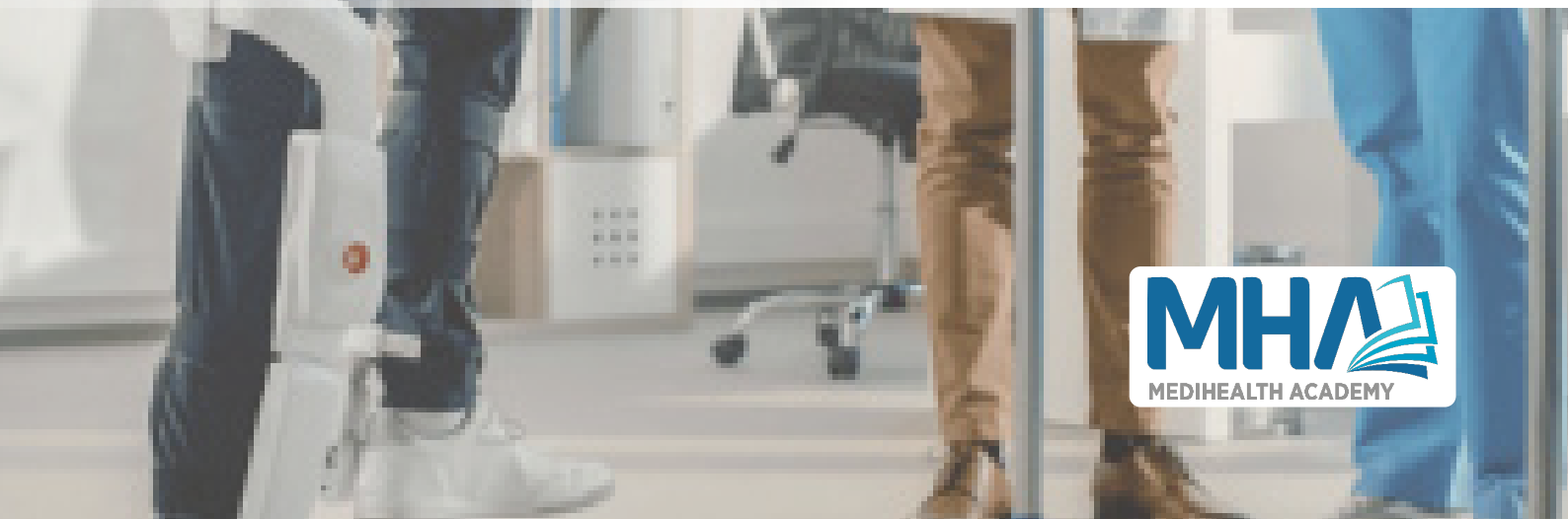

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EDITORIAL

Dear Colleagues,

It is a great pleasure to share together our Journal of Orthopedics Research and Rehabilitation (JORR), whose fourth issue was published this year. Our journal issues are healthy, both the interest in the journal and the indexing number of the journal are increasing. We hope that we will continue to do so with the same determination.

We would like to thank all our referees who agreed to be referees and evaluated the articles in our fourth issue. I would also like to thank the Editors and Editorial Board who contributed to the publication process of our journal.

Finally, we congratulate all our authors whose articles were published in 2023, see you in new issues in 2024.

Regards…

Assoc. Dr. İzzet BİNGÖL
Editor-in-Chief

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ORIGINAL ARTICLES

CASE REPORTS

Journal of Orthopedics Research and Rehabilitation

Original Article

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Hamstring muscle activation during the flywheel exercises

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ABSTRACT

Aims: Aim of this study was to determine hamstring activation during flywheel (FW) exercises, identify differences between muscles and classify the exercises.

Methods: Exercises were done by professional footballers and electromyography data from hamstring muscles were recorded and normalized according to maximum voluntary isometric contractions (MVIC). Differences between muscles and with-in exercises were compared with repeated measures ANOVA and categorized according to their intensity.

Results: The Exercise variable had significant differences ($F(3.1,81.5)=96.5$, $p<0.05$) but the muscles variable $F(1,26)=2.24$, $p>0.05$) and Exercise*Muscle interaction effect ($F(3.1,81.5)=0.97$, $p>0.05$) were not a significantly different. During Romanian Dead Lift, Single Leg Dead Lift, Leg Curl and Single Leg Hamstring Bridge determined over 80% activation according to MVIC for biceps femoris (BF) and medial hamstring (MH) with not significantly different between each other and they were categorized as high-intensity FW exercises ($p>.05$). During Bilateral Squat for both musclewere determined below 50% according to MVIC and it was categorized as low-intensity FW exercise. During Single Leg Squat and LUNGE in the MH were below 50% according to MVIC, these exercises were categorized as low-intensity FW exercises and in the BF in the range of 50-80% according to MVIC so they were categorized as medium-intensity FW exercises.

Conclusion: With this study, both parts of the hamstring contract similarly during the selected FW exercises. Low or moderate intensity FW exercises can be used in the early stages of rehabilitation or preventive hamstring exercise programs, while high intensity ones can be used in later processes.

Keywords: Hamstring muscles, eccentric overload exercise, electromyography, iso-inertial technology, football.

INTRODUCTION

The hamstrings are the most frequently injured muscle group in the lower extremity with a prevalence of 30% in athletes who compete, individually or as a team in running-based sports.[1] Biceps femoris (BF) long head is the most frequently injured muscle with 80% rate among hamstring injuries.[2] A decrease in individual or team performance after hamstring injuries and large losses in terms of time and cost and a high rate of repetition direct clinicians and researchers to different studies.[3-5] The flywheel (FW) ergometer has become the preferred equipment by clinicians in preventive rehabilitation programs and also in the process from injury to performance in recent years.[6,7]

The FW ergometer produced by Berg&Tesch researchers in 1994; creates extra load in the eccentric phase of the exercise by converting the moment of inertia generated by the rotating shaft and disk into the opposite force with the appropriate reel, rope and belt during the concentric phase of the exercise.[8,9] In order to complete the FW exercises in coordination with the ergometer, the movements must be done quickly. Speed increases power output and creates high eccentric peak torques of the exercises.[10] The physiotherapists prefer to the FW ergometer during hamstring rehabilitation because of Type II muscle activation and hypertrophy and length-shortening cycles specific to sportive functions during exercises also the ability to realize these effects painlessly and decrease hamstring injury severity and frequency when included in preventive rehabilitation programs.[11-16]

Surface electromyography (SEMG) method is a non-invasive evaluation that provides evidence-based decision making in exercise selection for physiotherapists and sports scientists by detecting and classifying the intensity of electrophysiological changes occurring in the muscles

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during exercises.[17] Commonly used hamstring strengthening exercises, eccentric hamstring exercises, Nordic hamstring exercises, sprinting and exercises are studies in the literature that identify and categorizethe activations occurring in the BF and medial hamstring (MH) contractions. In the literature, there are limited SEMG studiesavailable regarding FW exercises that are only about the leg curl for the hamstring muscles.[18-22]

Our aim in this study in which maximal hamstring activations occurring in 7 different FW exercises were analyzed for the first time, was to determine the BF and MH activation values that occur during exercises, to determine the differences between hamstrings and exercises, to classify exercises according to their intensity. After our studies, we believed that the results could help practitioners to use FW exercises effectively and reliably for post-injury hamstring rehabilitation process or preventive hamstring rehabilitation programs.

METHODS

Ethical Approval

Our research was carried out in the Turkish Super League Team Alanyaspor Club Physiotherapy Department and Indoor Gym. The study started with the permission of Gazi University Ethics Committee (Date: 09/11/2022, Decision No: E-77082166-604.01.02-506690). The individuals participating in the research were informed about the scope and content of the study and their consent was obtained. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Participants

20 male professional football players who have been doing professional team training for at least 4 years, who have not had a hamstring injury in the last 6 months, who have not had any lower extremity surgery before and who regularly continue team training, were identified and the research was started. Before the SEMG measurements two familiarization sessions were made with Desmotec Ergometer System (iso-inertialdevice D Full Line, Desmotec, Biella, Italy) with 0.060 kg.m^2 inertial load, one pro disc (diameter = 0.285 m; mass = 6.0 kg; inertia = 0.060 kg.m^2). Submaximally, the participants were accustomed to the chosen FW exercises and the demographic data recorded, participants' age, body weight, height and dominant extremity were recorded during the familiarization sessions.[15] The dominant side was determined by identifying the leg which he kicks the ball with. On the measurement day a verbal questionnaire with two questions was given to the participants, in which we asked them to evaluate their fatigue and pain out of 10. Six players with knee, groin, ankle and low back pain at a rate of more than 5, were excluded from the study so that the results would not be affected. The study was completed with 14 participants who did not feel any pain.

