Review of the Literature

THE RELATIONSHIP BETWEEN THE BARBELL HIP THRUST AND SPRINT PERFORMANCE IN SPORT

Peter J Mamo

Randwick, Sydney, Australia

4/81-83 Gilderthorpe Ave, Randwick – 0410381364 – peterjmamo@gmail.com

BLUF

The barbell hip thrust can significantly improve sprint performance over 10m – 40m distances in sport, with the appropriate periodised programming according to training age and athlete level.

ABSTRACT and KEY WORDS

The barbell hip thrust has historically been associated with the aesthetics of mainstream strength training; however in recent years owed to recent studies, this exercise has began to gain respect amongst coaches and athletes looking to improve sprint performance. The purpose of this review was to investigate the relationship between the barbell hip thrust and sprint performance in sport. Also this review looked to resolve what is the most effective approach of incorporating the barbell hip thrust in order to improve sprint performance at most levels of sport. A literature search was completed using Google Scholar database using keywords, which resulted in eleven key studies being included in this review. From the combined outcomes of these studies, a number of conclusions can be made. Increased strength and power in the barbell hip thrust exercise leads to improved sprint performance over the initial acceleration phase up to 40 metres, especially in athletes with a small training age. Anteroposterior-based exercises, specifically the barbell hip thrust are related to the initial phases of sprinting, more so than vertically directed exercises. Barbell hip thrust training with 60%-80% RM loads for 2-6 sets and 3-6 repetitions once a week can improve sprint times. Strength and conditioning professionals should consider employing the barbell hip thrust into periodised training plans to develop sprint performance.

Key Words - Sprint performance, barbell hip thrust, horizontal force, and sport.

INTRODUCTION

Historically the application of the barbell hip thrust has received much attention for purposes related to the hypertrophic development of the gluteus maximus muscle [8]. This was first published in an article led by Bret Contreras who is well known for promoting the exercise [8]. Traditionally many sprint coaches have resisted the practice of strength training to improve an athlete's performance but eventually began to include it in their programming [18]. Eventually the back squat was perceived as the exercise to display the most transfer to sprinting. The barbell hip thrust in recent times has faced similar opposition by current sprint and strength coaches in developing sprint performance in athletes. Possibly because there is a better understanding for utilising the barbell hip thrust as mentioned above to increase gluteal muscle mass and also as a supplemental exercise to develop gluteal strength in order to enhance the back squat, deadlift in powerlifting [9].

Sprint performance is a vital characteristic in most sports specifically for field-based athletes [16]. It can in many cases determine the outcome of game situations for teams, and be the difference in making the final squad, not to mention affect the potential income for athletes [20]. Strength and conditioning professionals are always looking to enhance athlete sprint performance, however research to date has been mixed in the relationship between the barbell hip thrust and sprint performance.

Strength relative to body mass and power is a contributing factor to sprint performance particularly over the initial acceleration phase and velocity (through 18.3m) [10]. Wisloff and colleagues found strong correlations between 1 RM squat and 10m-sprint time and 30m-sprint time in elite soccer players [11]. Seventeen players had their 1 RM half squat tested and recorded this was then compared to 10m and 30m sprint times three days later with strong links [11]. Comparably, a relationship between power and sprint performance have been shown in a broad range of field sports with the application of the hang power clean and sprint time over 20m [12]. Hori and others found significant correlation with 1RM hang power clean relative to the subject's body mass, 1RM front squat relative to the subject's body mass, and time in the 20-m sprint amongst other exercises (r = 0.51–0.60) [12].

In turn for athletes to sprint efficiently, well-developed gluteal muscles are understood to be an advantage [8]. Consequently the regular training of the loaded barbell hip thrust a hip extensor exercise is shown to enhance strength and maximise gluteus hypertrophy [8]. Recent literature supports the importance of horizontal ground reaction force production for sprint acceleration performance [13]. Morin and colleagues found numerous authors consistently reported that the ability to orient the resultant ground reaction force vector forward thus producing high amounts of net horizontal ground reaction force throughout the sprint was the strongest predictor of acceleration and sprint performance in subjects ranging from recreational to world-class sprinters [13].

