



Análise Comparativa Do Exercício Glute Ham Developer

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RESUMO

Introdução: O GHD (Glute Ham Developer) é um exercício recorrente em treinamentos e competições de modalidades Cross Training, estudos e análises cinemáticas deste movimento ainda são pouco encontradas na literatura. **Objetivo:** Analisar a cinemática do GHD e comparar a execução e ângulos de quadril e dos joelhos de dois voluntários, um experiente e outro novato na modalidade. **Método:** Um voluntário experiente e outro novato, mas fisicamente ativo, foram selecionados e tiveram suas frequências cardíacas de repouso aferidas. Foram convidados a executarem três movimentos no aparelho GHD, sendo que tais gestos foram acompanhados e filmados pelos pesquisadores. Após a execução do gesto a frequência cardíaca foi novamente aferida. Os vídeos foram analisados em software cinemático Kinovea e os resultados foram tabulados e comparados em software estatístico BioStat ($p < 0.05$). **Resultados:** A cinemática do GHD preconiza movimento de flexão do quadril e hiperextensão desta articulação. Os praticantes realizaram movimentos compensatórios com a articulação do joelho para auxiliar na flexão do quadril. **Conclusão:** O GHD é um movimento complexo que envolve os músculos iliopsoas, eretores da espinha, reto femoral, isquiotibiais e reto do abdome por meio de variações das articulações que estes músculos se fixam ou passam. O movimento deve ser previamente ensinado por meio de educativos e o devido fortalecimento dos músculos envolvidos também deve ocorrer, principalmente em indivíduos iniciantes.

Palavras-chave: Exercício, CrossTraining, Movimento, Cinemática, Esporte.

ABSTRACT

Introduction: GHD (Glute Ham Developer) is a recurrent exercise in training and competitions in Cross Training modalities, studies and cinematic analyzes of this movement are still little found in the literature. **Objective:** To analyze the kinematics of the GHD and compare the performance and angles of the hips and knees of two volunteers, one experienced and the other novice in the sport. **Method:** An experienced volunteer and another novice, but physically active, were selected and had their resting heart rates measured. They were invited to perform three movements on the GHD device, and these gestures were monitored and filmed by the researchers. After performing the gesture, the heart rate was measured again. The videos were analyzed using Kinovea kinematic software and the results were tabulated and compared using BioStat statistical software ($p < 0.05$). **Results:** the kinematics of the GHD recommends hip flexion and hyperextension of this joint. Practitioners performed compensatory movements with the knee joint to assist with hip flexion. Exercise can offer risks of disc injuries to the intervertebral discs, due to the tension load present during and hyperextension. **Conclusion:** GHD is a complex movement that involves the iliopsoas muscles, erector of the spine, rectus femoris, hamstrings and rectus abdominis through variations of the joints that these muscles act. The movement must be previously taught through education and the due strengthening of the involved muscles must also occur, mainly in beginners, considering the inherent risk of injuries resulting from the movement.

Keywords: Exercise, CrossTraining, Moviment, Kinematic, Sports.

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INTRODUÇÃO

The practise of physical exercises has been increasing in recent years, given the scientific reinforcement of positive effects on the control of chronic non-communicable diseases and psychological diseases. Among the most practised modalities, resistance training appears as the protagonist of this scenario.

Resistance training consists of executing movements, usually repetitive, against resistance, which can be a washer, rubber bands, bars, dumbbells or even the practitioner's body weight⁽¹⁾. There are several modalities within this training segment, with Cross Training being one of the most practised and sought after by the population.

Cross Training has substantially increased its visibility in the last twenty years, mainly in developing countries, such as Brazil. The training routine of this modality consists of jumping movements, squats, lifting, barbells, push-ups and various abdominal exercises⁽²⁾. There are even national and international competitions among franchise practitioners in this training segment, being televised worldwide and accompanied by thousands of supporters of the sport.

Abdominal exercises are among the pillars of a training program and are frequently developed and applied to Cross-train practitioners^(1,2). Adequate strengthening of the anterolateral abdomen wall, as well as the balance between the deep muscles of the

posterior abdominal wall, can generate in the practitioner more capacity for lifting loads, in addition to a substantial reduction of lesions in the lumbar region of the spine and umbilical hernias and inguinal⁽³⁾. This fact can be observed in the relationship made by Ghaderi who identified that individuals with properly conditioned abdominal walls had lower rates of low back pain without an apparent aetiology⁽⁴⁾.

In this sense, equipment is developed by manufacturers specialized in this modality to generate positive overloads that stimulate strengthening of the abdominal region, as well as other body areas, in a varied, fun, challenging and effective way. Among the equipment most used by Cross Training practitioners, the GHD (Glute Hamstrings Developer in abbreviation), is widely practised, used in international level competitions and challenging execution.

