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REVISÃO NARRATIVA SOBRE A EXECUÇÃO DO KIP NA BARRA BAIXA DAS PARALELAS ASSIMÉTRICAS

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Resumo: INTRODUÇÃO: O kip é uma habilidade fundamental amplamente utilizada nas rotinas de treinamento da ginástica artística. No entanto, faltam materiais didáticos que auxiliem o processo de ensino-aprendizagem dos alunos e dos professores iniciantes. OBJETIVO: Apresentar uma análise biomecânica qualitativa do kippe realizado na barra inferior das paralelas assimétricas. MÉTODOS: Esta foi uma revisão narrativa baseada no Google Acadêmico. Os termos utilizados para a busca dos materiais foram kippe e biomecânica, em Português e Inglês, considerando estudos experimentais e não experimentais. RESULTADOS: A literatura aponta diferentes termos para designar este mesmo movimento. Os movimentos articulares predominantes são extensão e flexão, o que justifica a maioria dos textos abordar a análise do plano sagital. O kippe tem seis instantes e três fases de movimento, Glide, Pike e Pull Up. A literatura mostra pequenas diferenças na execução em cada uma dessas fases. No entanto, alguns erros comuns de execução são apontados com algum consenso como deslizar muito curto, não alcançar o pike, abaixar as pernas muito rápido após o pike e flexionar os cotovelos na tentativa de encerrar o movimento. CONCLUSÃO: Há um número reduzido de estudos que integram a avaliação biomecânica ao processo ensino-aprendizagem na ginástica, bem como no contexto do esporte de alto rendimento. Demonstramos que essa abordagem qualitativa pode ser útil para o processo de ensino-aprendizagem desse exercício específico. A decomposição do movimento em fases permite estabelecer prioridades com base nas forças e fraquezas apresentadas pelos atletas / alunos, otimizando assim as intervenções para melhorar o seu desempenho.

Palavras-chave: fenômenos biomecânicos; educação física e treinamento; ensino.

Afiliação

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NARRATIVE REVIEW ABOUT KIP'S EXECUTION ON THE LOW BAR OF UNEVEN BARS

Abstract: INTRODUCTION: Kip is a fundamental skill widely used in artistic gymnastics trai-ning routines. However, there is a lack of didactic material that helps students' tea-ching-learning process and beginning teachers. OBJECTIVE: To present a qualitative biomechanical analysis of the kippe performed on the lower bar of the asymmetric parallel bars. METHODS: This was an narrative review based on Google Scholar. The terms used to search for materials were kippe and biomechanics, in Portuguese and English, considering experimental and non-experimental studies. RESULTS: The lite-rature points out different terms to designate this same movement. The predominant articular movements are extension and flexion, which justifies the majority of the texts to approach the sagittal plane analysis. The kippe has six instants and three phases of movement, Glide, Pike, and Pull Up. The literature show small differences in executi-on in each of these phases. However, some common execution errors are pointed out with consensus as glide too short, do no reach the pike, lower the legs too fast after the pike, and flexing the elbows in an attempt to end the movement. CONCLUSION: The-re is a low number of studies that integrate biomechanical assessment with the tea-ching-learning process in gymnastics, as well as in the context of high-performance sport. We have demonstrated that this qualitative approach might be useful to the tea-ching-learning process of this specific exercise. The decomposition of the movement in critical phases allows establishing priorities based on the strengths and weaknesses exhibited by the athletes/students, thereby optimizing the interventions to improve their performance.

Key words: biomechanical phenomena; physical education and training; teaching

Introduction

Artistic gymnastics is one of the most traditional sports, being part of the Modern Olympic Games since its first edition[1]. The practice of gymnastics in Brazil has increased during the last years[2–4]. For this reason, several authors reinforced that investments should be made in specific professional training to work with this modality, particularly within Physical Education courses[1–3,5]. On the other hand, evidence suggests that Physical Education curricula in Universities are frequently not adequate to satisfy this demand – in most cases, only aspects related to physical conditioning or basic elements are addressed, and sometimes gymnastics is simply not included as a formal discipline within the students' formation[3,4].

