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Overuse Injuries of Foot and Ankle and Healthy Training in Young Female Ballet Dancers

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ABSTRACT
This essay mainly focuses on analyzing ballet-specific risk factors about overusing injured feet and ankles and proposing some healthy and effective approaches that could help young female ballet dancers to prevent these injuries from affecting their performance. The risk factors can be categorized as intrinsic and extrinsic factors. In addition, the safe and healthy dance practice that includes adequate warm-up and cool-down and appropriate dance training are effective methods to prevent injuries in young dancers. It could offer correct training principles in the period of the growth spurt and maturation and affect young dancers' practice and well-being in the future.

Keywords: *overuse injuries, foot and ankle, young female ballet dancers.*

1. INTRODUCTION

Ballet is a physical activity with high risks of getting injuries. Because of demanding criteria in ballet, the non-physiological positions, and movements, such as turnout and en pointe, require massive practice hours in excessive rotation in the hip and extreme plantarflexion in the foot and ankle, all of which lead to overuse injuries in foot and ankle [1], causing common injuries for ballet dancers. Diverse studies revealed that those dance injuries often take place among adolescence, as young ballet dancers undergo rapid physical and psychological process [2]. Young athletes usually receive intensive physical training basically from the age of 10 to 19 [3]. And most young females proceed with menarche in accelerated growing stage from 11 to 13 years old [3]. Thus, intensive ballet practice may have their menarche and maturation put off [4]. Ballet dancers, the young female ballet dancers, in particular, delayed menarche and irregular menstruation could incur their weakness to overuse injuries of foot and ankle [5]. Moreover, young ballet dancers are supposed to make dance training safely and healthily priority in the phase of growth, otherwise their dance practice and wellbeing will thence get influenced [6]. Hence, young female ballet dancers' overuse injuries in foot and ankle incur extensive concerns.

This essay aims to analyze ballet-specific risk factors about overuse injuries of foot and ankle and propose some healthy and effective approaches that can prevent these injuries from happening in the first place. This paper will begin with a literature review towards overuse injuries in foot and ankle among young female ballet dancers and examine the risk factors that will cause these injuries. Subsequently, safe and healthy training will be suggested for injuries prevention. At last, it will be briefly concluded.

2. LITERATURE REVIEW

2.1. Overuse Injuries of Foot and Ankle in Young Female Ballet Dancers

2.1.1. Overuse Injuries

Overuse injuries refer to micro traumatic injuries in tissues, involving in bones, muscles, and tendons, due to repetitive maximal loading and the lack of adequate time for recovery and the natural reparative process [7]. Lower extremities, especially the foot and ankle are the most common spots that these injuries happen among young female ballet dancers, because their delayed maturity can add the potential risk of overuse injuries [5]. It is critical to check overuse injuries in foot and ankle on young ballerinas, because their delayed maturity has a possibility to add the potential risk of overuse injuries [5].

2.1.2. The Risk Factors of Overuse Injuries in Foot and Ankle Among Young Female Ballet Dancers

Namely, intrinsic, and extrinsic exist to be key types of risk factors that lead to overuse injuries in the foot and ankle among young ballerinas [4]. Intrinsic risk factors are connected to growth and maturation, joint range of motion in foot and ankle, and body structure [4]. In terms of extrinsic risk factors, it includes dance technique and dance training load [4]. These risk factors are demonstrated as follows.

With regard to intrinsic risk factors, young female ballet dancers incline to undergo growth spurts and maturation [2]. Growth means the formation alteration on some certain body parts [2]. During prepuberty, the asynchrony between the growth rate of height and mineral mass accumulation takes place, causing the state of comparatively low bone mass [4]. When young female ballet dancers are still in skeletal immaturity and receive high training loads, it would result in a great likelihood of overuse injuries [5]. Then, maturation intervenes in systematic variations in the body function and structure [2]. Because of extensive physical activities, young female ballet dancers tend to have their menarche at a later age and prone to have a greater risk of menstrual dysfunction than other normal females [4]. From that, these risk elements delayed onset of menarche and menstrual dysfunction in the duration of growth and maturation possibly result in overuse injuries among young ballerinas along with low bone mass.

Furthermore, extrinsic risks include the intensity and duration of dance training as well as fatigue [8]. According to Steinberg et al. [4], massive dance training time is the major risk factor causing overuse injuries. Afterwards, involving in en pointe and demi-pointe, undue monotonous movements probably produce high burdens in foot and ankle, along with ultra tension in surrounding ligaments and muscles for ballerinas in the growth spurt stages [4]. High strength and demand for training of en pointe position are prone to cause Achilles tendinopathy for dancers [1]. In addition, due to deficient dance techniques, ballet dancers usually apply compensation strategies like anterior pelvic tilts, rotating the knees and pronating the feet [8]. In contrast to ballet dancers with correct technique, dancers performing hyperlordosis, a type of compensation strategies, are more likely to have paratenonitis of foot and ankle [4]. Indeed, extrinsic risk factors are lined to overuse injuries in the foot and ankle for young ballerinas.