GHD consists of equipment that stimulates, by eccentric and concentric contractions, the muscles involved with trunk extension, hip flexion, and spinal stabilization. The movement performed on the machine for the stimulation of the anterolateral abdomen wall requires adequate fixation of the practitioner's feet on the appropriate location, proportional adjustment to the ischial tubule of each pelvic bone so that a favourable gesture lever is made, and stabilization of the spine during the movement⁽⁵⁾.

Despite being an exercise widely practised in Cross Training environments and

international competitions of this modality, the GHD as an exercise, is still little studied, a fact that makes it difficult to assert this movement by professionals working in this segment of training. Thus, the objective of the present study is to analyze the kinematics of the GHD exercise by comparing the movements performed by an experienced individual with the movements performed by an inexperienced individual in the modality, however, physically active.

METHODS

Experimental study design and selection of participants

Two individuals selected for accessibility criteria were recruited and previously informed about the objectives, development and interests of scientific research. They signed the Informed Consent Form, which belongs to the approved protocol of the research ethics committee of the Escola Superior de Educação Física of Jundiaí, São Paulo / Brazil (protocol number: 4095.924). It is also observed that the entire experimental procedure strictly followed the Helsinki declaration signed in 1964 by the World Medical Association. Participants were also instructed that they could give up scientific research at any time, without this representing physical damage, concerning the researchers or psychological.

One of the individuals was considered experienced in the Cross Training modality, has been practising for more than two years

(without interruption) and competing in regional and national events, in addition to not using any medication or ergogenic substances. Another individual was considered a novice in the Cross Training modality, not being a practitioner of this modality, however physically active and also exempt from the use of substances and medications that could offer better performance in the analyzes.

The experimental protocol consisted of previously assessing the resting heart rate of the two subjects in this case study, for which each participant was asked to wake up in the morning to position the heart rate sensor (POLAR H10) on the thoracic region and inform the researchers the frequency values shown on the watch/cell phone display paired with the sensor.

Before the exercise analysis, the volunteers were invited to a local warm-up, with ballistic movements of light to moderate intensity. Sequentially, the volunteers were asked to position themselves, one at a time, on the GHD device, with an accent height of 108 cm. The volunteers' feet were properly positioned on the specific supports and it was asked if they felt comfortable on the device, if the answer was affirmative, it was recommended that they perform three movements on the GHD device, being filmed by a 48MP camera (XIOMI®, Redmi 8) at a distance of 215cm from the volunteer on the device. The movements were standardized so that the

participants initiated the gesture of the exercise with hip flexion and performed the movement in the maximum amplitude they could reach, however recommending the due care to avoid the development of musculoskeletal injuries. After performing three movements, the volunteers again had their heart rate measured by the researchers, using the same equipment described previously.

The regions marked for verifying the angles were the spine, greater trochanter of the femur, epicondyle of the lateral condyle of the femur, lateral malleolus, the central region of the patella, centre of the deltoid, acromion, body of the clavicle, seventh cervical vertebra and external occipital protuberance.

Image analysis and statistical treatment

The images obtained from the individuals were treated and analyzed using

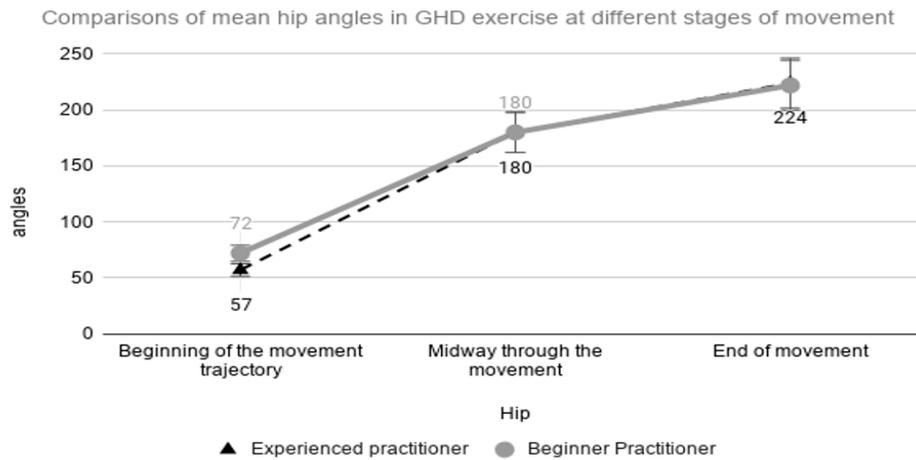
Kinovea® software (version 0.8.15). The results of the angles were transcribed to the BioStat statistical analysis software (version 5.0) and the data graphs were prepared using the Google Sheets software. The statistical treatment used initially was a descriptive analysis verifying the averages of central tendency, sequentially the ANOVA one way test with the post-t-student test was applied assuming $p < 0.05$ for the variables analyzed (hip angles and knee angles during the initial phase, average and end of the exercise path).

