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The *NSCA Coach* publishes basic educational information for Associate and Professional Members of the NSCA specifically focusing on novice strength and conditioning coaches. As a quarterly publication, this journal's mission is to publish peer-reviewed articles that provide basic, practical information that is evidence-based and applicable to a wide variety of athlete and training needs.

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THE GRAY AREA OF PROGRAMMING WEIGHTLIFTING EXERCISES

TIMOTHY SUCHOMEL, PHD, CSCS*D, RSCC

INTRODUCTION

As strength and conditioning coaches, we often seek the "best" training methods for our athletes. More specifically, we seek the methods that provide optimal training stimuli for achieving the goals (e.g., hypertrophy, strength, power, etc.) of each training phase. The key, however, is finding the method(s) that will optimize training for each individual athlete. In the age of social media where individuals frequently tout and/or adopt the latest training fad (34), it is important that we as strength and conditioning coaches fall back on three things when making our exercise prescriptions: 1) our athletes' ability to perform certain lifts (9), 2) our personal and coaching experience with certain lifts (9,64), and 3) the scientific literature (33). While we have more control over the first two aspects, the scientific literature is ever-expanding. Moreover, the latter may be humbling because some research may refute some of our go-to methods that we have used in the past. Enter the gray area.

The term "gray area" may be used in many different contexts in our lives, but it is often referenced in the strength and conditioning field when referring to different training methods that may be used to accomplish the same goal. While we all have our "bread and butter" exercises for achieving specific training goals, we can all agree that a gray area exists. For example, although strength and conditioning coaches at all levels may use different training methods (17,18,19,20,21,41), the goals are the same: help their athletes compete at the highest level by improving their performance and minimizing injury risk (31,32). While we can all be dogmatic at times when discussing the training methods we implement, this may be most apparent when discussing the use of weightlifting exercises (34,40). Specifically, we may engage in avid discussions about whether or not weightlifting movements should be implemented with non-weightlifting athletes or if we should include catching and/or pulling variations. Using the latter discussion topic as an example, it should be noted that weightlifting catching variations are typically prescribed more frequently than pulling variations, likely due to their similarity to the movements performed in competitive weightlifting (46). However, we should be hesitant to take extreme positions because context matters (34). For example, a growing body of evidence has outlined the potential benefits of weightlifting pulling variations when compared to catching variations. As a result, it is important to recognize that there may be a gray area to programming weightlifting exercises (catching and pulling variations) rather than exclusively prescribing one type or the other (46). Therefore, the purpose of this article is to discuss the gray area that should be considered when it comes to implementing weightlifting exercises.

TRAINING WITH WEIGHTLIFTING MOVEMENTS

Two common goals of strength and conditioning coaches are the development and improvement of lower body strength and power. While there are many other resistance training methods that may be used to train these characteristics (e.g., plyometric exercises, kettlebells, loaded jumps, etc.), previous literature has consistently shown that incorporating weightlifting movements, such as the clean, snatch, and their variations may produce the greatest improvements (3,25,39,62,63). These findings are due to the similarity between the second pull of weightlifting movements and the coordinated triple extension movement of the hip, knee, and ankle joints (plantar flexion) that occurs during other tasks like jumping, sprinting, and change of direction (2,26,30,42). Furthermore, weightlifting exercises may produce greater power outputs compared to non-weightlifting movements (45). Beyond training the triple extension movement, weightlifting movements may also enhance postural control due to the strength requirements throughout the movements (e.g., first pull from the floor and transition to the mid-thigh position). Finally, weightlifting movements also have the potential to train an athlete's ability to accept an external load (37). Given the broad training potential of weightlifting movements, it should come as no surprise that strength and conditioning coaches frequently program these exercises.