Exercises

As a result of the literature review, 7 FW exercises were determined that have been used before for lower extremity muscles and or hamstrings ; bilateral squat (BSQ), single leg squat (SLSQ), romanian dead lift ()RDL, single leg dead lift (SLDL), lunge, leg curl (LC) and single leg hamstring bridge were selected (Figure 1.).[15,16,18,23]

Figure 1. Fw Exercises, A1-A2: Procedure of FW BSQ Exercise, B1-B2: Procedure of FW LUNGE Exercise, C1-C2: Procedure of FW SLSQ Exercise, D1-D2: Procedure of FW RDL Exercise, E1-E2: Procedure of FW SLDL Exercise, F1-F2: Procedure of FW LC Exercise, G1-G2: Procedure of FW SLHB Exercise

In order to ensure the standardization of the movements among the footballers during the exercises:

During the FWBSQ the feet were positioned on the flywheel platform at shoulder width and parallel to each other. In order to squat depth, the tape was pulled to give a tactile warning when the femur was parallel to the ground. Verbal warnings were given to prevent medial displacement of the knee joint and to maintain the neutral position of the pelvis (Figure 1., A1-A2).

During the FW lunge exercise, the dominant extremity was placed in the position on the flywheel platform to the front. Verbal instructions were given to move towards the colored cone placed in front of the dominant extremity (Figure 1., B1-B2).

During the FW SLSQ exercise, the dominant side was also positioned on a flywheel platform on one leg. In order to standardize the squat depth, the tape was pulled to give a tactile warning when the knee joint was at the 90 degree angle. Verbal instructions were given to prevent the knee joint from moving medially (Figure 1., C1-C2).

During the FW RDL exercise, the athlete was positioned on the flywheel platform with his feet parallel to each other and at shoulder width. Deadlift depth was determined by measuring with a tape measure from the midpoint of the tuberositas tibia and proximal talus and marking it with a plaster. Exercise limited knee flexion to less than 20 degree angle. Verbal instructions were given to maintain the neural position of the pelvis (Figure 1., D1-D2).

During the FW SLDL exercise, the dominant side was positioned on one leg on the flywheel platform. Deadlift depth was determined by measuring with a tape measure from the midpoint of the tuberositas tibia and proximal talus and marking it with a plaster. The dominant side knee joint was limited to less than 20 degree flexion positions during exercise. The non-dominant leg remained neutral as the body

moved forward. Verbal instructions were given to maintain the neural position of the pelvis(Figure 1., E1-E2).

Before starting the LC exercise, the portable treatment table was positioned in front of the Desmotech device. While the athlete was in the prone position, his pelvis was fixed to the bed with the Mulligian belt. The flywheel rope was attached to the dominant side extremity at the ankle with the wrist belt. Verbal instructions were given to pull the heel towards the hip (Figure 1., F1-F2).

Before starting the SLHB exercise, 60 cm high boxes were placed on both sides of the desmotech device. After positioning the dominant side extremity heel on one boxing and the upper back on the other boxing, the desmotech rope was fixed to the athlete with a waist belt. Verbal instructions were given until the knee, hip joint, and shoulder were in the same direction (Figure 1., G1-G2).

SEMG Measurement

During the 7 flywheel exercises of the participants, hamstring activations were measured with a 6-channel FreeEMG 100 RT model SEMG device of BTS bioengineering company, which can record at 1000 Hz sampling rate. SEMG data was collected from the dominant side. Before the measurements, each player warmed up with a standard 10-minute 3rd level resistance 90 revolutions per minute (RPM) cycling (Indoor Exercise Bike, Technogym, Italy) and stretching program. After warming up, disposable, self-adhesive Ag/AgCl electrodes (Noraxon Dual EMG Electrode, U.S.A) with a diameter of 10 mm were attached on the skin after cleaning with a disposable razor blade and alcohol. EMG electrodes were attached to the dominant extremity parallel to the projection of the hamstring, the distance between the tuber ischiadicum and the tibia epicondyluslateralis and medialis was measured with a tape measure and attached to the midpoint of it with a distance of 20mm between them according to SENIAM guidelines.[24]

Maximum Volunteer Isometric Contraction (MVIC)

For MVIC, it was repeated 3 times in prone 45 degree knee flexion position. Each isometric contraction continued for 5 seconds, and a 30-second rest period was given between contractions.18 After the MVIC, the athletes were given a recovery time of 10 minutes.

Exercise Protocol

10 repetitions of FW exercises were performed with full effort for both extremities. At the same time participants were followed by an experienced physiotherapist with clear and loud verbal encouragements like 'as much as faster as you can'. The exercises were applied to all the athletes in the same order,to fix the rope of the flywheel device to the football players different equipment was required (desmotech vest, desmotech belt, short hand bar) and also (treatment bed, mulligan belt, 60 cm boxes) was required for some exercises. In order not to waste time randomization could not be done during the exercises. The exercises using the same equipment were done one after the other.

With a rest period of 5 minutes between the exercises.[18]

Another physiotherapist who had experiences about SEMG measurements, followed and recorded the raw SEMG data from hamstrings during FW exercises.

SEMG Data Analysis

First, the recorded raw EMG signals during the FW exercises and MVIC contractions were passed through a 20 Hz IIR Butterworth High Pass and 450 Hz IIR Butterworth Low Pass motion artifact and ECG filter. Root Mean Square (RMS) values were calculated from consecutive 0.1 s time windows from the filtered EMG signals.

The average of 3 peak EMGrms signal amplitudes observed during 5 sec MVICs were used as a reference.[18]

During each FW exercise, the average of 3 peak EMGrms signal amplitude was determined and divided by the reference value and normalization operations were applied.[25]

The normalised values below 50% had been categorized as low-intensity, those with a range of 50-80% had been categorized as medium-intensity and above the 80% had been categorized as high-intensity FW exercises for hamstrings.[18]

Statistical Analysis

Statistical analysis of the study was performed using the 'Statistical Package for Social Sciences' (SPSS) Version 22.0 (SPSS inc., Chicago, IL, USA) program. The normal distribution of the data was determined using visual (histogram and probability plots) and analytical methods (Kolmogorov-Smirnov/Shapiro-Wilk Test, Skewness/Kurtosis). Data was examined with Two Way ANOVAin the repeated measurements. Muscles were determined asan independent variable (between factor); and EMG data occurring in Exercises was determined as a dependent variable (with in factor).[21] Bonferroni's correction was used to reduce the margin of error for exercises pairwise comparisonsand the p value was accepted as 0.05.

RESULTS

Participants

18-30 age range with a median age of 18.5 years of the 14 participants other demographic data was summarized in the Table 1.

Table 1. Demographic datas.

	X±Sd	Min.	Max.
Height (cm)	180±7	169	193
Weight (kg)	73±7	60	89
Dominant side (player)	6 (left)		8 (right)

*X: mean value, Sd: standart deviation, Min.: minimum value, Max.:Maksimum value.

BetweenMuscleand with-in ExerciseDifference

According to the Two Way ANOVA in the repeated measurements test results, it was seen that the Exercise variablehad significant differences($F(3.1,81.5)=96.5$, $p<0.05$) but the Muscle ($F(1,26)=2.24$, $p>0.05$) and Exercise*Muscle interaction effect ($F(3.1,81.5)=0.97$, $p>0.05$) were not significantly different. In other words, when footballers work on the FW ergometer with full effort LH and MH muscles contract similarly, although there were differences between exercises.

Peak Muscle Activity

In all 7 FW exercises, muscle activation determined in BF muscles was higher than in MH muscles, but the activation difference was not significantly different ($p>0.05$) (Figure 2).

The highest muscle activation for BF and MH occurred in FW LC exercise ($p>0.05$) (Figure 2).

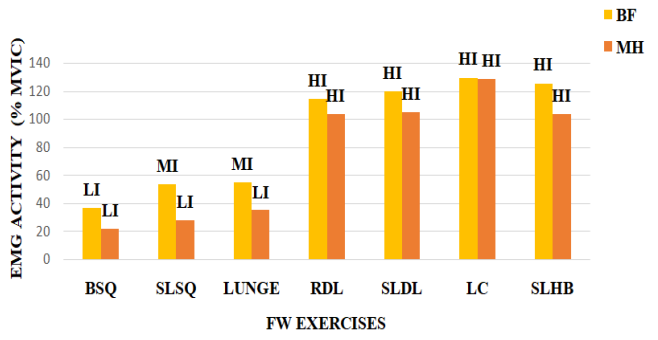

Figure 2. Hamstring EMG activity. *Bilateral squat: BSQ, Single leg squat: SLSQ, Romanian deadlift: RDL, Single leg deadlift: SLDL, LUNGE, Leg curl: LC ve Single leg hamstring bridge: SLHB.
*Biceps femoris: BF, medial hamstring: MH.
*HI: High intensity, MI: Moderate intensity, LI: Lowintensity.