Sprint performance is an attribute that should be well developed especially to play at an elite level and is one of the elements that are associated with effective playing performance [14]. Improving sprint performance therefore results in positive sporting outcomes hence meticulous thought into how to appropriately develop and structure lift programs that support an increase in sprint performance needs to be established. The purpose of this article is to review the literature to assess the relevant research related to the barbell hip thrust and sprint performance in sport, also to determine how coaches can effectively program.

METHODS

A literature search was performed using Google Scholar databases from 2011 to 2020 in order find relevant articles to include in this review. The standard literature search was conducted using the search terms 'hip thrust sprint sport' and 'barbell hip thrust sprint performance' in the title of the article. This resulted in some 1,200

matches, which were sorted by relevance many of which did not meet the specific criteria. This criterion included 1) the use of the barbell hip thrust, 2) for weight training, 3) its relationship with sprint performance and 4) any athlete types.

Articles were sorted by relevance this was followed by a further manual review conducted by the author ensuring suitability examining the abstract and content this led to many articles being omitted from this review as they a) did not include the barbell hip thrust, b) did not observe sprint performance or c) did not involve athletes. The remaining articles from the search were brought together. The articles were studied and those with relevant practical applications relating to the relationship between barbell hip thrust and sprint performance in sport were included. A total of eleven original key articles/studies are included in this review.

DISCUSSION

The barbell hip thrust is useful for athletes that rely on powerful hip extension movements as well as sprinting speed and acceleration and deceleration [9]. The direction of the resistance force vector relative to the body appears to play a role in transference to sprint performance. [2,3,5,6,13]. However with many influencing factors that can effect the connection of the barbell hip thrust to sprinting performance it is essential to take a deeper look at the literature.

Mechanics of the Barbell Hip Thrust

The barbell hip thrust exercise originally promoted by Contreras and colleagues was primarily endorsed for its use in encouraging hypertrophy of the gluteal muscles [8]. The technique is characterized by increasing the resistance with a barbell across the hips during a bridging exercise [8]. The exercise can be used to maximise gluteal muscle activation, develop end-range hip extension strength in the gluteus maximus musculature and increase horizontal force production [8]. A 2019 review by Neto and others found the mechanics of barbell hip thrust favours greater activation of the hip extensor muscles compared to more conventional exercises [19]. The article led by Contreras identified that the primary hip extensors (gluteus maximus, hamstrings, and hamstring part of adductor magnus), secondary hip extensors (adductors and posterior fibers of gluteus medius and gluteus minimus), posterior vertebral stabilizers (erector spinae), and knee extensors (rectus femoris and vastus muscles) were the muscles used during this exercise [8]. The same study went on to find that this bent-leg, horizontally loaded hip extension exercise decreases hamstring contribution to hip extension through active insufficiency increasing the contractile requirements of the gluteus maximus musculature [8]. Neto and others [19] found that neuromuscular activation in the hip extensor muscles (gluteus maximus and biceps femoris) demonstrated greater activation in the barbell hip thrust compared to the squat. Also regardless of the exercise variation and intensity used, the muscle excitation sequence is gluteus maximus, erector spinae, biceps femoris, semitendinosus, vastus lateralis, gluteus medius, vastus medialis and rectus

femoris.

In a nutshell, the barbell hip thrust begins in a seated position, set up with feet shoulder-width apart, knees flexed to slightly less than 90 degrees and upper back leaning against a stable flat bench. With the gluteus maximus on the floor the barbell should be placed just below the anterior superior iliac spine. The loaded barbell should be padded because of the pressure that the loaded barbell will place on the hip musculature and other structures. Arms should be shoulder-width apart with the hands gripping the barbell holding it in place.

Figure 1. Starting Position [9]

Breathe in and exhale while extending at the hips and focus on contracting the glutes to bring the body off the ground. At this point the upper back should act as a pivot point, keep the feet flat on the floor with the head and spine neutral during the movement. Extend the hips until full extension or torso is parallel to the floor.

