

# PROFESYONEL BALE DANCİLERİ İÇİN OLASI SAKATLANMALARIN ANATOMİK KONUMLARININ BELİRLENMESİ

Determining The Anatomical Locations Of Possible Injuries For Professional Ballet Dancers

**Dr. Ayşe Gül KABAKCI**

Orcid: 0000-0001-7144-8759 ♦ Cukurova University Faculty of Medicine Department of Anatomy ♦  
aysegulll-88@hotmail.com

**Doç. Dr. Seda AYVAZOĞLU**

Orcid: 0000-0002-6446-8521 ♦ Dokuz Eylul University State Conservatory, Department of Performing Arts ♦ seda.ayvazoglu@hotmail.com

**Prof. Dr. Memduha Gülhal BOZKIR**

Orcid: 0000-0003-4164-4227 ♦ Cukurova University Faculty of Medicine Department of Anatomy ♦  
gbozkir@cu.edu.tr

## ARTICLE INFO

Submit : 04.05.2021  
Accept : 14.09.2021  
Published : 30.09.2021

iThenticate Report: % 20 ✓

Area Editor: Prof. Dr. Şenay ŞAHİN

Technical Editor: Öğr.Gör. Şükrü KAYA

EOI:

http://eoi.citefactor.org/10.11243/ijhar.06.03.019

## Reference:

Kabakçı, Ayşe Gül. Ayvazoğlu, Seda. Bozkır, Memduha Gülhal (2021). Profesyonel Bale Dansçıları İçin Olası Sakatlanmaların Anatomik Konumlarının Belirlenmesi.

*Uluslararası İnsan ve Sanat Araştırmaları Dergisi*, 6(3): 301-310

**Anahtar Kelimeler:** Anatomi, bale, sakatlanma

**Keywords:** Anatomy, ballet, injury



## Özet

## Araştırma Makalesi ♦ Research Article

Klasik bale, dansçılarda sakatlanmalarla sonuçlanan, yoğun pratik gerektiren, yüksek fiziksel talepleri olan popüler bir dans türüdür. Bu çalışma, sağ kalça ve dizinde şiddetli ağrı ile ortopedi kliniğine başvuran 20 yaşındaki bir bale öğrencisini anlatıyor. Klinik ve MRI incelemesinde kemik iliği ödemi sendromu ortaya çıkmıştır. Kemik iliği ödeminin temel nedeni, üç yıl önce "rond de jambe en l'air" hareketini yaparken kalçada meydana gelen yaralanmadır. Olgu, hareket sırasında kalça abduksiyonu sırasında yoğun ağrı hissettiğini belirtmiştir. 12 haftalık destek egzersizlerinden sonra ağrı skoru 8 puandan 3 puana düşmüştür. Literatürde bale hareketi etiolojisine sahip kemik iliği ödemi vakası yoktur. Bu raporda, herhangi bir steroid ve cerrahi tedavi olmaksızın şikayetleri azaltmak için belirlenen anatomik yapıların kas ve eklemlerini destekleyecek doğru egzersizlerin planlanabilmesi için yaralanmanın anatomik lokasyonunun belirlenmesinin önemi vurgulanmıştır. Bu çalışmanın, bale eğitimi sırasında olası yaralanmaları önleme bilincine ve bale öğrencilerinde bireysel gelişimin tıbbi takibinin önemini anlamaya katkı sağlayacağını düşünmekteyiz.

## Abstract

Classical ballet is a popular type of dance with high physical demands requiring intensive practice with eventual overuse injuries in dancers. This case report describes a 20-year-old ballet student who referred to the orthopedic

© 2021 The Author(s).

This is an Open Access article distributed under the terms of the Creative Commons Attribution-Non-Commercial-No Derivatives License (<http://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium provided the original work is properly cited and is not altered, transformed, or built upon in any way.

clinic with severe pain on right hip and knee. The clinical and MRI examination revealed bone marrow edema syndrome. The main reason for bone marrow edema is injury in hip while performing the "rond de jambe en l'air" movement three years ago. The case stated that she felt intense pain during hip abduction while movement was realized. After 12-weeks of supportive exercises, the pain score decreased from 8 to 3 points. In the literature, there is no bone marrow edema case with the etiology of ballet movement. In this report, the importance of determining the anatomical location of the injury is emphasized so that correct exercises to support the muscles and joints of the determined anatomic structures can be planned to reduce the complaints without any steroid and surgical treatment. This study will contribute to awareness of preventing possible injuries during ballet training and to understand the importance of medical follow-up of individual development in ballet students.