WEIGHTLIFTING PULLING DERIVATIVES

Weightlifting catching derivatives may be defined as weightlifting movements that remove an aspect from a traditional clean or snatch, such as lifting the barbell off the floor or omitting a full squat catch (e.g., power clean, hang power snatch, mid-thigh power clean) (46). In contrast, weightlifting pulling derivatives are those that remove the catch phase of traditional weightlifting movements and emphasize the triple extension movement (e.g., mid-thigh pull, hang high pull, jump shrug, etc.) (47). While strength and conditioning coaches may exclusively program weightlifting catching derivatives, there are several benefits of using weightlifting pulling derivatives in resistance training programs that may provide a gray area when programming weightlifting exercises. For example, like catching derivatives, pulling derivatives may be programmed from the floor, knee, or mid-thigh positions and serve as less technical alternatives due to the focus on the second pull and elimination of the catch phase. Furthermore, pulling derivatives may provide a unique training stimulus across the entire loading spectrum (46,52,53). These benefits are discussed in more detail below.

TECHNIQUE

A common reason that some strength and conditioning coaches provide for not implementing weightlifting movements is that they are too technical and take too long to teach. One study noted that it may take athletes with no experience with the hang power clean up to four weeks to see improvements in vertical power output that results from changes in technique (24). Furthermore, an additional study indicated that small differences in the barbell trajectory and vertical displacement during the catch phase of a snatch may be difference between a successful and unsuccessful lift in elite weightlifters (38). Given that competitive weightlifters consistently refine their technique, it is clear that a large skill component must be developed to efficiently complete weightlifting movements. A primary benefit of weightlifting pulling derivatives is that they are less technically demanding than catching derivatives, and therefore take less time to learn. This is due to the elimination of the catch phase and the fact that pulling variations may serve as progression exercises to the full weightlifting movements (11,12,13,14,15,48,49). Taking this into consideration, strength and conditioning coaches may consider this a gray area and implement weightlifting pulling variations as foundation exercises upon which other exercises can be progressed. For example, the mid-thigh pull (12) and countermovement shrug (11) may teach and reinforce the mid-thigh (power) position from which the second pull is initiated. In addition, the pull from the knee (15), hang pull (35), hang high pull (48), and jump shrug (49) may help athletes improve their transition (scoop) from the knee to the mid-thigh position. Finally, the pull to the knee (14) and pull from the floor (13) may help athletes work on proper first pull technique and merging the previous exercises together into one synchronous movement. While the previously discussed movements may serve as progression exercises (Figure 1), they may also be used as effective training exercises on their own.

VERSATILITY

A wide variety of athletes may benefit from using weightlifting movements and their derivatives. However, common reasons for not implementing them include sport coaches that have a negative outlook on weightlifting movements, athletes who lack the mobility to effectively rack the barbell during a clean variation, or injuries that prevent athletes from performing a catching derivative. While these situations may occur, strength and conditioning coaches should note that weightlifting pulling derivatives may provide a gray area for these athletes by providing an effective training stimulus characteristic of weightlifting exercises while eliminating the perceived issues of catching derivatives. Previous literature discussed the potential use of weightlifting pulling derivatives with baseball players and noted that certain pulling derivatives may place less stress on upper extremity joints due to the elimination of the catch phase (56). For athletes that have difficulty racking the barbell during a clean variation, pulling derivatives may be prescribed as an effective training stimulus (5,52) while they continue to work on their mobility. Finally, pulling derivatives may also serve as effective alternatives for injured athletes. Specifically, pulling variations like the mid-thigh pull and countermovement shrug include a small displacement of the barbell compared to catching variations. While returning to full health, athletes could use these exercises to not only train the triple extension movement as noted above, but also to modify/solidify their second pull technique.

OVERLOAD

If the ultimate goal of a resistance training program is power development, the underpinning factors of force (strength) and velocity must be developed (55). While weightlifting catching derivatives may provide effective training stimuli, they may be limited by the loads that can be implemented. On the upper end of the loading spectrum, strength and conditioning coaches cannot prescribe loads greater than the athlete's 1RM of a catching derivative. Because submaximal loading is often used throughout the training year, this may prevent athletes from experiencing greater force production against heavier loads during the triple extension movement. Rather than only including catching derivatives, the inclusion of pulling derivatives may provide coaches with a gray area of exercise selection to improve force production. For example, certain pulling derivatives may allow athletes to use loads in excess of their catching-based 1RM (e.g., mid-thigh pull, countermovement shrug, pull from the knee, and pull from the floor)—providing an overload stimulus—due to the omittance of the catch phase and a smaller barbell displacement (6,7,22,35,36). A recent study demonstrated that this method of loading may allow individuals to develop greater magnitudes of force production compared to training with submaximal loads during catching variations (52).