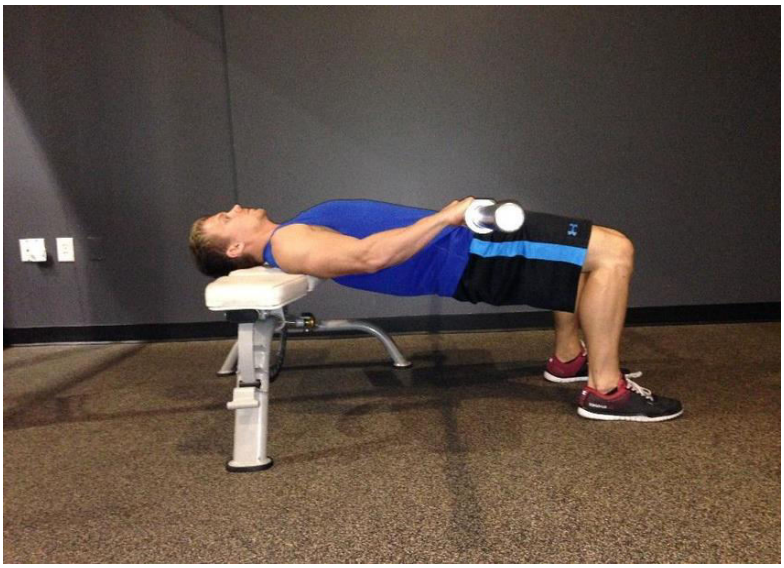

Figure 2. End Position [9]

Breathe in while slowly bending at the hips and slightly flexing at the knees. Continue to bend at the hips and knees until the original starting position is obtained and the gluteus maximus is just above the floor [9].

Horizontal Force and Sprint Performance

Being able to apply the correct amount of force in the appropriate direction at the correct time is critical to developing sprinting performance. The relationship between horizontal force, barbell hip thrust and sprint performance has been stated in a number of articles. Loturco and Contreras [5] found that athletes with the primary objective of developing speed qualities more related to the initial phases of sprinting may consider the use of horizontally-directed (anteroposterior) exercises, specifically the barbell hip thrust, over the use of vertically-directed exercises like the squat. Results indicated that the hip-thrust is more associated with the maximum acceleration phase (from zero to 10-m; r = 0.93) [5].

Abade and colleagues [2] stated that training routines must consider the direction of force application, particularly when strength exercises are performed. 24 players were randomly assigned to a control, vertical or horizontal force training group and performed a general strength training while vertical and horizontal force groups additionally performed barbell half squats and barbell hip thrusts, respectively. The program progressed as follows: Weeks 1–7, 3 sets 10–8RM; Weeks 8–14, 3 sets of 8–6RM; and Weeks 15–20, 3 sets of 4–6RM. After 20 weeks small improvements (likely) were observed in 10m-sprint test for vertical group, while the horizontal group presented a moderate effect (very likely). The same trend was revealed for the 20m-sprint test [2].

Williams and colleagues [3] found that although ground reaction force was lower, peak EMG activity in the gluteus maximus was higher in the hip thrust than in the back squat (p = 0.024; 95% confidence interval [CI] = 4–56% MVIC) and split squat (p = 0.016; 95% CI = 6–58% MVIC). Peak sprint velocity correlated with both anteroposterior (horizontal force) (r = 0.72) and peak ground reaction force during the barbell hip thrust (r = 0.69) but no other variables. Given that maximal sprint speed correlated with horizontal force production but not vertical production, using exercises that develop force in the horizontal plane may provide superior transfer to sprint based performance [3].

This may suggest that force production during the barbell hip thrust may be associated with sprint performance in team sport athletes. Furthermore, anteroposterior-based exercises, such as the barbell hip thrust, may be more effective for improving maximal sprint speed compared to the back squat and split squat, due to the increased activation of the gluteus maximus [3]. Contreras and others [6] reported that a 6-week training block consisting of two control groups, one using the barbell hip thrust and the other using the front squat led to very likely beneficial effects (D = 21.67%; d = 1.14 [0.67–1.61]) observed for 20-m sprint time

with the barbell hip thrust group, while unlikely beneficial effects were observed in the front squat group (D = 20.66%; d = 0.19 [20.34 to 0.72]). In addition to lower-body training, both groups performed upper-body and core exercises. The repetition scheme used for hip thrusts and front squats were as follows; week 1, 4 sets 12 repetitions, week 2-3, 4 sets 10 repetitions, week 4-5, 4 sets 8 repetitions, week 6, 4 sets, 6 repetitions.