## Introduction

Classical ballet requires intense physical exercise and therefore overuse injury are common in classical ballet. It has been reported that 50% of injuries are due to overuse (20% lower extremity, 15% wrist and 15% feet) (Albisetti et al. 2010) In addition, musculoskeletal system is also affected in the range of 40-84% during injuries. The reasons for this high rate of injuries in ballet include limited muscle strength, inadequate joint mobility, lack of strengthening exercises, physiological and motor control deficiencies. It has been reported that lower extremity injuries are the most common type among all ballet injuries (65-80%) followed by 7-14% at hip, 14-20% at knee, 5-8% at leg, 15-22% at wrist and 13-15% at the foot of ballets (Mistiaen et al. 2012).

Bone marrow edema syndrome (BMES) is a rare condition which mainly affects the hip area. The etiology and pathogenesis of BMES is still unclear (Yi, Lee and Kim 2015). BMES was first described by Curtiss and Kincaid (1959). The patient with the classic bone marrow edema syndrome is 30-60 years old, male sex, and pain in the single bone of a joint. (Dabak and Sertkaya 2010). Hoffman et al. (2004), bone marrow edema can be categorized into three distinct groups according to etiology (Table 1).

*Table 1. Classification of bone marrow edema syndrome*

Ischemic BME	Mechanical BME	Reactive BME
• Osteonecrosis	• Bone contusion (bone bruise)	• Gonarthrosis
• Bone marrow edema syndrome (BMES)	• Microfracture	• Osteoarthritis
• Osteochondritisdissecans (OCD)	• Stress-related BME	• Postoperative BME
• Complex regional pain syndrome (CRPS)	• Stress fracture	• Tumor-related BME

There are several fundamental movements in ballet training. Among them, the "rond de jambe en l'air" movement (large semi-circling movement of the leg from front, through the side, and to the back) is an integral part of ballet vocabulary. A main stay of adagio work at the barre and center exercises in a ballet class, this movement not only requires strength and range of motion, but with continued practice, develops strength and range of motion (Figure 1). The basic position of this movement requires a 90° abduction of the hip (Wilson 2008; Wilson, Lim and Kwon 2004). This is an exercise that has been taught since the first year of classical ballet training. It is safe to say that a ballet student has low risks of injury due to these types of movements, because at their 7th year of formal education they already attained proper physicality training, skills and experience from all the prerequisite courses accomplished prior to this year. At this level the ballet student is assumed to be able to perform such exercises with no risks of injury. However, much of this literature simply reported observed values rather than acknowledging if this value was "desirable" in terms of decreased injury risk. Factors at the hip that may limit turnout include femoral anteversion, capsular flexibility, orientation of the acetabulum, and muscle-tendon unit flexibility, as well as strength of the six deep external rotator muscles to sustain the external rotation movement (Negus, Hopper and Briffa 2005). The 'rond de jambe en l'air' movement builds rotation, otherwise known as turnout, or external rotation of the hips. It increases strength, warmth, and mobility in the six external rotator muscles of the hip: piriformis, quadratus femoris, gemellus superior, gemellus inferior, obturatorius internus, obturatorius externus (Wilson, Kwon and Ryu 2007).

Ronds de jambe en l'air is made in the bar and central practice and can be single or double. Ronds de jambe en l'air can also be performed with the leg extended into the second position (half position) and closed to the calf of the supporting leg. The thighs should be kept still and the hips should be well turned out, all movement should be done by the leg below the knee (Figure 1) (Wilson, Kwon and Ryu 2007).



**Figure 1.** Rond de jambe en l'air (2015) (<http://balletwithchiara.weebly.com/blog/rond-de-jambe-en-lair>).

The bodies of ballet dancers often get into the difficult positions, which are contrary to the normal anatomical and physiological characteristics. Anatomy science is important as it translates the features of the body into the quantitative data (Kabakçı, Yücel and Ayvazoğlu 2017). This case report describes bone marrow edema in a ballet and emphasizes the importance of determining the exact anatomical location of the injury.