Another issue precluding the dissemination of gymnastics refers to the lack of studies that didactically systematized the elements of the sport. In short, the technical development of gymnastics should be followed by scientific-based pedagogical approaches allowing proper teaching-learning processes, from the sports initiation to top-level performance. In this sense, a better understanding of elements comprised of exercises of different difficulty levels is important.

The kip is a basic skill of uneven bars and high bar exercises[6], which is often used as a transitive sequence in gymnastics. It is present in the training routines of beginners and experienced gymnasts[7]. Therefore, its correct learning and performance are paramount to allow more complex routines[7–9]. The description of what would be a correct kip performance is not easy since disagreement exists even in its designation. Different terms are applied to refer to the same motor gesture: 'Kip'[6], 'Glide Kip'[7,9–11], 'Kippe'[2,3] or 'Run Kippe'[8]. The terms 'Kippe', 'Support Kippe', and 'Kippe to Support' are also used. Due to this lack of standardization, there are nuances in the kip performance that less experienced practitioners are hardly capable to remark.

Biomechanical analysis is of great importance in many sports. The determination of biomechanical parameters through quantitative analysis helps to identify factors determinant of the successful performance of sports techniques. This strategy allows decomposing movements with different complexity levels to identify its phases, difficulties, and critical features[12]. We have advocated in prior texts that qualitative biomechanics can be applied in different contexts, either educational, ludic, or competitive[13], and should be considered as a major tool within sports learning and coaching. However, there is no general agreement on the existence of ideal models for the qualitative analysis of sports techniques, and further studies using this approach

are warranted. This study presents a narrative review of Kip's qualitative biomechanical analysis performed on the low bar of uneven bars. The aim was to illustrate how this approach could be applied as a pedagogical tool in artistic gymnastics' teaching-learning process.

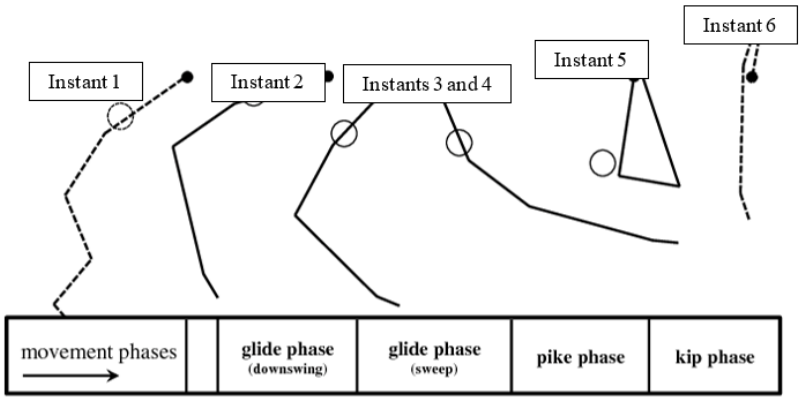
Methods

The description of Kip phases was made through integrative review, which allows using theoretical information and empirical data to produce a synthesis of a given topic[14]. The terms used to search for materials were kippe and biomechanics, in Portuguese and English, considering experimental and non-experimental studies at Google Scholar database. The following aspects were reviewed: a) General description of the Kip performed on the low bar; b) Qualitative analysis of Kip phases; c) Usual errors in the Kip.

Results

The Kip is an element in which, essentially, the gymnast moves from a suspended position under the bar to a support position with the bar at the waist level[15]. Kip starts with a complete glide under the bar to gain momentum, followed by the feet elevation towards the bar. It ends when the gymnast pushes the bar down with the elbows extended, raising the body to put the bar at the waist level[16] (Figure 1). In short, the most important feature is the post-active transmission of the swing, which is transferred from the lower to the upper part of the body[16].

Figure 1. Kip on the low bar[7].