The lowest muscle activation for both BF and MH occurred in the FW BSQ exercise (p>0.05) (Figure 2).

Pairwise Comparisons of FW Exercises

The maximal activation values measured in BF and MH muscles during FW exercise are as summarized in (Table 2).

There are significant activation values differences between during the FW RDL, SLDL, LC and SLHB exercises and the BSQ, SLSQ and LUNGE exercises (p<0.05) (Table 2).

During FW; RDL, SLDL, LC and SLHB exercises activation values were determined over 80% compared to MVIC for both BF and MH muscles and not significantly different between them and they were categorized as high-intensity FW exercises for both muscle groups (p>0.05) (Table 2).

During the BSQ, SLSQ and LUNGE exercises in the MH muscle, the maximal activation values were determined and were not significantly different between them and below 50% compared to the MVIC, these exercises were categorized as low-intensity FW exercises for the MH muscles (p>0.05) (Table 2).

During the LUNGE and SLSQ exercises in the BF muscle, the maximal activation values were used in the range of 50-80% according to the MVIC and were categorized as medium-intensity FW exercises. During BSQ exercise in the BF muscle, the activation value was determined below 50% according to MVIC and it was categorized as low-intensity FW exercise. There was not a significant difference between the values determined during the BSQ, SLSQ and LUNGE exercises for the BF muscle (p>0.05) (Table 2).

DISCUSSION

The main purpose of this study was to determine the maximal muscle activations in 7 different FW exercises and the differences between hamstring muscles and to be able to make evidence-based FW exercise selection in clinical decision making. In this study, which was conducted for the first time in the literature, BF activation was higher than MH activation in all 7 FW exercisesperformed by 14 professional football players, but the difference was notstatistically significant. FW RDL; SLDL; LC and in SLHB exercises, over 100% activation occurred in both muscle groups compared to MVIC, but the differences between exercises were not significantly different. FW BSQ; SLSQ and in LUNGE exercises, activation occurred in both muscle groups below 60% compared to MVIC, but the activation differences in the muscles in these exercises were not significantly different. In the literature; the average activation that occurs during the exercises according to the MVIC for hamstrings was categorized as low intensity exercises that are below 50%, medium intensity exercises in the range of 50-80%, high intensity exercises that are above 80%.[18] According to this categorization method, FW RDL, SLDL, LC, SLHB exercises were high-intensity for both muscle group; FW BSQ exercise was low-intensity for both muscle groups; FW LUNGE and SLSQ exercises were low-intensity for MH muscles, but medium intensity for BF muscles. There were significant differences between FW exercises that produce high-intensity activation for hamstrings and FW exercises that create medium or low-intensity activation for hamstrings.

Although the rehabilitation process varies depending on the size and location of the hamstring injury, eccentric exercise loads progress from low intensity exercises in the first weeks to medium and high intensity exercises in the following week or from bilateral close-kinetic-chain-exercises (CKCE) such as BSQ, RDL, LUNGE to open-kinetic-chain-exercise (OKCE) such as LC.[26,27] If we interpret our study results together with that knowledge, we thought that bilateral CKCE such as FW BSQ, LUNGE, where hamstring activation was moderate or low intensity could be used after early period ofpostinjury rehabilitation and unilateral CKCE such as FW SLSQ could be more suitable for optimal loading in the following process. At the beginning of the remodeling phases, high-intensity CKCE exercises that bilateral FW RDL or unilateral FW SLDL, SLHB not significantly different each other could be used. The FW LC exercise, which is a high-intensity OKCE, could be used in functional rehabilitation or return to sports phases.

There were also studies in the literature show that weekly regular FW exercises within the scope of preventive rehabilitation reduce hamstring injuries. Askling et al.[16] in 2003 published a controlled study in that 10-week FW LC exercise performed within the scope of preventive rehabilitation in addition to the routine team training showed decreases in hamstring injury severity and frequency. According to a controlled study published by de Hoyo et al.[14] in 2015 ,showed that football players who performed 10-week FW LC and FW BSQ exercises performed as part of preventive rehabilitation in addition to routine team training showed decrease in the frequency of hamstring injuries per 1000 hours of training and/or game time. When this information was synthesized with the results of our study, we think that

Table 2. Hamstrings % values according to MVIC.

	BSQa	SLSQa	LUNGEa	RDLb	SLDLb	LCb	SLHBb
BF	36±34	53±32	55±35	114±52	120±42	129±29	125±35
MH	22±16	27±17	35±23	103±57	104±33	129±27	103±24

*all values mean % MVIC ± SD, *Bilateral squat; BSQ, Single leg squat; SLSQ, Romanian dead lift; RDL, Single leg dead lift; SLDL, LUNGE, Leg curl; LC ve Single leg hamstring bridge; SLHB, *Biceps femoris; BF, medial hamstring; MH, *a not significantly different between exercises for BF and MH, p>05, b not significantly different between exercises for BF and MH, p>05, a and b significant differences between exercises for BF and MH, p<05.

there was a potential to reduce the severity and frequency of hamstring injuries by creating permanent chronic adaptations as a result of long-term training, especially due to the FW LC exercise, which created the highest EMG activation. In addition, we think that the FW SLDL, RDL or SLHB exercises, which created high-intensity activations for BF and MH which were similar to FW LC exercises in our study and may cause chronic adaptations in the hamstrings when they are included in the weekly training program.

There were some studies where the Nordic exercise which was the most commonly used eccentric hamstring exercise and FW exercises were compared.[28] Timmins and his colleagues divided a football team into two groups, one group performed the Nordic hamstring exercise and the other group performed the FW BDL exercise for preventive rehabilitation purposes during the season. In repeated measurements at the end of the season, significant changes in the length of the athletes' BF fiber in both groups compared to the pre-season were measured, and the difference between the groups were not significant.[29] The SEMG study, in which they compared the hamstring activation that occurred in football players during the Nordic hamstring exercise and FW LC exercise, the activation values in the hamstring muscles during the exercises were found to be equal for the eccentric phase and higher in the FW ergometer than Nordic exercise for the concentric phase. Therefore, they interpreted the results of the study as using the FW LC exercise can be an alternative to the Nordic exercise.[22] These results also support our view that high-intensity FW exercises for hamstring muscles, such as RDL and LC, could cause chronic adaptations.

Research about FW ergometer that had high levels of evidence; Meta-analyse, systematic reviewand randomized controlled trial had a consensus that it can be used for an eccentric overload training.[30-32] FW LC, RDL, SLDL and SLHB exercises, in which we determined high-intensity SEMG activation with 0.06kg.m^2 inertial load in the hamstring muscles in our study and can be used during the return to running, playing or sports phases of rehabilitation for reduce the strength difference between the extremities. In addition, we anticipated that it could be used for preventive rehabilitation purposes in order to minimize the risks determined as a result of advanced analyses such as extremity symmetry index, functional hamstring quadriceps ratio. Although different studies need to be done about these views, we think that our study results will help clinicians in choosing flywheel exercises to protect against hamstring injuries.

Limitation

Although we commanded the exercises to be done as fast as possible, the fact that no method was used to measure the movement speed was a limitation of our study.

CONCLUSION

With this study, both parts of the hamstring contract similarly during the selected FW exercises. Low or moderate intensity FW exercises can be used in the early stages of rehabilitation or preventive hamstring exercise program, while high intensity ones can be used in later processes.

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ETHICAL DECLARATION

Ethics Committee Approval: The study was carried out with the permission of Ethical Committe of Gazi University. (Date: 09/11/2022, Decision No: E-77082166-604.01.02-506690).

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

Reviewer Evaluation Process: Externally peer-reviewed.

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

Financial Disclosure: The Authors declare that they have no known competing financial interests or personal relationships that could have appeared the work reported in this paper.

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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Evaluation of the relationship between respiratory muscle strength and disability due to low back pain, fatigue and cardiorespiratory fitness in individuals with chronic low back pain

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ABSTRACT

Aims: It has been suggested that the incidence of low back pain is higher in individuals with respiratory disorders compared to healthy individuals. In this study, it was aimed to calculate the relationship between respiratory muscle strength and low back pain-related disability, fatigue and cardiorespiratory fitness in individuals with chronic low back pain.

Methods: The study included 36 individuals (21F, 15M, 46.61±10.19) aged 18-65 years with low back pain. Respiratory muscle strength was measured with Pocket-Spiro MPM100 device. Disability due to low back pain was assessed by Oswestry Function Questionnaire and fatigue was assessed by fatigue severity scale. For cardiorespiratory fitness, a 6-minute walk test was performed.

Results: No significant correlation was found between maximum inspiratory pressure (MIP) and maximum expiratory pressure (MEP) values and disability status due to low back pain and fatigue ($p>0.05$). There was a significant, positive and moderate correlation between MIP and MEP values and 6 minute walk test ($p<0.05$).