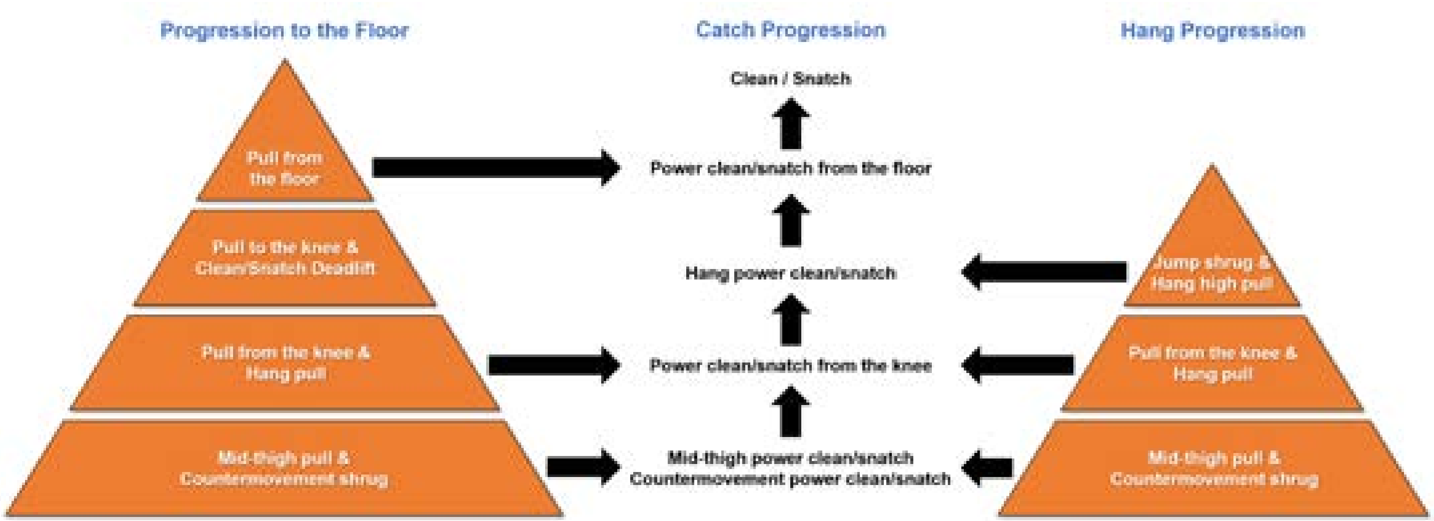

FIGURE 1. LIFT PROGRESSIONS

While the 1RM is specific to each catching variation (27), these lifts may still have velocity limitations. For example, catching variations such as the mid-thigh power clean may be programmed with loads as low as 50% of an athlete's 1RM power clean from the floor (52). However, lighter loads may make it difficult for an athlete to maximize their effort due to the potential to "over-pull" the barbell (i.e., elevate the barbell to greater height than is necessary to efficiently perform the catch phase). Instead, athletes may put forth minimal effort during catching variations, which in turn may decrease the amount of lower body work being performed compared to maximizing barbell height (10). Taking this into account, strength and conditioning coaches may acknowledge that a gray area exists when programming weightlifting movements for velocity adaptations. On the lighter end of the loading spectrum, pulling variations may produce greater velocity, rate of force development (RFD), and power characteristics compared to catching variations (28,29,57-61). This is due to the ability to accelerate throughout the triple extension movement rather than decelerating to drop under and catch the barbell. While weightlifting movements are semi-ballistic exercises (i.e., athletes may leave the ground only to reposition their feet), pulling derivatives like the jump shrug and hang high pull may be more ballistic in nature (46). For example, athletes should be cued to jump as high as possible during the jump shrug (49). Combining ballistic intent with lighter loads during the jump shrug and hang high pull has been shown to optimize velocity and power characteristics with loads as low as 30% of a 1RM catching derivative (29,43,44,54,61).