RESULTS

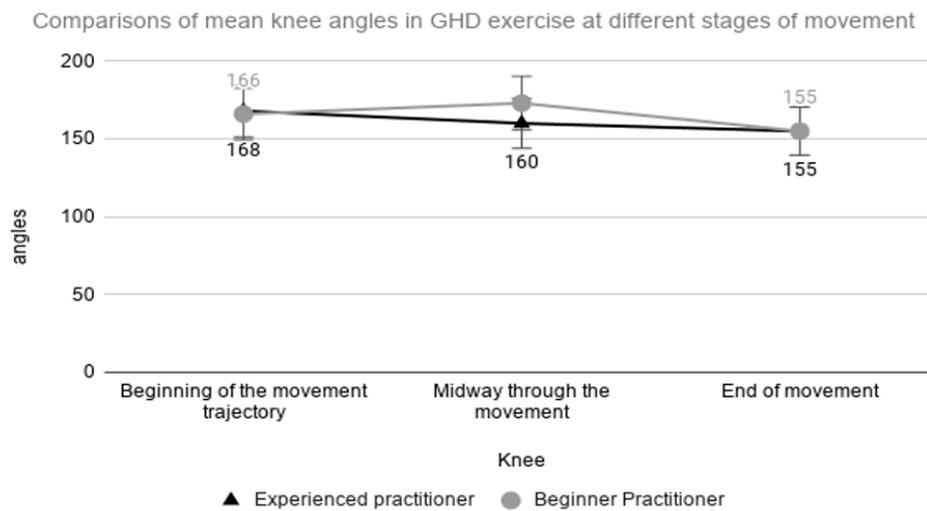
Initially, the result of the heart rate variation of the individuals in this study will be presented (graph 1). Afterwards, the graphs of mean variations of the hip and knee angles of the individuals will be presented.



Graph 1: Variation in heart rate of individuals before and after the execution of the GHD. δ indicates the delta of the variation.



Graph 2: Variation of the volunteers' hip angles during the execution of the movement. Comparison between the experienced individual and the novice individual in the sport. * indicates $p > 0.05$.



Graph 3: Variation of the knee angles of the volunteers during the execution of the movement. Comparison between the experienced individual and the novice individual in the sport.

Figures 1 and 2 shows the experienced and novice individual, respectively, performing

the movement on the GHD device. The images were analyzed using the Kinovea® software.

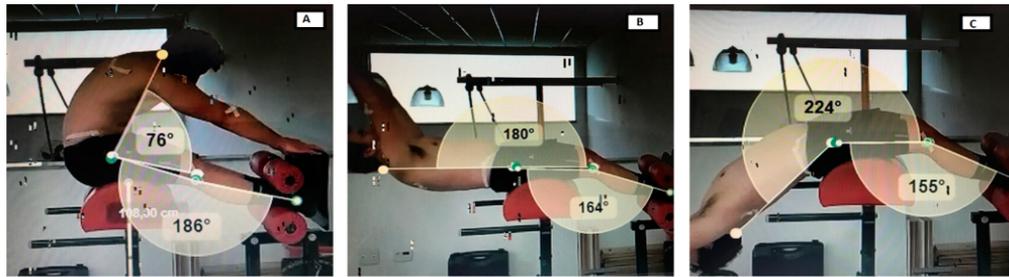


Figure 1: Experienced practitioner running the GHD. Analysis by Kinovea® software.



Figure 2: Novice individual running the GHD. Analysis by Kinovea® software.

DISCUSSION

The hip flexion movement is a gesture that few animals on the zoological scale can perform. This gesture, which consists of a reduction in the angle of the hip joint, is provided by a thick muscle called iliopsoas⁽⁶⁾, with origins in the vertebral bodies, accessory processes of the transverse processes, intervertebral discs from T12 to L4, as well as a portion which originates in the iliac fossa of the ilium wing. The insertion of this large muscle occurs in the lesser trochanter of the femur. The innervation of the iliopsoas is done by anterior branches of the lumbar nerve roots, as well as by the femoral nerve (the iliac portion of the muscle). Iliopsoas preferentially contributes to hip flexion, however, it is also an

important muscle that acts in the swing phase of the lower limb during the individual's gait⁽⁶⁾. The pectineus and rectus femoris muscle also contribute to hip flexion, given its origins in the pubis and anteroinferior iliac spine and an area below, close to the acetabulum limbus, respectively.