Conclusion: The number of studies in the literature investigating the relationship between low back pain and respiration is limited and no general consensus has been reached. The generally accepted view is that inadequate functioning of the diaphragm may lead to impaired intra-abdominal pressure modulation, which may reduce spinal stabilisation and increase low back pain. However, no data confirming a direct relationship between respiratory muscle strength and low back pain were found in this study. More comprehensive studies are needed in this field.

Keywords: Low back pain, respiratory muscle strength, fatigue

INTRODUCTION

Low back pain is a pain that starts from the bottom of the costal region to the upper part of the gluteal lines and can be characterized by tension, stiffness and localized pain in the muscles, with or without the pain reflected in the leg.[1] It is one of the most common musculoskeletal diseases, with a prevalence reaching 80% worldwide, that restricts the social life of individuals by causing difficulty in performing daily vital activities. Its effects are not just physical; It also negatively affects individuals psychologically.[2,3] Ignoring low back pain negatively affects individuals' integration into society, living standards and financial well-being.

An important topic focused on in the etiology of low back pain is trunk stabilization. The muscles responsible for maintaining trunk stabilization are core stabilization muscles. Core stabilization system; It includes the trunk and pelvic muscles, which are responsible for ensuring the stability of the pelvis and spinal colon and facilitate the transfer of energy from large parts of the body to small parts during many activities.[4] However, these muscles do not work alone; they play a role in providing stabilization as active systems. There are two sub-systems, local and global. The local system includes the transversus abdominus, multifidus, quadratus lumborum, diaphragm and pelvic floor muscles whose origo and insertion are located in the vertebrae and is responsible for coordinated movement of body segments, control of the cavity in the lumbar region and stabilisation in

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the lateral and sagittal planes. The global system is responsible for the transmission of force from the pelvis and thoracic cage to the arms and legs. The global system includes the erector spinae, psoas major, rectus abdominus and external oblique muscles, which have large cross-sectional areas and long moment arms.[4-6] The diaphragm muscle, which is one of the muscles in the local system, has the anatomical role of separating two major cavities within our body, while its primary physiological function is respiration. However, as mentioned above, the diaphragm also plays a role in spinal stabilization. The diaphragm, which plays a role in trunk stabilization especially during postural activities, performs this function by adjusting intra-abdominal pressure.[5,7,8] The diaphragm, which originates from the L1-L3 vertebrae, is also in relationship with the lumbar region in terms of its origin region. Although the correct breathing pattern is always important for us, correct breathing while in motion is more important to ensure the continuity of stability in the spine. If the diaphragm does not function adequately and does not work symmetrically, a problem occurs in the intra-abdominal pressure required for stabilization, and to compensate for this, the workload of the lumbar region muscles increases. In other words, these differences in the course of decrease in diaphragm activation cause increased muscular activation of the paraspinal muscles in the lumbar region, resulting in regional spasm and an increase in low back pain.[7-9] Decreased spinal proprioception is mentioned in individuals with inadequate inspiratory muscle function.[10,11]

In this study, we aimed to determine the relationship between respiratory muscle strength, low back pain-related disability, fatigue and cardiorespiratory fitness in individuals with chronic low back pain.

METHODS

A total of 36 individuals with low back pain, 21 women and 15 men with an average age of 46.61 between the ages of 18-65, were included in our study. The inclusion criteria were to be diagnosed with chronic low back pain, to be in the appropriate age range, not to have undergone surgical operation in the last 6 months, not to have undergone surgical operation in the lumbar region, not to be pregnant, not to have orthopedic problems that may prevent the 6-min walk test, not to have cognitive and mental problems that may prevent the study, and to volunteer to participate in the study.

Ethics committee approval for our study was received by Kırıkkale University Non-interventional Clinical Researches Ethics Committee on 21.12.2022 with decision number 2022.12.04. Participants were asked to read the case information form first. Afterwards, approval to participate in the study was obtained and they were included in the study. All evaluations were made in accordance with the principles of the Declaration of Helsinki and ethical committees.

The evaluation started by obtaining demographic information. In the demographic information section, age, occupation, education level, height, weight, BMI, cigarette and alcohol use, medication and assistive device use, and comorbidities were noted. The age of onset of individuals' back pain, the type of back pain, and the duration of back pain recurrences were also recorded.

Respiratory muscle strength measurement was made using the Pocket-Spiro MPM device. This device is an electronic oral pressure measuring device. This method is a non-invasive evaluation method frequently preferred in clinics to measure respiratory muscle strength. Maximal inspiratory pressure (MIP) and maximal expiratory pressure (MEP) values were measured for respiratory muscle forces. MIP refers to the maximum voluntary inspiratory pressure against a closed airway. MIP measurement was performed while the patients were in a sitting position, and firstly, the patients were asked to perform maximum expiration. Then, the airway was closed with the help of a valve and the patients were asked to take maximum inspiration and maintain this for 1-3 seconds. MEP refers to the maximum pressure required to empty the alveoli of the total lung capacity. MEP measurement was also performed while the patients were in a sitting position. Patients were first asked to take maximum inspiration and then to make maximal expiration against the closed airway for 1-3 seconds. Measurements were repeated at least 3 times. The highest value was recorded care was taken to ensure that there was no difference of more than 10% between the two highest values.[12]

Oswestry disability index (ODI) was used to determine disability due to low back pain. This index was created to determine the functional disability caused by low back pain in individuals. It consists of 10 questions in total and each question has 6 options. The severity of pain, lifting weights, sitting, standing, walking, sleeping, personal care, travel, social life and the degree of change in pain are questioned. During the calculation, the options in each question are calculated based on the answered questions by giving a value between 0-5 points. The score the patient receives is divided by the maximum possible score and multiplied by 100. The maximum possible score for the patient who answers all questions is 50. A deduction of 5 points applied for each unanswered question. Interpretation is made according to the resulting percentage value. 0%-20% low back pain does not cause a significant problem in the patient's life, 20%-40% it slightly restricts daily life, 40%-60% severely restricts daily life, 60%-80% completely restricts daily life, 80%-100%. It is interpreted that he is bedridden or that the symptoms are exaggerated.[13]

6-minute walk test was used to assess cardiorespiratory fitness. The 6-minute walk test is an easy-to-apply physical performance test that reflects functional capacity and can be applied by trained individuals. The test was carried out in a closed area at a distance of 30 meters. People were asked to walk quickly without running. Encouraging suggestions were given in 1-minute intervals. Rest was allowed during the test. The test result was recorded in meters. Average values for healthy individuals are between 400-700 meters.[14,15]

Fatigue severity scale-FSS, whose Turkish validity and reliability have been established, was used to evaluate fatigue. This scale is used to measure the fatigue experienced by people in the last week, including the current day. The scale, consisting of a total of 9 items, questions the effect of fatigue on activities such as motivation, physical function, exercise and social life. Individuals are asked to give a score between 0-7 for each option. In the calculation part, all points are added and divided by 9. If the result is less than 2.8, there is no fatigue; if it is greater than 6.1, it is interpreted as chronic fatigue syndrome.[16]

Analysis of all data obtained was made using IBM SPSS 23.0 program. Mean standard deviation and median values were used to indicate continuous data, and number and percentage values are used to indicate discrete data. The

Shapiro Wilks test was used to examine whether the data showed normal distribution. Relationships between scales were analyzed with Spearman correlation coefficient. P<0.05 was accepted as the limit of statistical significance.

RESULTS

In this study, the relationship between respiratory muscle strength and the oswestry disability index, 6-minute walk test and fatigue severity scale was examined. The average age of the patients participating in the study was 46.61±10.19 years, their average height was 168.22±11.18 cm, their weight was 78.61±14.52 kg, and their body mass index was 27.89±5.25 kg\m². The demographic information of the participants is shown in Table 1.

Table 1. Demographic structure of individuals with chronic low back pain and their knowledge about low back pain

Variables		Mean ± SD/ %
Age(year)		46.61 ± 10.19
Height(cm)		168.22 ± 11.18
Weight (kg)		78.61 ± 14.52
Body mass indeks (kg/m2)		27.89 ± 5.25
Participant gender	Women	21 (58.3%)
	Man	15 (41.7%)
Participant's smoking use case	Unavailable	25 (69.4%)
	Available	11 (30.6%)
Participant's alcohol use case	Unavailable	31 (86.1%)
	Available	5 (13.9%)
Age at which low back pain complaints begin		36.97 ± 11.93
Description of low back pain	Local	19 (52.8%)
	Pain referred to the leg	15 (41.7%)
	Reflected in the leg + tingling, numbness	2 (5.6%)
	None	0 (0%)
Frequency of participant's low back pain constant		5 (13.9%)
	1-2 times week	2 (5.6%)
	1-2 times a month	11 (30.6%)
	every 2-3 months	5 (13.9%)
	Every 6 months	9 (25%)
	1 time per year	4 (11.1%)
	No back pain	0 (0%)

Maximum inspiratory pressure (MIP) and maximum expiratory pressure (MEP), Oswestry disability index, fatigue severity scale and 6-minute walk test results are shown in Table 2.