### **Case and Treatment**

This case was a 20-year-old girl ballet student from the Ballet Department of The State Conservatory. The student who has been training ballet for seven years injured her groin while executing the "rond de jambe en l'air" movement. She did not have any history of chronic discomfort in her inguinal region. She referred to the orthopedic clinic with pain that started on the right hip joint during hip abduction before a few months in 2017. The student stated that the reason for her injury was because she was unable to sufficiently warm-up before executing the "rond de jambe en l'air" movement. Radiological examination revealed edema around the right iliopsoas muscle and inside the rectouterine cavity. Steroid treatment was recommended to the patient, but the patient refused to use it. Therefore, the patient was recommended exercises that strengthen the hip joint muscles, a month break from ballet exercises, cold application and nonsteroidal anti-inflammatory drug (if needed). Although the ballet student had seen a doctor because of the pain that started at her groin, she could not provide the necessary rest time to rehabilitate prior to her classes. Because the injury occurred during the recital (performance) period of the semester, she felt that she had to perform the exercises despite the physical discomfort she felt from her injury. During classes which took place after her injury, she stated that she remedied the pain caused by contractions through performing various stretching exercises, which targeted more on extending the muscles at the injured area. It can be said that the ballet student tried to make the injury just a little more tolerable as opposed to treating it: Ballet dancers use the fully externally rotated position of the hip in 95% of movements in training, performance and competition, so it is virtually guaranteed that they will experience tightness and muscle

shortening in this area. Care should be taken to fully stretch the rotator group and apply soft tissue techniques where necessary to release this area (2020) (<https://www.nbsenb.ca/resources/dancers-physio-tips/turnout-tips>).

The patient's pain decreased but did not disappear. In 2020, she came to the orthopedic clinic with the complaints of increasing pain in the right knee with walking and ballet exercises. The patient's pain increased, especially during 'rond de jambe en l'air' movement. The patient's right knee MRI examination revealed edema in the patellar tendon close to the patella lower pole, knee joint and suprapatellar bursa and BMES was observed in the intereminensial region, tibia plateau and subcortical area in the posterior of patella. In addition, millimeter-sized Baker Cyst in the posterior popliteal fossa and chondromalacia (grade 2) in the posterior of the patella were observed. Steroid treatment was recommended again to the patient, but the patient refused to use the drug. The patient was recommended to rest for a month, receive nonsteroid anti-inflammatory medication and then called for control during which her pain decreased. In addition all the test procedures were performed according to the Helsinki Declaration of Principles and a voluntary consent form was obtained from the case.

### **Anatomical Treatment Exercises**

In this case, the ballet student did not adhere to the mandatory rest period and continued on with her ballet trainings. Even though she partially recovered from her injury after the final examinations during the term break, she still chronically experienced mild and uncomfortable sensations due to her injury when she did not warm up prior to exercises. The best advice that could be given to this particular ballet student was to thoroughly execute conventional stretching exercises after warm-ups during the holidays. Later on, when she feels ready and her pain subsides, strengthening exercises can be recommended for the area previously affected by the injury. Especially among dancers, supportive exercises are commonly utilized to strengthen various muscle groups involved in ballet. 20-30 minutes of warm-up exercises containing strengthening and stretching powers were done before each ballet lesson. So strengthening the muscles that support her knee will reduce stress on her knee joint. Strong muscles help her knee joint absorb shock. Stretching the muscles that her strengthen is important for restoring range of motion and preventing injury. Gently stretching after strengthening exercises can help reduce muscle soreness and keep her muscles long and flexible. The muscle groups targeted in these warm-up exercises include: musculus quadriceps femoris (front of the thigh), hamstrings (musculus biceps femoris, musculus semimembranosus, musculus semitendinosus, back of the thigh), abductors (outer thigh), adductors (inner thigh) and musculus gluteus medius and musculus gluteus maximus.

Supporting functional muscle structure helps dancers keep their normal muscle tone, strength, and flexibility. Additionally, it helps to prevent these injuries from daily training by strengthening supportive muscles and correcting imbalances.

The muscles of the pelvic region involved in a typical pelvic strain are the adductors. There are five adductor muscles whose main function is to pull the legs together, towards the midline and are also responsible for stabilizing the pelvis. Three are the short adductor muscles whose origin is the pelvis and insertion at the femur. The other two are the long adductors whose origin is the pelvis and insertion at the knee. Anatomical exercise program can help lengthened muscles. Additionally, many movements in anatomical exercise program increase mobility of the hips and joints. This exercise program was applied every other day (40 minutes) for 12 weeks.