Consequently horizontally force exercises like the barbell hip thrust must not be eliminated during maximal speed phases, while (in theory) vertically force exercises should be prioritised [5].

Barbell Hip Thrust for Strength

Research studies [15, 16] have found that not only is lower body strength correlated with sprint performance but also increases in lower body strength have a positive transfer effect to sprint performance. This means that if athletes are stronger in exercises such as the squat, they will sprint faster, and if they have not previously done any lower body resistance training and start participating in this type of training, then athletes sprint times will improve. Overall, the reported improvement in sprint performance (sprint ES = -0.87, mean sprint improvement = 3.11 %) resulting from resistance training is of practical relevance for coaches and athletes in sport activities requiring high levels of speed [15]. Vallance found that increased strength in both the back squat and hip thrust movements could be related to increased sprint performance and, in the case of the hip thrust movement, increased acceleration performance [1]. Significant correlations were observed between all sprint speed measures (10-yard, 20-yard and 40-yard) and hip thrust strength. Only 40-yard dash time, but neither of the two splits, correlated with relative back squat strength ($_{\rho}$=-.576, p=.001)

In a more recent study Abade and colleagues [2] also found when youth football players were put into two groups being a back squat and hip thrust group. During 20-week in-season strength training program the horizontal group (hip thrust) showed unclear results in vertical jump; however, large improvements were observed in horizontal jump (most likely, 13.0; ±4.8%), 10 m and 20 m sprints (very likely −3.0; ±1.8% and most likely −3.8; ±1.0%, respectively). However an 8-week randomised controlled study by Jarvis and others [7] suggested that increasing maximum hip thrust strength through the use of the barbell hip thrust does not seem to transfer into improvements in sprint performance in collegiate level athletes.

Furthermore Contreras and others noted that because of the increased muscular tension throughout the full range of motion, the hip thrust exercise would theoretically heighten the hypertrophic stimulus for the gluteal muscles and thus increase strength and power potential because of the relationship of these factors to muscle cross-sectional area [8]. Also the exercise can be used to maximise gluteal muscle activation, develop end-range hip extension strength in the gluteus maximus musculature, increase horizontal force production, and increase the contribution of

the gluteus maximus relative to the hamstrings during hip extension movement, which may decrease the risk of hamstring injuries [8].

However Fitzpatrick during a 2019 study [17] on the force-vector theory took eleven collegiate female athletes aged 18⁻24 years and completed a 14-week hip thrust training programme. Subjects improved their 3-repetition maximum hip thrust performance by 33.0% ($d = 1.399$, $p < 0.001$, $\eta^2 = 0.784$) and their vertical and horizontal jump performance (improvements ranged from 5.4⁻7.7%; $d = 0.371^{-}0.477$, $p = 0.004$, $\eta^2 = 0.585$). However, there were no differences in the magnitude of the improvement between horizontal and vertical jumping ($p = 0.561$, $\eta^2 = 0.035$). This is could be correlated with its influence on sprint acceleration outcomes.

Barbell Hip Thrust for Power

Historically power exercises involve the Olympic lifts and derivatives, plyometrics and medicine ball throws. Eckert and Snarr found that competitive sports that can benefit from incorporating the barbell hip thrust into their training programs include basketball, sprinting, football, as well as power and Olympic weightlifters [9]. Also when using power exercise prescriptions developed by the National Strength and Conditioning Association (with 60%-80% RM loads for 2-6 sets and 3-6 repetitions) that the barbell hip thrust is useful for athletes that rely on powerful hip extension movements as well as sprinting speed and acceleration and deceleration [9].