Table 2. MIP, MEP, oswesrty disability index, fatigue severity scale and 6 minute walk test results for chronic low back pain

Variables	Mean ± SD
MIP	78.36 ±18.92
MEP	115.33 ± 35.5
Oswesrty Scale	16.52 ±17.85
FSS	3.54 ±1.64
6 min. walk test	549.74 ±97.72

MIP average result is 78.36 cm H_2O, MEP average result is 115.33 cm H_2O, Oswestry scale average result is 16.52, FSS average result is 3.54, 6-minute walk test average result is 549.74 m.

No significant correlation was found between MIP result and age (p>0.05), but a significant, negative, moderate correlation was found between MEP value and age (p<0.05). No correlation was found between MIP and MEP values and BMI (p>0.05). There was a statistically significant, negative and weak correlation between MEP and age at onset of low back pain (p<0.05). It was observed that low back pain frequency values did not have a statistically significant relationship with MIP and MEP examinations (p>0.05) (Table 3).

Table 3. The relationship between respiratory muscle strength and demographic structure and low back pain information

	MIP		MEP	
	r	P	r	p
Age	-0.303	0.072	-0.524	0.001
BMI	0.135	0.431	-0.070	0.687
Age at which low back pain complaints begin	-0.242	0.154	-0.382	0.022
Frequency of lower back pain	0.054	0.755	0.008	0.962
VAS	-0.172	0.315	-0.080	0.642

r: Correlation coefficient
The p value is less than 0.05

No significant correlation was found between Oswestry function questionnaire and MIP and MEP values (p>0.05). No significant correlation was found between fatigue severity scale and MIP and MEP values (p>0.05). 6min walk test value and MIP and MEP examinations were found to have statistically significant, positive and moderate correlations (p<0.05) (Table 4).

Table 4. Relationships between respiratory muscle strength and Oswerty, fatigue and 6 minutes individuals with chronic low back pain

	MIP		MEP	
	r	P	r	p
Oswestry	-0.033	0.849	-0.177	0.303
Fatigue	0.204	0.232	0.009	0.959
6 min.	0.406	0.014	0.538	0.001

r: Correlation coefficient
The p value is less than 0.05

DISCUSSION

In our study in which we examined the relationship between respiratory muscle strength and low back pain-induced disability status, fatigue and cardiorespiratory fitness in individuals with non-specific chronic low back pain, no significant relationship was found between respiratory muscle strength and low back pain-induced disability status and fatigue, but a significant relationship was found between respiratory muscle strength and cardiorespiratory fitness.

Low back pain is a health problem with a very high prevalence that negatively affects the quality of life of individuals and prevents them from social life. Epidemiological studies indicate that women are more affected by low back pain, and our study also supports this situation.[17-19]

When we look at the literature, high BMI value; It is considered a risk factor for low back pain due to the extra load on the spine, increased mechanical demand and

the metabolic consequences of obesity. However, there is insufficient evidence for this view.[20] Normal BMI values are between 18.5-24.5. The average BMI value of the individuals with low back pain who participated in our study was 27.89, which can be interpreted as a BMI value above normal may be a risk factor for low back pain.

In recent years, the causes of low back pain have been focused on the decrease in the activation of the multifidus, transversus abdominus, and pelvic floor muscles, which are the muscles of the core region. Fewer studies have addressed the diaphragm. In the study conducted by Hodges et al.[8] in 1997, they showed that there was no change in the diaphragm during small distal extremity movements, but the diaphragm was activated before the extremity movements involving large muscle groups and stated that the diaphragm played an important role in postural control. One of the similar studies is the study of Kolar et al.[7] in 2012 in which the effect of diaphragm on postural function was investigated. In the study, the researchers observed the movements of the diaphragm during isometric contractions of the upper and lower extremities and stated that in individuals with chronic low back pain, there was restriction of movement in the anterior and medial part of the diaphragm during isometric muscle contraction and that the diaphragm moved asymmetrically during inspiration.

Maintaining an upright posture during daily activities requires dynamic stabilization. While healthy individuals apply spine-centered, multi-part, flexible postural control strategies to maintain balance; It has been observed that individuals with low back pain use a strict ankle strategy rather than spine-centered control.[21]

It is known that muscle fatigue has a negative effect on proprioceptive feedback. Respiratory corrective plays a role in postural control. However, it is stated that people with lower back pain cannot fully achieve this. Janssens et al.[22] in their study conducted in 2010, where they examined the effect of inspiratory muscle fatigue on postural control in patients with low back pain, they showed that inspiratory muscle fatigue negatively affected postural control. In 2015, Janssens et al.[22] in their study where they examined the effect of inspiratory muscle training on postural control, they divided individuals with low back pain into two groups and applied high-intensity inspiratory muscle training to one group and low-intensity inspiratory muscle training to the other group. And they observed that in the group in which high-intensity inspiratory muscle training was applied, ankle synergies of postural control decreased and spine-centered synergies increased. In other words, thanks to this training, the participation of the trunk in postural control has increased in individuals with low back pain, as in healthy individuals. They also stated that the severity of low back pain decreased more in this group.[23]

In a study conducted by Dülger et al.[24], in which they compared the respiratory functions of individuals with low back pain and healthy individuals, no significant difference was found between the two groups.

In our study, we evaluated the relationship between respiratory muscle strength and the state of being affected by low back pain. However, we could not find a relationship between low back pain involvement and respiratory muscle strength. One of our limitations in this study is that all patients were diagnosed with chronic low back pain, but not all of them had active pain at the time of evaluation. We think that this situation affected the result of the study.

In our study, no relationship was found between fatigue and MIP and MEP values. We thought that the fatigue severity scale, which we used to evaluate fatigue, did not provide comprehensive enough results because it only addressed fatigue in the last week. A significant positive relationship was found between cardiorespiratory fitness and respiratory muscle strength. This conclusion supports the literature.

Our study has some limitations. Firstly, although the study was conducted on individuals with chronic low back pain, some individuals had pain during the evaluation, while some individuals did not have active pain. We did not consider these individuals in different groups during the statistical analysis. This was not taken into consideration in most studies in the literature. We think that whether individuals have active pain at the time of evaluation affects the results. Another limitation is that this study only looked at respiratory muscle strength. Considering all parameters of breathing will give more comprehensive results. Although there is no control group in this study, the study is being continued and the values compared to the control group will be examined.

CONCLUSION

There was no significant relationship between MIP and MEP values and disability and fatigue due to low back pain. A significant, positive and moderate relationship was found between MIP and MEP values and the 6-minute walk test. The generally accepted view is that inadequate functioning of the diaphragm may lead to impaired intra-abdominal pressure modulation, reducing spinal stabilization, and this may increase low back pain. It is recommended that the sample size be larger, all respiratory parameters are addressed, and evaluations are made during acute pain.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Kırıkkale University Non-interventional Clinical Researches Ethicshics Committee Decision (Date: 21.12.2022, Decision No: 2022.12.04).

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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Case Report

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Our treatment approach in a super obese patient with lipedema: a case report lipedema

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ABSTRACT

Conditions that cause edema in the lower extremities are frequently seen in the community. When it is bilateral, conditions such as heart failure, kidney failure, nephrotic syndrome, etc. usually come to mind. Lipedema, which should be considered in order to make a diagnosis, is more common than expected. Lymphedema and lipedema are often delayed in diagnosis and are progressive disorders. Lipedema is a disease that is frequently seen in women, results in fat accumulation in the extremities and especially in the legs, the origin of which has not been fully resolved, and has a hereditary role. The reason why it is frequently seen in women is thought to be the possibility of women being estrogen dependent. Another trigger is obesity. Although its prevalence in the general female population is reported to be around 10%, the cause of lipedema is still unknown. Increasing awareness among physicians about this condition will facilitate diagnosis. With this case report, we wanted to draw attention to the increasing incidence of lipedema due to obesity and many factors.