*Table 2.12-week exercise practices*

Block	Equipment	Exercise	Notes
Warm Up	Mat	-Pelvic Curl -Spine twist supine -Chest Lift -Knee Sway (10 reps)	-Fundamental warm up essential before beginning the program, progressing to the Intermediate warm up -Waist must support to floor scapular

		-Criss cross -Pelvic tilt (anterior and posterior tilt) -Clock work (during 20 sec.) -Toe tap ( 10 reps) -Side Leg Series R/L 10 reps	mobility and stability: protraction, retraction in addition arm circles series p.s: can change according to need, seated or lying on back.
Footwork	Reformer Wunda Chair	-Footwork series including single leg -Footwork series including calf raises & single leg -Side Split R/L (10reps)	-It's important to include single leg in the series, to focus on the individual leg. -Feet must be parallel; adductor muscle group Works differently than the rotation we used in ballet.
Hip Work	Cadillac Reformer Chair	-Basic Leg Springs Single -Leg Supine -Push through barre series, supine position leg kick and tendon stretch -Supine Leg Series -Shoulder bridge 10 reps -Frog and Leg Circle - Series with straps 10 reps -Tendon Stretch R/L 10 reps.	-Working on hip disassociation and pelvic lumbar stabilization. -Lumbar Pelvic stabilization should aim. -The spine should move in order. -Feet must be parallel. -Spine must be round position and posterior pelvic tilt.
Spinal Articulation	Reformer WundaChair Cadillac	-Bottom Lift -Bottom Lift w/Ext -Pelvic Curls -Roll back barre series; roll back and roll up	-Ensuring the legs remain parallel and adductors engage especially on extension. -Short spine massage. -Very slow and controlled.
Stretches	Ladder Barrel Mat Reformer	-Stretches: Gluteals, Adductors, Hamstrings, Hip Flexors -Rolling like a ball -Russian Split	-This series of stretches is welcome part of the session, especially the Adductors stretch since it incorporated a nice lateral flexion stretch as well for ballet dancers.

Specific exercises to strengthen the adductor muscles are detailed in the Table 2. This table is exhaustive of all the exercises over the 12 weeks in recovering injury practice the particularly important ones for the ballet student. Exercises are gradually increased in order to strengthen the adductor muscles. To perform hip abduction in a healthy way is very important and necessary for the "rond de jambe en l'air" movement. Therefore pain assessment (using the Visual Analog Scale 1 to 10 points) and hip range of motion (hip abduction) using a digital inclinometer (Acumar digital inclinometer model; ACU001, USA) were assessed before and after of exercises in the 12-week program.

Moreover, the study was approved by Cukurova University Faculty of Medicine, Non-Invasive Clinical Research Ethics Committee (26/3, December 6, 2013), was authorized by the Chairman of Conservatory Ballet Art Branch and voluntary consent form was obtained.

## Results

The evaluations were made by recording the degree of hip abduction and pain scoring at the time when the pain first appeared during the movement. The VAS pain score decreased from 8 to 6 at the end of the 4-week exercise program to 4 at the 8th week and to 3 at the 12th week. Meanwhile hip abduction was recorded as 30 degrees at the 4th week and increased to 60 degrees at the 8th week and to 90 degrees at the end of the 12th week. The patient could easily perform the hip abduction with no need of medical or surgical therapy at the end of 12

weeks. Finally, the patient who had pain-induced movement limitations initially returned to routine ballet training with almost no pain and proper hip abduction.

## Discussion and Conclusion

Classical ballet is a popular activity requiring intense physical demands (Stuart, David and Brukner 2006; Kabakçı Yücel and Ayvazoğlu 2017). Therefore, the connections between the classical ballet performance and the anatomical/physiological factors related to flexibility, endurance, power and muscular strength, along with the anaerobic energy systems, should be established in detail (Uygur et al. 2019). Wrong technical implementation, teaching or perception of movement are factors that cause injury. Certain basic ballet positions which are unsuitable to the anatomical structure may cause injuries and developmental disorders. Turnout has both an aesthetic appeal and functional implications (Trentacosta, Sugimoto and Micheli 2017) and, over the past two decades, has been the subject of some debates as to the requirements and implications of "appropriate" turnout. The definition of turnout varies significantly, such as "full external rotation of the hips" (Martin et al. 1998) or "external rotation of both legs so that the feet are rotated 180° away from each other (Khan et al. 1995)" In this case, the anatomical explanation of the injury starting around the hip joint and then continuing at the knee; the basis of each position in the ballet is made from the hip joint. The flexibility of the ligaments and the strength of the muscles around the hip joint support the hip joint movement, and the foot positions are carried out correctly. For this reason, it is important that external rotation in all foot positions in the ballet should be done through the hip joint, not the knee and ankle joint. Thus, the anatomical structures are not forced and the movement is performed according to the purpose. If external rotation is not performed from the hip joint, the ankle and knee joint will have more difficulty to compensate, causing injuries such as rupture of joint ligaments, intra-articular edema, sprains. In this case, the knee joint was overloaded due to disability in the hip joint and bone marrow edema occurred in the knee joint. The student mentioned that she was not able to pause her ballet studies during her recovery period, and that she tried to alleviate her pain by making changes on her balance during exercises, such as transferring more loads to the uninjured side of her groin and increasing weight on the knee joint of the same leg.