The performance of the kip on the bar includes the following phases: a) start, with elbows extended under the bar; b) hip flexion, allowing the instep of feet to approach the bar; c) swing backward, in semi-inverted suspension; d) hip extension to achieve support[17–19]. Goeller[9] highlights the major participation of the hip flexors in the movement. The shoulder muscles are also highly requested[15].

In general, Kip is described as comprising four instants and three phases: Glide (downswing + sweep), Pike, and kip (or Pull up phase). Glide represents the swing under the device to obtain the required momentum, and the kip represents the movement to bring the body over the bars[16]. The glide phase refers to the displacement from instant 1 to 3 in Figure 1, when the gymnast glides forward under the bar with elbows and knees extended[15]. Mooney[10] and Arun et al.[6] claim that the hip shall remain backward at the beginning of the movement until it reaches a vertical position under the bar. The gymnast then performs a complete hip extension forwards and upwards, while keeping the legs extended[9] and shoulders close to the ears (Instant 4). The glide phase ends when the performer reaches the maximum height, with hips, knees, and ankles extended. During this phase, the gymnast produces the energy (momentum) needed to complete the kip. The greater the trunk extension, the easier the next phase[9]. A variation of phase 1 consists of adding a movement called *Upswing*[10] – in this case, the gymnast performs a skip back holding the bar before initiating the glide.

In Figure 1, the Pike phase corresponds to the transition between moments 4 and 5. After the complete extension of the body in the glide phase, the gymnast vigorously flexions the hips, bringing the feet up to the bar (Figure 1, moment 5). A reduction in the angle of the hip joint occurs[10], reducing the moment of inertia with a redistribution of body mass around the movement axis. A common mistake is to begin the pike phase too early, that is, before the full extension of the body in the Glide phase[16] – this reduces the momentum and makes it difficult to transfer the energy from the swing to complete the movement.

The Pull-Up phase refers to the transition between moments 5 and 6 (Figure 1). It is the final phase of the Kip, in which the gymnast inverts the trunk position on the bar. It begins with the angle reduction in the hip joint caused by the vigorous swinging of the legs upwardly, ending when the center of the shoulder joint is in line with the vertical drawn from the bar to the up. In other words, the gymnast moves from a suspension to a support position. During this phase, the hip is extended and moved upwards, elevating the body and consequently approaching the body's gravity center to the bar. This movement reduces the moment of inertia and allows the body to rotate until it reaches the frontal support position. During this movement, the gymnast pulls vigorously the bar, moving the legs forward and downward, while arms and shoulders rotate around the bar [10].

Usual errors in the kip are related to: glide to short, do no reach the pike, lower the legs too fast after pike and flexing the elbows in an attempt to end the movement. The gymnast starts Instant 3 before completing Instant 2, failing to obtain the maximum extension of the

body and therefore to take advantage of the momentum generated by the movement. On the other hand, the hyperextension of the column is also considered an error. Similarly, if the gymnast makes an incomplete movement on Instant 3, that is, the feet are not adequately moved towards the bar, the pull-up phase is performed incorrectly.

Lower the legs too fast after pike implicate that to assume the support position more quickly, the gymnast frequently flexes the elbows and projects the shoulders forwards. Ideally, the elbows should remain extended throughout the whole movement. Finally, flexing the elbows in an attempt to end the movement, to assume the support position more quickly, the gymnast frequently flexes the elbows and projects the shoulders forwards. Ideally, the elbows should remain extended throughout the whole movement.

Discussion

The main limitation of this study is related to the low number of studies that integrate biomechanical assessment with the teaching-learning process in gymnastics, as well as in the context of high-performance sport. The present study aimed to present a biomechanical qualitative analysis of the kip performed on the low bar of uneven bars based on literature and how this approach could be applied as a pedagogical tool. In this sense, the present study aims to act precisely in the gap between the biomechanical assessments as a tool in the teaching-learning process of artistic gymnastics movements.