It is noticed that the hip flexion gesture is a fundamental movement in the GHD exercise, analyzed in this study. The movement consists of extensions, which can reach hyperextensions (as shown in Figure 2) and hip flexions. This movement is also observed in other abdominal exercises, such as the declined abdominal and the suspended abdominal. However, the originality of GHD is mainly due to the importance of the practitioner in

keeping the spine properly extended, an action made by the erector muscles of the spine⁽⁷⁾.

The erector muscles of the spine (iliocostal, spinal and very long) originate in the posterior portion of the iliac crest and the dorsal aspect of the sacrum. They follow the cranial direction, fixing along the vertebral groove (spinal), the transverse processes of the vertebrae (very long) and the angles and tubercles of the ribs (iliocostal). Its innervation is quite heterogeneous, being made by the anterior branches of the spinal nerves along the spine. The action of these muscles is to support the upright spine, that is, its extension⁽⁷⁾.

During the execution of the movement, the extension of the spine must be maintained mainly in the eccentric phase of the gesture performed on the GHD, a fact that recruits too much the fibres of the erector muscles of the spine, with predominantly glycolytic and oxidative metabolic (type I or type IIa)⁽⁸⁾, and prescriptions of strength exercise for this musculature do not give satisfactory results and local pain may develop, especially in the lumbar region^(9,10).

It is noticed that the hip movement during the GHD exercise reaches amplitudes of hyperextension. The fact that could lead to progressive disc injuries - for example, low back pain, radiculopathy and spondylolysis^(11,12) -, if the subject does not have adequate professional monitoring and strengthening of the anterolateral abdomen wall, in addition to

a balance of the surrounding muscles^(4, 13).

The GHD exercise also promoted some changes in the knee angles of both individuals evaluated. The fact that correlates the kinematics of the gesture with the knee flexion and extension movement, thus trying, through the activity of the hamstring muscles and the femoral rectum, given the origin of these being in the hip and its insertions after the femorotibial joint surfaces and patellofemoral, to assist the hip flexion movement and return to the initial moment of the movement⁽¹⁴⁾. It is observed that the rectus femoris, in addition to being an important knee extensor, is also an aid to hip flexion, given its origin in the anteroinferior iliac spine and on the surface just below this ileum accident. However, the high activity of the rectus femoris during exercise causes a greater shear force in the lumbar region, not being indicated for individuals with pathologies of the lumbar disc, low back pain, instability or weak abdominal muscles⁽¹⁴⁾.

Other researchers observed that the trunk flexion movement, an adequate stimulation of the rectus abdominis muscle (with origins in the costal cartilages of the 5th to 7th rib and the xiphoid process of the sternum and insertion in the pubic tubercle and the pubic symphysis, innervated by the thoracoabdominal nerves and with trunk flexion action) is preferably active when the individual's hip is stabilized, and in case of elevations of the hip or lower limbs, the

iliopsoas muscle would also be active and contributing to the execution of the movement⁽¹⁵⁾. Such results expressed by this case study and compared with the current scientific literature, suggest that GHD predominantly stimulates the erector muscles of the spine and also the iliopsoas, however, due to the condition of stabilization of the hip at the same level of the lower limbs, it can be inferred that the rectus abdominis muscle is also involved with the concentric movement of this exercise⁽¹⁵⁾, a fact that makes it highly versatile and of advanced complexity.

Thus, it can be seen that the prescription of this GHD exercise, at least in what was observed in this study, will be better used in advanced or experienced individuals in the modality, even if the beginners have been physically active or have practised other sports for some time. because of the need for prior knowledge about the movement for an adequate execution of the exercise. It is also observed that the variations in the hip angles during the gesture recommend an intense activity of the erector muscles of the spine and hip flexors, a fact that must be carefully monitored by the professional who prescribes this movement, because in case of recurrent hyperextensions of the spine and weakened abdominal muscles, progressive disc injury may occur.

CONCLUSION

The GHD exercise, used in cross-training and competitions of this modality,

is a complex movement, involving different muscle groups in different phases of the exercise. The previous strengthening of the anterolateral abdomen wall as well as a control of the extensor muscles of the spine is predetermining factors for the prescription of this exercise, because of the risk of developing progressive disc injuries due to the high degree of hyperextension amplitude. In addition to the activation of the abdominal muscles, erector of the spine and iliopsoas, other auxiliary muscles in hip flexion - such as rectus femoris and hamstrings - are included, an aspect observed through the angular alteration of the knees. Thus, it is an exercise that requires both a specific body awareness for this movement and careful attention from the responsible professional, to prevent any injuries resulting from the performance and conditioning of the student.

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