The student stated that the reason for her injury was that she was unable to sufficiently warm-up before executing the "rond de jambe en l'air" movement. Therefore we can conclude that her injury was indeed caused by lack of proper warm-up exercises prior to the ballet practice. During the execution of 'rond de jambe en l'air', more burdens are placed on the standing leg, especially on its hip abductors. These muscles serve to orient the pelvis over the standing leg and to facilitate the balancing movement of the pelvis in relation to the leg movement. This is turn allows to limit excess or undesired movement of the pelvis. It is thus very important to include emphasis on the standing leg in teaching 'rond de jambe en l'air' and in fact for other movements requiring full range of motion at the hip (hip abduction, flexion, extension) (Kwon, Wilson and Ryu 2007). The student's attempt to avoid the injury pain will inevitably also hinder the development of correct positioning in ballet, which, in turn, will cause visual aesthetic problems in ballet composition: For example, movement of the pelvis complements the height of the moving leg, while at the same time, movement of the trunk and head complements action in the lower body, helping the dancer maintain balance and achieve a specific line or aesthetic requirement. Understanding the dynamic relationships among these accessory movements in the body, the corresponding proportions of these actions, and the amount of muscular efforts invested during the execution is of interest to dancers, dance teachers, and researchers (Wilson 2009). At the same time, using incorrect balance in ballet may also cause other injuries in the body. Excessive pelvic tilt, particularly anterior tilt, appears to be a common technical fault among pre-professional dancers, and may be caused by an imbalanced use of muscles that control the pelvis and lumbar spine, turtight hip flexors, or structural anomalies. Several dance training authorities suggest that misalignment of the pelvis in dancers may lead to vertebral stress and knee, foot, and ankle injuries due to compensatory movements and excess muscle tension (Grieg 1994; Fitt 1996). In fact, during winter semesters, in order to prevent such injuries like this, the ballet students should have done a complete warm-up and stretching session prior to the

ballet class. Because during winter times the affect of cold weather may slow down the warm up processes, therefore a full session of stretching and warming up is a very important requirement prior to class sessions. It can be concluded that if a ballet dancer does not adhere to the proper rehabilitation period, various further unwanted injuries may occur in the body, in turn making the absence of the student from the ballet classes even longer. Although dancers develop overuse injuries common in other athletes, they are also susceptible to several unique injuries. Professional dancers develop more problems and injuries in the foot, ankle, and knee than any other area (Kadel 2006). In the literature, there is no study on BMES in ballet. Therefore, sharing the cases about injuries is very important in terms of taking preventive measures. This case may also help to prevent possible injuries for students in ballet education. Significant positive effects of the exercise program applied on the anatomical structures were observed in our study and we can recommend this method as a supportive treatment for ballet students who have complaints in the hip and knee region.

## References

- Albisetti, W., Perugia D., De Bartolomeo O., Tagliabue L., Camerucci E., Calori G.M. (2010). Stress fractures of the base of the metatarsal bones in young trainee ballet dancers. *Int Orthop*, 34(1):51-5. doi: 10.1007/s00264-009-0784-3.
- Curtiss, P.H., Kincaid, W.E. (1959). Transitory demineralization of the hip in pregnancy. A report of three cases. *J Bone Joint Surg Am*, 41-A:1327-33. PMID: 13849487.
- Dabak, T., Sertkaya, K., Sertkaya, Ö. (2010). Ağrılı kemik iliği ödemi: Erken evre avasküler nekroz mu? *Türk Ortopedi ve Travmatoloji Birliği Derneği Dergisi* 9(1):19-23.
- Denys, J. (2020). Turnout insight for dancers, dance teachers, and dance parents. Canada's National Ballet School. Accessed July 7 2020. A.: <https://www.nbsenb.ca/resources/dancers-physio-tips/turnout-tips>, E.T.07.07.2020.
- Fitt, S.S. (1996). *Dance Kinesiology*. New York: Schirmer Books.
- Grieg, V. (1994). *Inside Ballet Technique*. Hightstown, NJ: Princeton Book Company, 1994.
- Hofmann, S., Kramer, J., Vakil-Adli, A., Aigner, N., Breitenseher, M. (2004). Painful bone marrow edema of the knee: differential diagnosis and therapeutic concepts. *Orthopedic Clinics North*, 35: 321-33. doi: <https://doi.org/10.1016/j.ocl.2004.04.005>.
- Kabakcı, A.G., Ahmet Hilmi Yücel, A.H., Ayvazoğlu, S. (2017). Physical characteristics of students to receive ballet training. *Cukurova Medical Journal*, 42(1):55-60. doi:10.17826/cutf.280093.
- Kadel, N.J. (2006). Foot and Ankle Injuries in Dance. *Physical Medicine and Rehabilitation Clinics of North America*, 17(4):813-26. doi: <https://doi.org/10.1016/j.pmr.2006.06.006>.
- Khan, K., Brown, J., Way, S., Vass, N., Crichton, K., Alexander, R., Baxter, A., Butler, M., John, W. (1995). Overuse injuries in classical ballet. *Sports Medicine*, 19(5): 341–57.
- Kwon, Y.H., Wilson, M., Ryu, J.H. (2007). Analysis of the Hip Joint Moments in Grand Rond de Jambe en l'Air. *Journal of Dance Medicine & Science*, 11(3):93-9.
- Kelly, R.M. (1994). Injury in ballet: a review of relevant topics for the physical therapist. *Clinical Commentary JOSPT*, 19(2): 121-9. doi: 10.2519/jospt.1994.19.2.121.
- Martin, S., Felix, M., Ordonio, M., Allen, D.D. (1998). Measuring functional range of motion in ballet dancers hips. *Journal of Dance Medicine & Science*, 2(2): 56–62.