The Kip is a fundamental skill for both beginners and experienced gymnasts, being part of training and competition routines[7]. It integrates sequences that the gymnast should master to the highest level for a successful transition to other more complex elements. However, biomechanical variations within gymnasts of different levels when completing this exercise seems to occur. Yamada et al.[20], for instance, compared the Kip performed on the horizontal bar by experienced gymnasts and beginners, concluding that differences occurred in crucial phases as the time to start the hip flexion, production of shoulder joint torque, and in the time to apply hip flexion torque.

In a very similar approach to our study, Aceski and Spasovska[11] compared kinematic characteristics in the joints of knee and hip during the Kip, between a top gymnast and Physical Education college students. The gymnast and students showed a very similar angle-time pattern of movement in the hip joint, but substantial differences in the knee joint, particularly in the fourth phase of the element. In regards to temporal characteristics, the movements performed by students were longer, albeit with a similar rhythm. The students also showed a different direction of swinging with their legs in the fourth phase. This information might serve coaches or teachers on how to improve the element performance. In agreement with our theoretical analysis, it is clear that each of the Kip stages has its key characteristics – in the case of the Physical Education students in the trial by Aceski and Spasovska[11], the most important instruction for learning the movement should refer to the knee joint within the fourth

phase.

Prassas et al.[21] listed some factors influencing the swing phase of the Kip, including the friction between gymnasts' hands and the apparatus and torque associated with individual body mass. In general, friction tend to delay the movement, while the torque from body mass dislocation determines the speed during the swing. The friction between hands and bar is in the opposite direction to the movement. The faster the turning speed, the greater will be the friction due to a stronger grip (*handgrip*), which may be a source of acute (e.g., blisters) or chronic (e.g., calluses) injuries. The use of palm protectors and chalk minimize the risks, but skin sprains can still occur due to protectors' leather strips. Teachers must observe the proper adjustment of protectors and the use of chalk to attenuate the friction during the exercise [22]. As for the body dimensions, shorter individuals show a mechanical advantage over taller counterparts of similar technical competence due to a lower moment of inertia throughout the movement axis [23]. This contributes to reaching faster speeds during the movement with lower friction.

A good example of how biomechanical analyzes might help to establish priorities in gymnastics training routines is the particular concern with the integrity of shoulders within the kip performance. During the Glide phase an axial tractive force occurs increasing the space between the humeral head and joint capsule, which predisposes to shoulder instability. To counteract this disengagement the gymnast applies force in the opposite direction. The Pull Up phase is another challenging phase for the shoulders, as it requires strength to support the legs after the feet are in contact with the bar and to pull the body up with the elbows extended[9]. Therefore, exercises to strengthen the stabilizing muscles of the shoulders are important to avoid injuries such as dislocations or subluxations[24].

In this sense, it is worth emphasizing the importance of original studies that investigate kinematic and kinetic parameters during the movement. Such aspects are extremely important for a better understanding of the characteristics of the movements, as well as the specificities of the individuals. The use of video-based kinematics or an inertial parameter system with surface electromyography, are essential to assess mechanical efficiency and movement control strategies, as well as to verify the muscular activation of the executed gestures.

In addition, the assessment of the kinetics of physiological variables (heart rate, oxygen consumption and rating of perceived exertion) in conjunction with biomechanical parameters would also be of great value for a better understanding of the demands of gymnastic movements. Studies involving physiological and biomechanical parameters are scarce in different sports, however these relationships are extremely important for training prescription.

Future studies should also attempt for importance of original studies that use biomechanics quantitative and qualitative assessment methods is pointed out to more accurately analyze the specificities of the kip in the bar, and at the same time enable the assessment by technicians and physical trainers. Thus, biomechanical assessment can be used appropriately in the daily training of athletes of different competitive levels, as well as guiding which components of physical fitness should be worked

on.

Conclusion

In the present study, we adopted a qualitative biomechanical approach to describe the characteristics, common errors, and risk of injuries related to the Kip performed on the low bar of uneven bars through a narrative review of the literature. Although there may be some divergence in the details of the movement, common errors are reported with a certain consensus in the literature. Further studies adopting this approach are warranted to provide gymnastic teachers with systematic didactic tools capable of supporting the teaching process of different techniques and exercises.

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