Keywords: Super obesity, lipedema, lipedema treatment, edema, circulatory disorder, diuretics, antidiabetics

INTRODUCTION

The prevalence of obesity is increasing all over the world. In patients who come with excess weight, it is generally thought that this situation is only related to weight. In these patients, there may be excess weight due to widespread edema in the whole body. This excessive edema is caused by heart, kidney failure, etc. As it may be due to conditions such as hypothyroidism, hard, non-pitting edema, and sometimes lymphedema due to lymphatic circulation problems. Lipedema, which is often overlooked and should be considered in order to make a diagnosis, is more common than expected. The cause of lipedema is still unknown, although its estimated prevalence in the general female population is around 10%. Increasing awareness among physicians about this condition will facilitate diagnosis.[1-3]

Lipedema is a disease of unknown origin, which is frequently seen in women, resulting in fat accumulation in the extremities and especially in the legs. It is suggested that the reason why it is frequently seen in women is the possibility of being estrogen dependent. There are only a few cases of male gender in the literature. Impaired lymphatic microcirculation, microangiopathy, altered adipogenesis are the presumed causes of the disease. It is thought that the disease may be of hormonal origin, since the incidence of the disease is high during the periods of major hormonal changes. Hereditary factors are also included in its etiology.[1,4-6]

Lipedema is not usually considered; For this reason, it is misdiagnosed, delays in diagnosis, and missed diagnosis.[1] With this case report, we aimed to both convey our experience in the treatment approach of super-obese and lipedema patients, and increase awareness among physicians about lipedema.

CASE

A 59-year-old, menopausal female patient, who gave birth to 7 children, applied to our polyclinic with the complaints of her excess weight restricting her movement and pain in her knees due to weight. Other complaints of the patient were pain while walking, leg swelling after exertion and increased with inactivity, and a throbbing headache. Known diseases of the patient were noted as hypertension, Chronic obstructive pulmonary disease (COPD), cataract. The patient had a history of cerebral edema and recurrent infection requiring hospitalization for 20-25 days per year. He was actively using antihypertensive, anti-thrombolytic, inhaler bronchodilator and PPI. Extensive laboratory tests were planned from the patient at the time of presentation. Complete blood count was within normal limits. Kidney and liver function tests and electrolyte measurements were

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normal. C-reactive protein (CRP) was found to be 19.7 mg/L (normal range 0-5 mg/L) and there was no sign of infection on examination. Other notable non-reference values were: lactate dehydrogenase (LDH) 271 U/L (normal values 0-250U/L), fibrinogen 5.07 g/L (normal values 1.8-3.5 g/L), D-dimer 1209 µg/dl (normal range 0-550 µg/L). Necessary additional evaluation was made regarding these tests and no additional underlying pathology was detected.

The body mass index (BMI) of the patient with a height of 152 cm and a body weight of 156 kg was calculated as 67.5 kg/m². In the physical examination of the patient who was super obese (BMI>50 kg/m²), it was observed that the weight was mainly in the extremities -especially the legs- and there was widespread adiposity throughout the body. In line with her complaints, while the drugs used by the patient were rearranged, additional drug therapy was recommended to the patient in order to reduce the body mass index to normal levels and to increase the patient's life standards. It was aimed to reduce edema with diuretic and antidiabetic (metformin+empagliflozin) added to the treatment, and to decrease appetite with GLP-1 receptor agonist (exenatide). The patient's adherence to treatment was high; at the end of the first month, it was observed that he lost 10 kg in the control, his complaints decreased, and the treatment was beneficial.

Figure. The development of case: a, b before treatment; c, d a month later

CASE 2

A 55-year-old female patient, who gave birth to 2 children, underwent parathyroidectomy; he was admitted to our outpatient clinic for control after parathyroid surgery and with complaints of swelling in the legs and edema increasing with effort. Other complaints of the patient were weakness, tingling in the tips of the toes, frequent headaches, and intestinal motility disorders. Known diseases of the patient were noted as osteoarthritis of the kneecaps, herniated disc, parathyroid tumor, and major depression. He was actively using antidepressant, anti-thrombolytic, antihypertensive, antidiabetic, antihyperlipidemic and synthetic thyroid hormones. Large-scale blood tests were studied for pre-treatment control. Leukocytosis was found to be 10.23 X 109/L (normal limits 4-10 X 109/L) in the complete blood count. Sedimentation was seen as 35 mm/h, CRP 6.2 mg/L (0-5 mg/L). An examination for infection was performed and infection was excluded. Urea was 45 mg/dl (normal ranges were 17-43mg/dl), creatinine was 0.96 mg/dl, and eGFR was 67. Triglyceride was 165 mg/dl, T4 and T3 were within normal limits, while TSH was 5.915.91 IU/ml (0.27-4.2 5.91 IU/ml). Other than these, liver function tests, electrolytes, hormone and vitamin tests were normal. The patient's height was 155 cm and body weight were 110 kg, and BMI was calculated as 45.8 kg/m². In the physical examination of the patient, who was classified as morbidly obese, it was observed that the excess weight was collected, especially in the lower extremities and the presence of edema in the whole body. While the medications used by the patient were rearranged in line with her complaints, additional drug treatment was recommended to reduce the BMI value to normal levels and to increase the patient's life standards. It was aimed at reducing edema and appetite with diuretics, antidiabetics (metformin+empagliflozin) and exenatide added to the treatment. In the control examination and tests, the results showed that the compliance with the treatment was good. It was observed that the patient lost 5 kg in the 1st month follow-up, the edema that increased with effort decreased, and the response to the treatment was good.

DISCUSSION

Lipedema is a disease whose origin has not yet been fully explained. Patients usually present the first finding during periods of hormonal change. Its specific finding is an imbalance of body fat distribution. In these patients, there is a fat accumulation occurs in the extremities, especially in the legs. Significant weight gain is observed in patients. Often, this situation affects daily activities, causes heaviness in the body, leg pain, and causes the patient to consult a doctor. Circulation and adipogenesis disorders, which are thought to be the cause of the disease, and hormone changes are being investigated. It is considered that genetic factors may also be predisposing.[7] Since the etiology has not been fully resolved yet, there is no cure in the literature. Therefore, treatments such as drug treatments (diet, diuretics, tight stockings, rest and elevation, and massage), intermittent pneumatic compression, liposuction and, in some patients, surgery, etc. are applied in these patients.[6] Since the treatments we come across are usually surgical-based, patients may be hesitant to be treated. It is possible to get more pronounced positive results with surgical treatments; however, weight control is not usually at the forefront in surgical treatments for lipedema. In terms of being an alternative treatment, the patient's compliance with the drug treatment is high. Patients may not recover completely with these drug treatments, but it is not possible to recover completely with surgical treatments.[1,2,4-9]

Szolnoky et al.[9] found that edema and weight-reducing treatment for lymphedema increased capillary circulation, reduced leg pain and improved symptoms in patients with lipedema and lymphedema.

Weight-loss drugs have provided similar benefits. With

drug treatments, symptoms decrease, lymphedema decreases, and a better and relatively acceptable image appears in a significant part of the patients visually.[6-12]

A significant amount of weight loss and physical relief can be satisfied in patients who are older, who do not have much cosmetic expectation, and who want to relax more in terms of health, and these patients can be satisfied with surgery, etc. There is no need for you to go into different searches. As a matter of fact, in the cases we presented, our treatment approach focusing on edema and weight loss provided clinical benefit to the patients without the need for surgery.

CONCLUSION

Lipedema is often confused with lymphedema or other causes of edema and overlooked; However, with the correct diagnosis, the standard of living of the patients can be increased significantly. Although there is no cure for lipedema yet, symptomatic treatments can reduce the complaints of patients. The effectiveness of treatment can also be increased by encouraging patients to lose weight. Weight control and drug treatments for reducing edema, if any, are important approaches in terms of lipedema, as it is an alternative to surgical treatments and has high compliance. Therefore, before making the surgical decision, the patient should be evaluated in terms of drug therapy. The drugs used are promising in terms of side effects and prevention of recurrence. The patients we follow are mostly middle-advanced aged and are at risk in terms of anesthesia. Medication; It is a safer option than surgical treatments and liposuction. For this reason, we think that it would be more appropriate to take approaches to control weight and edema in patients with drug treatments, and to start other treatments if necessary.

ETHICAL DECLARATIONS

Informed Consent: Written informed consent was obtained from all participants who participated in this study.

Referee Evaluation Process: Externally peer-reviewed.

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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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Case Report

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Short period corticosteroid therapy related multifocal ostonecrosis: a case report

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ABSTRACT

Corticosteroid therapy is the most common iatrogenic etiologic factor for osteonecrosis and is most commonly seen in the femoral head. When osteonecrosis occurs in 3 or more regions, it is called multifocal osteonecrosis. The fact that corticosteriod treatment was administered in very large groups of patients during the coronavirus (COVID-19) pandemic indicates that large groups of patients with osteonecrosis will be encountered in a certain period. Despite the large patient masses treated with corticosteriod, the low number of reported cases of multifocal osteonecrosis suggests that it may be clinically asymptomatic. The paucity of studies reporting multifocal osteonecrosis despite extensive corticosteroid use suggests that it may be asymptomatic. The aim of this article is to present a case of multifocal osteonecrosis after short-term low dose corticosteroid use and to describe its clinical features. There is a variable relationship between the risk of osteonecrosis and steroid use. Multifocal osteonecrosis is a treatment complication that can develop even after short-term low-dose corticosteroid use. The widespread use of corticosteroids during the COVID-19 pandemic appears to be a risk factor for increased incidence of osteonecrosis.