3. RISK FACTORS OF FOOT AND ANKLE OVERUSE INJURIES IN DANCE PRACTICE

3.1. Growth and Maturation

Growth and maturation are lined to overuse injuries of foot and ankle among young female ballet dancers. First, the motor skill developments of young ballet dancers may be restrained by their growth and maturation. Since bones grow faster than ligaments and tendons and soft tissues attached to bones are tight [6], which triggers the constraints in flexibility and strength of muscle and tendon fibres and leads to a high incidence of injured soft tissues [6]. Young ballet dancers' soft tissues of foot and ankle are overwhelmed during long-term excessive exercise, which initiates a great chance of getting injured. Additionally, extensive training could slow down the development of young female ballet dancers. Ballerinas who begin their dance training before menarche have a higher chance to experience delayed menarche when they get older and are accompanied by a high risk of menstrual dysfunction, comparing to those who start their dance training after menarche [3]. Young dancers with delayed menarche tend to have lower bone mass and lower bone quality along with functional strength and greater incidence of stress fractures than normal dancers [4]. The continuous changes of physical development and maturation in young female dancers contribute to a higher risk of overuse injuries in the foot and ankle.

3.2. Joint Range of Motion

Hyper foot and ankle joint range of motion is one of the factors that cause overuse injuries for young ballet dancers. It is associated with numerous critical ballet movements. First of all, turnout position indicates hyper external rotation in the hip. Each ballet movement could take itself no way without turnout position. Strength of muscle, as well as extensibility of soft tissue and skeletal anatomy play critical roles in efficient turnout position [5]. A long term in turnout position makes muscles around the foot and ankle joint fail to maintain proper kinematics movement pattern, causing injured muscles [5]. In this way, such extraordinary range hip movement could initiate overuse injuries in the foot and ankle. Besides, the en pointe and demi-pointe position are sorts of hyper ankle plantar flexion. It incurs adaptive shortening of soft tissues and propels to raise the chance of foot and ankle injuries [4]. Furthermore, the consolidation of turnout, en pointe, demi-pointe and other repeated ballet movements and extended joint motion would further overuse injuries in lower limbs [4]. During adolescence, excessive exercises meaning overstretched ligaments and overused muscles possibly increased the risk of inflammation on ligaments, muscles and tendons in the foot and ankle [1]. As a

result, lasting and reduplicative movements lead to overuse injuries in the foot and ankle for young females.

3.3. Dance Techniques

Incorrect dance techniques will increase the chance of overuse injuries in young dancers. Overuse injuries for ballet dancers are tied up with ballet dancers' compensation strategies like tilting the pelvis, screwing the knees, rolling in and sickling in [8]. Precisely speaking, to perform turnout position perfectly, dancers who are with finite hip external rotation attempt to grow the "turnout" via getting additional joints movements [4]. It is common to place the feet at an angle of 180 degrees in turnout with hip and knee flexed. Then, ballet dancers force the hip and knee to gradual extension with no feet movement, which is known as screwing the knee. Besides, the hip joint, compensatory movements, as production of anatomical parts, possibly induce ballet dancers' vulnerability to overuse injuries [8]. Moreover, dancing with extreme plantar flexion possibly applies compensation strategies. Working on en pointe position repeatedly places the foot in an erratic position and it is likely to force dancers to optimize compensation strategies like rolling in or sickling in [8]. From that, young ballet dancers who follow compensation strategies possess a greater risk of having overuse injuries in their foot and ankle.

4. SAFE AND HEALTHY PRACTICE FOR YOUNG FEMALE BALLET DANCERS

4.1. Warm-up and Cool-down

Warming up and cooling down are the fundamental exercise for young female ballet dancers before taking physical movement and after. Primarily, dancers should take warm-up as their priority, to raise body temperature and heart rate and mobilize the joints at the beginning of dance classes [6]. Rubbing the body, lying, sitting and standing with eyes closed, and mildly moving the limbs are solutions of the fall of coordination as growing up [6]. Then, the purposes of cooling down are to reduce pulse and ease out the joints as well as stretch the muscles, which could regain the normal functioning of the body. Dancers need to stretch continuously and concentrate on maintaining flexibility [6]. Likewise, safe stretching should be based on control, appropriate limb alignment and incorporation of the respiration to relax [6]. Thus, young ballet dancers learn to avert injuries of the foot and ankle after mastering the consolidation of controlled warming up and cooling down.

4.2 Appropriate Dance Training

Dance teachers and dancers need to have applicable training plans and be aware of their physical competencies and avoid excessive training that is going to add unhealthy pressure on their musculoskeletal system. First, dance teachers should correct inappropriate techniques and avoid compensation strategies by introducing and reinforcing correct exercises. To improve muscle balance in the hip external rotator, young dancers should focus on stretching and exercises that aim to diminish the compensation strategies in turnout position [4]. Dance teachers are supposed make students aware to obtain turnout in the premise of their motion availability [4]. Second, it is essential to train young dancers away from over stretching their muscles and ligaments. Seeing alterations in the ratio between trunk and limb length, young female dancers should be trained to comply with their joints range of motion [6]. The strength, power and flexibility of training should be adjusted, according to different phases of growth and maturity in young ballerinas [6]. Indeed, appropriate content, progression and condition of dance practice can reduce overuse injuries in the foot and ankle for young female dancers to some degree.

5. CONCLUSION

To sum up, this essay aims to evaluate and examine the risk factors of overuse injuries in the foot and ankle and propose several healthy and safe methods to fend off these injuries for young female ballet dancers. The risk factors include intrinsic and extrinsic aspects. Intrinsic factors are sorted by skeletal development and delayed menarche in the stage of growth and maturation, hyper rotation in the hip and extreme ankle plantarflexion which induce overuse injuries in the foot and ankle for young dancers. Extrinsic factors involve false dance technique and excessive training. Moreover, effective warm-up and cool-down, and appropriate dance training are necessary to avert injuries among young dancers.

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