- Mistiaen, W., Roussel N.A., Vissers, D., Daenen, L., Truijen, S., Nijs, J. (2012). Effects of aerobic endurance, muscle strength and motor control exercise on physical fitness and musculoskeletal injury rate in professional dancers: an uncontrolled trial. *Journal of Manipulative and Physiological Therapeutics*, 35(5):381-8. doi: 10.1016/j.jmpt.2012.04.014.
- Negus, V., Hopper, D., Briffa, N.K. (2005). Associations between turnout and lower extremity injuries in classical ballet dancers. *Journal of Orthopaedic & Sports Physical Therapy*, 35(5): 307-18. doi: 10.2519/jospt.2005.35.5.307.
- Trentacosta, N., Sugimoto, D., Micheli, L.J. (2017). Hip and Groin Injuries in Dancers: A Systematic Review Hip problems in dancers. *Sports Health*, 9(5):422-27. doi: 10.1177/1941738117724159.
- Tondi, C. (2015). Rond de Jambe En L'Air. Ballet with Chiara. E.: <http://balletwithchiara.weebly.com/blog/rond-de-jambe-en-lair>, E.T.17.07.2020.
- Uygur, A.G., Polat, S., Ayvazoğlu, S., Yücel, A.H. (2019). The physical features suitable for classical ballet trainin. *Journal of Back and Musculoskeletal Rehabilitation*, 32:569-78. doi: 10.3233/BMR-181173.
- Warden, S.J., Burr, D.B., Brukner, P.D. (2006). Stress Fractures: pathophysiology, epidemiology and risk factors. *Current osteoporosis reports*, 4:103-9. doi: 10.1007/s11914-996-0029-y.
- Wilson, M. (2008). The Science and Art of Grand Rond de Jambe en l'air: Applications to Teaching and Performance. *Journal of Dance Education*, 8(4):117-25. doi: 10.1080/15290824.2008.10387372.
- Wilson, M. (2009). Applying biomechanic research in the dance studio. *International Association for Dance Medicine & Science*, 1(2):11-3.
- Wilson, M., Lim, B.O., Kwon, Y.H. (2004). A three-dimensional kinematic analysis of grand rond de jambe en l'air skilled versus novice ballet dancers. *Journal of Dance Medicine & Science*, 8(4):108-15.
- Wilson, M., Ryu, J.H., Kwon, Y.H. (2007). Contribution of the pelvis to gesture leg range of motion in a complex ballet movement grand rond de jambe en l'air en dehors. *Journal of dance medicine & science*, 11(4):118-23.
- Yi, S.R., Lee, Y.H., Kim, H.M. 2015. Bilateral bone marrow edema syndrome of the femoral head with a unique onset a case report. *Hip Pelvis*, 27(4):273-7. doi: 10.5371/hp.2015.27.4.273.