Keywords: Multifocalosteonecrosis, COVID-19, facial paralysis, glucocorticoid

INTRODUCTION

Osteonecrosis (ON) is ischemia and tissue death in bone that develops in many different situations.[1] Corticosteriod (CS) use is the most common cause of iatrogenic ON[2,3] and is frequently seen in the femoral head.[4] ON occurring in three or more sites is termed multifocal osteonecrosis (MFON). The incidence is around 3%.[5] The most important risk factor for MFON is CS use. Systemic lupus erythematosus (SLE), coagulation disorders, renal failure, inflammatory bowel diseases, multiple sclerosis, sickle cell anemia, and hematologic malignancies may cause MFON.[6]

Glucocorticoid use varies in terms of dosage, route of administration or duration depending on the current diagnosis and the patient's condition. Calculated on prednisone, there are low (<7.5 mg/day), intermediate (7.5-30 mg/day), high (30-100 mg/day), very high dose (>100 mg/day) and pulse therapy alternatives.

The fact that CS treatment was applied in very large patient groups during the coronavirus (COVID-19) pandemic period indicates that patient groups with clinical signs and symptoms related to ON and the mechanical failure and joint destruction it causes will be encountered.[7]

Although there are many patients treated with CS, there are few case reports of MFON, suggesting that MFON may be asymptomatic and the number of patients who develop degenerative joint disease in the future may be high.

The aim of this case report is to raise awareness about the risk of encountering a high number of patients with sequelae of MFON in the near future and to draw attention to the detection of asymptomatic cases through a patient who developed ON in four extremities, which occurred approximately 2 years after methylprednisolone treatment for facial nerve paralysis.

CASE PRESENTATION

A 37-year-old male patient presented with rest pain in the left shoulder that increased with movement. It was learned that the patient was diagnosed with facial paralysis with facial numbness, inability to close the eyelid and asymmetry around the mouth 2 years ago and 16 mg/day methylprednisolone treatment was started and the drug was tapered and discontinued within one month.

On physical examination, range of motion was complete and Neer, Hawkins, Yergason and Speed tests were negative. Neurovascular examination was normal. Radiography revealed density loss, local osteopenic areas and patchy sclerotic appearance consistent with ON without collapse of the humeral head. While the patient was being evaluated, the same complaints started in the right shoulder and the patient was hospitalized in our clinic again. Radiographs of the right shoulder showed findings compatible with

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ON. Magnetic resonance imaging (MRI) revealed diffuse bone marrow edema in both shoulders and double line findings compatible with stage 2 ON according to Cruess classification (Figure 1).[8]

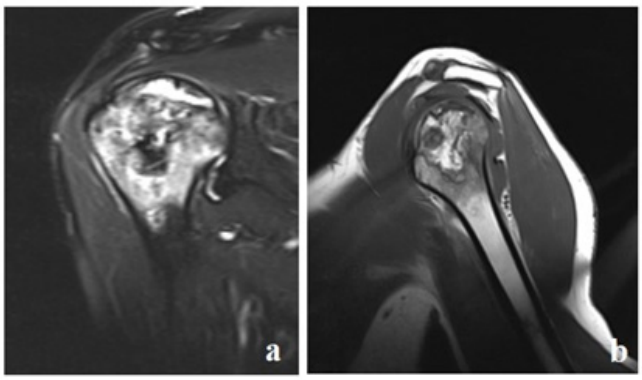

Figure 1. MR images in different planes and modalities showing Stage-2 osteonecrosis in both shoulder joints.

Cor decompression was planned for treatment and pain management and range of motion exercises were started. During this period, the patient presented with pain in the left hip that increased with walking. Physical examination revealed full but painful range of motion of the left hip joint. The patient had an antalgic gait. FABER and FADIR tests were positive. There was no active complaint in the right hip joint. Range of motion was full and painless. FABER and FADIR tests for the right hip joint were normal. MR imaging revealed stage 2 CON in both hip joints according to Steinberg classification (Figure 2).[9] Core decompression surgery was performed on all 4 extremities of the patient at different times. In the second postoperative year, the patient had full motion in all joints. Harris scores were 77 (fair) and 89 (good) for the left and right hip joints respectively, Quick DASH scores were 30 for both shoulders and DASH-work module was 50. Written informed consent was obtained from the patient for this case report.

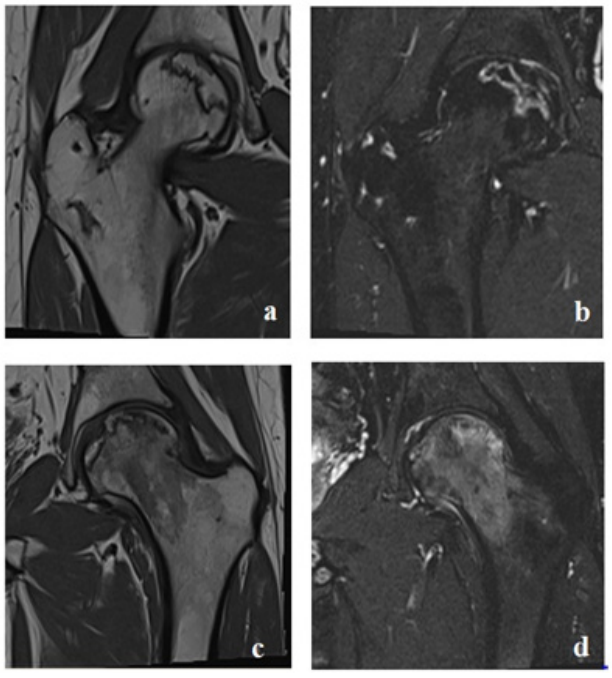

Figure 2. MRI images obtained in the coronal plane showing Stage-2 osteonecrosis in both hip joints.

DISCUSSION

In this case report, 3 main features of ON due to steroid use are presented.

The first feature is that ON may occur as late as 2 years after steroid use. Koo et al.[10] emphasized that the risk is high in the first 12 months after the start of treatment and close follow-up is required in this period. Oinuma et al. SLE, Saito et al. found ON between 3-12 months with MR follow-up after CS in renal transplantation patients. In our case, ON developed 2 years later with a short-term (1 month) treatment. It has been reported that the risk of ON development increases with increasing duration and dose of CS use (above 20 mg/day), while short-term low-dose or low-dose cumulative CS treatment does not lead to a significant increase in the risk of ON.[11,12] Our case shows that short-term treatment also carries this risk.

Based on this case, we think that patients should be followed up for at least 2 years for ON after CS treatment, and if the duration of treatment is long and the dose taken is high, follow-up should be performed at more frequent intervals.

The second feature of this case is that ON is multifocal and affects more than one joint. Krez et al.[3] in their study of 55 patients who developed MFON after CS, Krez et al. showed that the highest risk was SLE (45%) and the risk was increased in patients with hematologic malignancy, HIV, alcoholism and deep vein thrombosis receiving CS. Sun et al.[6] in their 96-case MFON series, SLE and hematologic diseases were the top two risk factors. In both MFON series, neuropathies were not reported as a risk factor. The absence of risk factors in our case suggests that MFON may develop due to CS use in every diagnosis. In Sun's series, 78% of the patients received high doses of CS over 20 mg/day and 24% over 80 mg/day. Unlike these data, an important finding of our case is that MFON may develop even at a dose of 16 mg/day. Krez et al.[3] found the mean duration of treatment to be 300 days and the shortest duration to be 90 days. Our case shows that even short-term treatments such as 30 days may be risky in terms of the risk of MFON development.