Dello-Lacono and colleagues [4] research showed positive correlations with eighteen elite male soccer athletes between the barbell hip thrust's 1RM and power values. It was also found that both heavy-loaded and optimum-power hip thrust exercises can induce a post-activation potentiation (PAP) response (acute effects) improving short sprint time, with the optimum-power development protocol preferred due its higher efficiency [4]. When data were pooled for each individual athlete, the BHT-relative peak power scores were highly and very highly correlated to the same overall changes in performances over 5 m ($r = 0.735$, $P < 0.01$), 10 m ($r = 0.535$, $P = 0.02$) and 20 m ($r = 0.549$, 350 $P = 0.02$) [4]. It is feasible that a positive effect could result from power training protocols used in conjunction with the barbell hip thrust.

The 2019 review article led by Neto concluded using the barbell hip thrust even with lighter and submaximal loads at maximum velocities could improve sprint times [19]. Current evidence may look favourable however further studies within elite sport populations are required to assess if power-training prescriptions using the barbell hip thrust have a positive impact on sprint performance.

CONCLUSIONS AND PRACTICAL APPLICATIONS

This review has considered the qualities of the barbell hip thrust relating to sprint performance in sport. Coaches should consider these findings when programming for athletes during different phases of the annual training plan. Overall this review

expressed that an upturn in strength and power within the barbell hip thrust is significantly related to improved sprint performance predominantly over the early acceleration phase up to distances of 40m. This is particularly evident in younger athletic populations whereby an improvement in strength in hip extension, similar to that seen in the barbell hip thrust will most likely transfer to enhanced sprint performance.

It has been established that the barbell hip thrust supports the larger activation of the extensor muscles of the hip compared to traditional exercises. This increased activation of particularly the gluteus maximus would imply a relationship with maximal running speed, especially useful in novice and intermediate athletes in order to get muscles firing more like that of an elite athlete. This reinforces that increased strength and activation in the barbell hip thrust exercise results in increased acceleration performance.

On the other hand, it seems plausible that barbell hip thrusts with 60%-80% RM loads executed at a maximal bar speed amongst athletes with a strong base of hip extensor strength (elite athletes) would be able to enhance sprinting ability by increasing the ability of the gluteus maximus to exert force at a high-velocity. This ideally would be performed for 3-5 repetitions of 3-6 sets programmed once a week.

This means that heavy barbell hip thrusts, which involve very slow velocities, may not be ideal for continual sprint development for elite athletes as it may prevent the development of explosive strength (power). Hence elite athletes may benefit from using sub-maximal loads that are in line with maximal bar speeds, in order to improve sprint times however further investigations are needed. This review supports that horizontally directed exercises like the barbell hip thrust is a reliable tool that can be used for improving sprint performance over 10m – 40m distances, the importance of performing both vertical and horizontal force-vector exercises to enhance overall sprint performance is emphasised.

Strength and conditioning professionals may look to prescribe a training program employing the barbell hip thrust to improve sprint performance by increasing hip extensor activation, strength and muscle hypertrophy. Dependent on training age, level of athlete and the time of year the coach should aim to seamlessly integrate different training qualities (hypertrophy, strength and power) into their annual training plan to continue to encourage sprint performance development. Future studies are needed in elite athletes and other populations, as these findings cannot be concluded. It is strongly recommended that vertically directed exercises (squat, vertical jump) should not be eliminated from training programs, considering the later sprint phases and their significant relationships throughout the different sprinting distances.

REFERENCES

1. Vallance, S.R. The Relationship Between Maximal Strength and Performance Measures: A Correlational Study. **University of Stirling.** 2017.

2. Abade, E., Silva, N., Ferreira, R., Baptista, J., Gonçalves, B., Osório, S., Viana, J.L. Effects of Adding Vertical or Horizontal Force-Vector Exercises to In-season General Strength Training on Jumping and Sprinting Performance of Youth Football Players. **Journal of Strength and Conditioning Research.** 10.1519.3221. 2019.

3. Williams, M.J., Gibson, N., Sorbie, G.G., Ugbolue, U.C., Brouner, J., Easton, C., Activation of the Gluteus Maximus During Performance of the Back Squat, Split Squat, and Barbell Hip Thrust and the Relationship With Maximal Sprinting. **Journal of Strength and Conditioning Research.** 10.1519.2651. 2018.

4. Dello Lacono, A., Seitz, L.B. Hip thrust-based PAP effects on sprint performance of soccer players: heavy-loaded versus optimum-power development protocols **Journal of Sports Sciences.** 36(20):2375-2382 2018.