## Geniş Özet

Giriş; Klasik bale eğitimi küçük yaşlardan itibaren uzun yıllar süren yoğun, disiplinli bir çalışma programı içerir. Bu eğitimin sağlıklı bir şekilde üstesinden gelebilmek ve istenilen niteliklere ulaşabilmek için denge, koordinasyon, zihinsel olgunluk, dayanıklılık ve disiplin gibi vasıflara sahip olmak gereklidir. Klasik bale yoğun fiziksel egzersiz gerektirir ve bu nedenle sakatlanmaların %50'sinin aşırı kullanıma bağlı sakatlanmalar olduğu bildirilmiştir. Sakatlanmaların %20'si alt ekstremitte, %15'i bilek ve %15'i ayak kaynaklı olduğu literatürde belirtilmiştir. Bu çalışmada da nadir görülen kemik iliği ödemi kaynaklı sakatlanma incelenmiştir. Kemik iliği ödemi tüm vakalarda travma olmaksızın başlar, aktivite ile artar, istirahat ile azalır, genellikle kasıkta ve uyluk ön yüzünde hissedilir, zamanla dinlenme esnasında bile artarak ilerleyebilmektedir. Kemik iliği ödemi bazen kendiliğinden



geçebilmektedir. Fakat balede nadir görülen bu sakatlanma önüne geçilip, erken farkedilmezse daha olumsuz durumlara da neden olabilmektedir.

Amaç; Bale eğitimi sırasında olası sakatlanmaları önleme ve bale öğrencilerinde sakatlanmaların anatomik lokalizasyonunun belirlenerek takiplerinin yapılmasına katkı sağlamak. Çalışmamızda Ronds de jambe en l'air hareketi esnasında oluşan kemik iliği ödemeğine bağlı sakatlanma incelenmiştir. Profesyonel bale hayatı boyunca sanatçıların karşılaşabileceği ve nadir görülen bu rahatsızlığın incelenmesiyle olası sakatlanmaların önüne geçilmesi de amaçlanmıştır. Böylece sanatçıların sağlıklı ve uzun süren bale hayatına sahip olunmasına katkı sağlayacağımızı düşünmekteyiz. Ayrıca kemik iliği ödemi belirtileri, tedavisi ve önleme çalışmaları konusunda bale öğrencilerinde ve öğretmenlerinde farkındalık yaratmayı da hedefledik.

Bulgular; On iki haftalık egzersiz programı ile 20 yaşındaki bale öğrencisinin ağrı düzeyinde azalma, eklem hareket genişliğinde artış gözlemlenmiştir. On iki haftalık egzersiz programı, ısınma, ayak egzersizleri, kalça egzersizleri, omurga egzersizleri ve esneme egzersizlerini kapsamaktadır. Egzersizler esnasında, mat, reformer, wunda sandalye, cadillac, ladder barrel kullanılmıştır.

Tartışma ve sonuç; Bale, kuralları belli akademik dans tekniğinin, başka sanatsal öğelerle de birleştirilerek bir sahne gösterisi oluşturacak biçimde sunulmasıdır. Bir gösteri sanatı olarak genelde müzik eşliğinde, dekor ve sahne giysileriyle sunulan, son derece titiz bir dandır. Bale tekniği, vücudun yapısını normal fonksiyonları dışında kullanma zorunluluğu getirir. Genellikle eğitimi sekiz yılı kapsayan bale mesleğine, 6-7 yaşlarında başlamak mümkündür. Ancak 11-12 yaşından önce klasik bale müfredatını içeren egzersizlere başlamak henüz kemikleri yumuşak olarak tanımlanabilecek çocuklarda fiziksel hasara neden olabilir. Hangi dansçının profesyonel bir bale dansçısı olup olmayacağını belirleyen vücut şekilleri ve özellikleri vardır. Bale öğrencilerinin değişik motorik ve koordinatif özelliklerle, yeterince psikolojik, anatomik ve fizyolojik gelişmeler sağlanmadan özel hareketlere ve tekniklere ağırlık verilmesi, öğrencilerde aşırı yüklenmelere, gelişim bozukluklarına ve sakatlanmalara neden olmaktadır. Literatür incelendiğinde, alt extremitte sakatlanmaları bütün bale sakatlanmaları arasında %65-80 oranında yer almaktadır. Alt extremitede en çok görülen sakatlanma sıklıkları (yüzdeleri) ayrıntılı incelenecek olursa; %7-14 kalça, %14-20 diz, %5-8 bacak, %15-22 bilek ve %13-15'i ayak sakatlanmalarından kaynaklanmaktadır. Diz ve ayak bileği sakatlanmalarının sık görülme nedeni ve bu nedenin aşırı kullanıma bağlı oluşunun nedeni, temel pozisyonların anatomik yapıya uygun olarak kalça ekleminden gerçekleştirilmeyip, diz ve ayak bileğine binen aşırı zorlanmadandır. Literatürde Ronds de jambe en l'air kaynaklı sakatlanma etiyojisine sahip araştırmalar yapılan çalışmalar sınırlıdır. Ronds de jambe en l'air hareketi bacağın havada daire çizmesini ifade eder ve bale eğitiminde profesyonelleşme sürecinde önemli bir harekettir. Bacağın havada yaptığı dairesel hareketleri içeren Rond de jambe en l'air hareketi, dizden ayak parmağına kadar olan kısmın hareketliliğinin gelişimine yardımcı olur. Rond de jambe en l'air hareketi sırasında, vücut ağırlığı destek bacak üzerindedir. Çalışan bacak da, dizin üst kısmının sabit tutulması yapılan dairesel hareket sırasında dizin aşağı yukarı hareketini engelleyerek doğru bir açıyla hareketin yapılmasını sağlar. Destek bacak olabildiğince gergin ve turn-out pozisyonunda tutulmalıdır. Çalışmamızda Ronds de jambe en l'air hareketi esnasında oluşan kemik iliği ödemeğine bağlı sakatlanma incelenmiştir. Bazen bir uzun yürüyüş, bazen alışık olunmayan şiddetli bir aktivite bazen de hiç bir sebep olmaksızın ortaya çıkabilir. Kapalı bir odacık gibi kabul edebileceğimiz kemik iliğinde biriken ödem sıvısı basınç artışına bu da şiddetli ağrıya yol açar. Kemik iliği ödemi sendromu hakkında son yirmi yılda literatürde bildirilen olgu sayısı oldukça fazla olmasına rağmen hastalığın nedeni anlaşılamamıştır. Bu klinik tablo ilk olarak hamile kadınlarda tespit edilmiş olsa da genelde genç ve orta yaşlı erkeklerde izlenir. Çalışmamızda ise 20 yaşında kadın balerinin