The third finding regarding the development of ON after CS in our case is that ON may be asymptomatic. In studies evaluating risk factors for MFON, it has been shown that involvement in one joint carries a risk of ON in the symmetrical joint.[1,3,6] When this information is combined with the asymptomatic clinic, we think that when ON is detected in one joint, the symmetrical joint should be evaluated in detail in terms of ON. Although MRI is the most sensitive imaging method known in the diagnosis of ON, we think that bone scintigraphy, which gives the chance to detect MFON at an earlier stage and has the potential to reveal multifocal involvement including asymptomatic involvement, may have a place in the diagnosis.[2]

One of the reasons for presenting a case of MFON due to CS use is that in the last 3 years, during the COVID-19 pandemic, CS treatment has been applied in large masses and the possibility of encountering single or multifocal ON patients with an increasing incidence in the clinic has emerged in this process. One follow-up study that in the literature, highlights the importance of MRI for evaluating the origin of hip and knee pain and timely detecting ON after the combined treatment with corticosteroids. The authors diagnosed ON at 2-year follow-up of 8 corticosteroid-naïve subjects exposed to variable doses and durations of

corticosteroid therapy.[13] In the literature, it has been reported and recommended that the use of methylprednisolone (1-2 mg/kg/day for 5-7 days) in patients with severe COVID-19 pneumonia is associated with better radiographic findings and shorter duration of supplemental oxygen therapy. And in daily practice there have been many COVID-19 patients treated with this and higher doses of corticosteroid.[14,15] Shetty demonstrated that in addition to the use of systemic CS, the hyperinflammatory state and activation of the coagulation cascade caused by SARS-CoV2 virus infection, endothelialitis and cardiac dysfunction will contribute to the development of ON with its direct effect on blood flow and multiply the risk.[16] Based on these findings, we would like to emphasize that ON should be kept in mind in the differential diagnosis of joint pain in patients with a history of COVID-19 who have received CS treatment, and that the possibility of developing ON is higher compared to the general population.

CONCLUSION

MFON may occur even with short-term and low dose CS treatment. Multifocal involvement may develop in ON and MFON may be asymptomatic. CS treatment during the COVID-19 pandemic is a risk factor that may lead to an increase in the number of patients developing ON.

ETHICAL DECLARATIONS

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

Reviewer Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: During the course of this study, no financial and/or moral support was received from any company that provides and/or manufactures any drugs, medical devices, equipment and supplies, or from any commercial company.

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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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Journal of Orthopedics Research and Rehabilitation

Case Report

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A rare case of bilateral septic arthritis: a case report

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ABSTRACT

Acute septic arthritis is an orthopedic emergency that requires rapid diagnosis and treatment to prevent serious complications, morbidity, and mortality. Delayed or inadequate treatment can lead to irreversible joint damage. Risk factors for septic arthritis include previous joint pathologies like rheumatoid arthritis and crystal arthropathy, joint prostheses, low socioeconomic status, and diabetes. Given the increasing frequency of cases of septic arthritis infected with resistant and rare microorganisms, knowing regional epidemiological data is important and necessary for planning treatment approaches. The aim of this article is to present a case of bilateral knee septic arthritis caused by *Bacillus* spp. as a pathogen. The blood parameters and joint fluid culture of the patient led to the diagnosis of bilateral septic arthritis. In the differential diagnosis of a hot and swollen joint, especially in the presence of risk factors, septic arthritis should be considered until ruled out. It should not be forgotten that opportunistic pathogens can also cause septic arthritis.

Keywords: Septic arthritis, opportunistic pathogen, debridment

INTRODUCTION

Septic arthritis should be considered and diagnosed immediately in every patient without a history of trauma who presents with joint pain, swelling and fever. Risk factors for septic arthritis include the patient's age over 80 years, diabetes mellitus, rheumatoid arthritis, recent joint surgery, hip or knee replacement surgery, skin infection, and immunosuppressive drug use.[1] Delay in diagnosis and treatment can cause permanent morbidity and mortality. Physical examination findings and serum markers, including erythrocyte sedimentation rate and C-reactive protein (CRP), are helpful in diagnosis but are nonspecific. Synovial fluid studies are required to confirm the diagnosis.[2] *Staphylococcus aureus* is the most common pathogen isolated in septic arthritis; however, other bacteria, viruses, fungi, and mycobacteria can cause disease. After synovial fluid has been removed, empirical antibiotic therapy should be initiated if there is clinical concern for septic arthritis.[3] Surgical debridement and lavage should be applied in the early period. *Bacillus* spp. may cause endocarditis, meningitis and septicemia, especially in immunocompromised patients.[4] In patients with suppressed immune systems, it should be kept in mind that it is an opportunistic pathogen.[5] In our case, we will present the rare bilateral knee septic arthritis caused by *Bacillus* spp. as a pathogen.

CASE

A 63-year-old male patient was admitted to the emergency room due to redness, swelling and pain in both knees. It was learned that the patient with idiopathic lung fibrosis is on a daily 40 mg of cortisol usage. It was observed that the patient's body temperature, 38.7˚C; respiratory rate, 16/minute; heart rate, 110 beats/minute; the blood pressure, 130/80 mmHg. No acute bone pathology was found in the patient's plane radiological examination (Figure 1). Visual Analogue Scale (VAS) score was evaluated as.[9] It was observed that the patient's blood parameters showed a white blood cell count (WBC) of 10.500/µL and a CRP level of 193 mg/L. Subsequently, it was observed that purulent joint fluid was obtained during the joint aspiration. (Figure 2), and the obtained joint fluid was sent for direct microscobic examination and culture. Empirical antibiotic therapy was initiated for the patient. Emergency surgery was planned for the patient after it was observed that >90% of polymorphonuclear leukocytes (PMNs) were present in the direct microscobical examination sample. In the operating room conditions, debridement and lavage were performed by applying open mini arthrotomy to both knees with a medial parapatellar incision. Cultures from the joint fluid obtained from the

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patient revealed the growth of *Bacillus* spp. in both knees. The patient was administered antibiotic therapy with cefazolin 4x1 g and ciprofloxacin 2x750 mg. At the first month follow-up, the patient's VAS was found to be two, and it was observed that the patient returned to active life in the first month. At the sixth-week follow-up, the patient, whose CRP was 1.3 mg/L, was discontinued from oral antibiotic therapy. At the third month follow-up, it was observed that the VAS score was 0 and the patient continued his daily life without any restrictions.

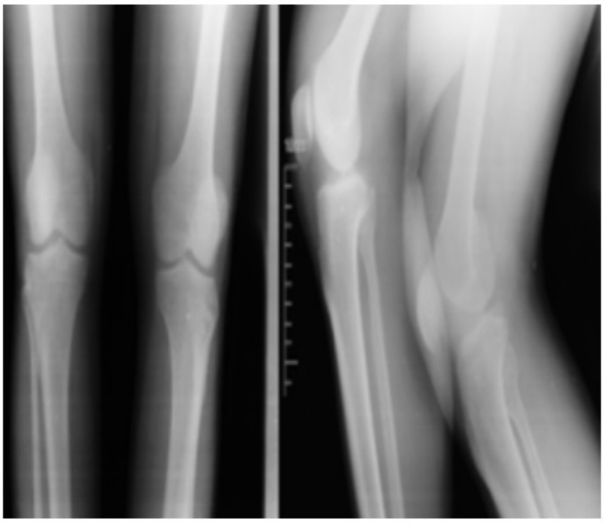

Figure 1. Plane radiological examination

Figure 2. Joint aspiration fluid right and left knee

DISCUSSION

Septic arthritis of the knee joint is an inflammatory condition caused by an infectious source. It primarily affects the synovium and subsequently involves most anatomical structures within joint boundaries.[6] The hip, knee and ankle joints are the most commonly affected areas in the body.[7] The pathogenesis of this condition typically arises through one of three fundamental mechanisms: direct inoculation, contiguous spread, and hematogenous dissemination.[8] The presence of 75% or more leukocytes in the direct microscopic examination of the joint fluid sample is an important finding for septic arthritis.[9] Clinical conditions such as white blood cell count over 11.000/μL, body temperature over 38.5°C, and high CRP are used for the diagnosis of septic arthritis.[10]

It is known that the most common cause of knee septic arthritis in society is *Staphyloccocus aerus*.[11] However, in immunosuppressed patients, such as the use of cortisol, which suppresses the bone marrow, other opportunistic pathogens may cause the disease.[12] *Bacillus* spp. may cause endocarditis, meningitis and septicemia, especially in immunocompromised patients.[4] It is known that septic arthritis causes morbidity by causing cartilage damage due to proteinases produced in the infective process. It is known that septic arthritis leads to morbidity by causing cartilage damage due to proteases that emerge during the infectious process. Therefore, in patients with suspected septic arthritis, urgent surgical debridement and lavage should be performed.[13] The patient's comorbidities, especially factors that suppress the immune system such as rheumatoid arthritis, diabetes or immunomodulatory therapy, are important. In the case of a second focus of infection, chronic kidney disease, or advanced age, patients are at risk of worse outcomes.[14] Bilateral knee septic arthritis is extremely rare.[15] In our case, it was considered that the elderly male patient living in a rural area had become immunosuppressed due to long-term cortisone use. It was observed that *Bacillus* spp., an opportunistic pathogen commonly found in normal skin flora, grew in the culture of joint fluid from both knees.

CONCLUSION

The case of bilateral knee septic arthritis is rarely encountered in the literature. Opportunistic pathogens found in the normal flora should be kept in mind in patients who are immunosuppressed for any reason. In this context, it has not been encountered in the literature before, a case of *Bacillus* spp.causing such septic arthritis.

ETHICAL DECLARATIONS

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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