5. Loturco, I., Contreras, B., Kobal, R., Fernandes, V., Moura, N., Sigueira, F., Winckler, C., Suchomel, T., Pereira, L.A. Vertically and horizontally directed muscle power exercises: Relationships with top-level sprint performance. **Plos One.** 13(7) 2018.

6. Contreras, B., Vigotsky, A.D., Schoenfeld, B.J., Beardsley, C., McMaster, D.T, Reyneke, J.H.T, Cronin, J.B. Effects of a Six-Week Hip Thrust vs. Front Squat Resistance Training Program on Performance in Adolescent Males: A Randomized Controlled Trial. **The Journal of Strength and Conditioning Research.** 31(4):999-1008. 2017.

7. Jarvis, P., Cassone, N., Turner, A., Chavda, S., Edwards, M., Bishop, C., Heavy barbell hip thrusts do not effect sprint performance: an 8-week randomized controlled study. **Journal of Strength and Conditioning Research.** 33(7S): S78–S84 2019.

8. Contreras, B., Cronin, J., Schoenfeld, B., Barbell Hip Thrust. **Strength and Conditioning Journal.** 33 (5): 58-61. 2011.

9. Eckert, R.M., Snarr, R.L. Barbell Hip Thrust. **Journal of Sport and Human Performance.** 2 (2): 1-9. 2014.

10. Brechue, W.F., Mayhew, JL., Piper, F.C., Characteristics of sprint performance in college football players. **Journal of Strength and Conditioning Research.** 24(5): 1178. 2010.

11. Wisloff, U., Castagna, C., Helgerud, J., Jones, R., Hoff, J. Strong correlation of maximal squat strength with sprint performance and vertical jump height in elite soccer players. **British Journal of Sports Medicine.** 38:285-288. 2004.

12. Hori, N., Newton, R., Andrews, W.A., Kawamori, N., McGuigan, M.R. Does performance of hang power clean differentiate performance of jumping, sprinting and changing of direction? **Journal of Strength and Conditioning Research.** 22(2):412-418. 2008.

13. Morin, J.B., Gimenez, P., Edouard P., Arnal, P., Jimenez-Reyes, P., Samozino, P., Brughelli, M., Mendiguchia, J., Sprint acceleration mechanics: The major role of hamstrings in horizontal force production. **Front Physiol.** 26;6:404. 2015.

14. Gabbett, T.J., Jenkins, D.G., Abernethy, B., Relationships between physiological, anthropometric and skill qualities and playing performance in professional rugby league. **Journal of Sports Sciences.** 29(15):1655-1664. 2011.

15. Seitz, L.B., Reyes, A., Tran, T.T., Saez de Villarreal, E., Haff, G.G., Increases in lower-body strength transfer positively to sprint performance: a systematic review with meta-analysis. **Sports Med**. 44(12):1693-702. 2014.

16. Baker, D., Nance, S., The relation between running speed and measures of strength and power in professional rugby league players. **Journal of Strength and Conditioning Research**. 13(3):230-5. 1999.

17. Fitzpatrick, D.A., Cimadoro, G., Cleather, D., The Magical Horizontal Force Muscle? A Preliminary Study Examining the "Force-Vector" Theory. **Sports (Bassel).** - 22;7(2). 2019.

18. Kraemer, W.J., Duncan, N.D., Volek, J.S., Resistance Training and Elite Athlete: Adaptations and Program Considrations. **Journal of Orthopaedic & Sports Physical Therapy**. 28(2); 110-119 1998.

19. Neto, W.K., Vieira, T.L., Gama, E.F., Barbell Hip Thrust, Muscular Activation and Performance: A Systematic Review. **J Sports Sci Med**.18(2): 198-206. 2019.

20. Treme, J., Allen, S.K., Widely Received: Payoffs to playr attributes in the NFL, **Economics Bulletin**. 29(3). 2009.

Brief description of the author

Peter Mamo is a Sydney based strength and conditioning coach working with team sports and private clients. Peter's career has spanned time employed in New York, which has allowed him to view the industry of fitness and athletic performance from several lenses.