kemik iliği ödemi incelenmiştir, bu durum nadir görülen bir durum olduğu için literatüre katkı sağlayacaktır. Bu çalışmada, herhangi bir steroid ve cerrahi tedavi olmaksızın şikayetleri azaltmak için belirlenen anatomik yapıların kas ve eklemlerini destekleyecek doğru egzersizlerin planlanabilmesi için yaralanmanın anatomik lokasyonunun belirlenmesinin önemi vurgulanmıştır. 12 haftalık egzersiz programının etkinliği değerlendirilmiş ve etkili olduğu sonucuna ulaşılmıştır.

Öneriler; kişi sayısının fazla olduğu benzer çalışmalar yapılmasını ve sakatlanmaları önleyecek 12 haftalık egzersiz programının eğitim sürecinde ve sonrasında da uygulanmasını önermekteyiz.

### **Etik Kurul Kararları**

Çalışmamız Çukurova Üniversitesi Tıp Fakültesi İnvaziv Olmayan Klinik Araştırmalar Etik Kurulu tarafından onaylanmıştır (26/3, 6 Aralık 2013).

### **Araştırmacıların Katkı Oranı Beyanı**

Makalenin planlanma ve analiz aşamasında; Birinci Yazar %34, İkinci Yazar %33, Üçüncü Yazar %33 oranında katkı sağlamıştır. Makalenin yazım ve uygulama aşamasında; Birinci Yazar %34, İkinci Yazar %33, Üçüncü Yazar %33 oranında katkı sağlamıştır.

### **Çatışma Beyanı**

Yazarlara, ilişkili bölümlere, ilişkili kuruluşlara, kişisel ilişkilere veya doğrudan akademik rekabete yönelik ilgili ticari kaynaklar ile diğer finansman kaynakları dâhil olmak üzere herhangi bir yanlılık ve çıkar durumu yoktur.

### **Yayın Etiği Beyanı**

Bu makalenin planlanmasından, uygulanmasına, verilerin toplanmasından verilerin analizine kadar olan tüm süreçte "Yükseköğretim Kurumları Bilimsel Araştırma ve Yayın Etiği Yönergesi" kapsamında uyulması belirtilen tüm kurallara uyulmuştur. Yönergenin ikinci bölümü olan "Bilimsel Araştırma ve Yayın Etiğine Aykırı Eylemler" başlığı altında belirtilen eylemlerden hiçbiri gerçekleştirilmemiştir. Bu araştırmanın yazım sürecinde bilimsel, etik ve alıntı kurallarına uyulmuş; toplanan veriler üzerinde herhangi bir tahrifat yapılmamıştır. Bu çalışma herhangi başka bir akademik yayın ortamına değerlendirme için gönderilmemiştir.