In summary, weightlifting pulling derivatives may allow athletes to maximize their effort across a larger loading spectrum that could range from ~30 – 140% of a 1RM power clean compared to ~50 – 100% 1RM with catching variations alone. This in turn may allow strength and conditioning coaches to provide greater force and velocity overload stimuli, ultimately benefitting lower body power to a greater extent.

LOAD ACCEPTANCE

Some strength and conditioning coaches may view pulling derivatives as "incomplete" exercises because there is seemingly no load acceptance phase since the catch is excluded. However, if athletes do not release the barbell following the second pull of a pulling derivative, they may experience a load acceptance phase as the load descends due to gravity. Some research has shown that certain pulling derivatives may require greater work during the load acceptance phase compared to several catching derivatives (8,50,51). To be clear, this research does not claim that the catch phase does not benefit load acceptance, rather, it supports the idea that exercises may exist on a continuum and that a gray area exists for training these characteristics. For example, the hang power clean, hang high pull, and jump shrug may require athletes to accept external loads differently: moderate force and moderate duration, low force and long duration, or high force and short duration, respectively (51). Interestingly, a recent study showed that greater eccentric force adaptations occurred when using pulling variations with force- and velocity-specific loading rather than submaximal catching or pulling variations (53). However, further research needs to examine technique and loading effects during the load acceptance phase of weightlifting movements as these factors may alter the stimulus.

PROGRAMMING BOTH CATCHING AND PULLING DERIVATIVES

IMPROVING CATCHING WHILE PULLING

Catching the barbell during clean and snatch variations is a skill that requires practice. Although a recent study showed that training with only pulling derivatives for 10 weeks may improve 1RM power clean performance, the participants mentioned that performing a catch after not catching for 10 weeks felt "awkward" and/or "unnatural" (52). As noted above, if strength and conditioning coaches want their athletes to perform the catch during clean or snatch variations, pulling derivatives may serve as foundational exercises (11-15,48,49). For example, by improving the pull, the barbell path may be improved and elevated to a greater height, making the catch easier to perform. While the catch phase can be difficult to teach, it is important to optimize the training time with athletes so that they still receive an effective training stimulus rather than programming catching drills that practice "turning over the bar." While several strategies have been discussed regarding improving the catch (1,4,16), it is important that athletes consistently train to practice the skill and ensure that the necessary strength requirements are being developed in the front rack (e.g., front squats, jerk drives, etc.) and overhead positions (e.g., overhead squats, snatch balances, jerk recoveries, etc.). In this light, researchers suggested implementing associate exercises (i.e., variations of full weightlifting movements) to improve explosive strength during the second pull in less skillful weightlifters (23). Therefore, if strength and conditioning coaches want their athletes to eventually perform a catch phase, a gray area exists that would allow pulling derivatives to serve as an effective teaching and training stimulus while catch technique is refined. From here, the skill of catching may be introduced using strategies such as within-set complexes, drop sets, between-set complexes, and complete sets (Table 1).

ADDRESSING PHASE-SPECIFIC GOALS

Weightlifting movements may be programmed throughout the training year. While weightlifting pulling derivatives may allow for greater force and velocity overload stimuli as noted above, it is important to note that a gray area exists within the middle of the loading spectrum. Previous literature discussed this concept stating that specific movement velocities may be achieved using catching or pulling variations, depending on the exercise and load (46). In fact, researchers showed that training with load-matched catching or pulling derivatives for eight weeks produced similar improvements in vertical jump and rapid force production characteristics (5). Therefore, either catching or pulling derivatives may benefit performance with moderate-heavy loads (e.g., 60 – 90% 1RM) (5). However, it is important that we consider the technical demands of each exercise, the training volume, and loading potential when programming exercises to meet the goals of each training phase.

Furthermore, it is important to take an individualized approach based on the training history of each athlete. Although many different exercise combinations may be implemented, example training blocks are provided in Tables 2 – 5. For high volume, strength-endurance phases (Table 2), pulling derivatives may serve as our foundation due to less technical demand; however, strength and conditioning coaches should consider using cluster sets to maintain technique integrity (52). During strength phases that focus on improving force production and RFD (Tables 3 and 4), pulling derivatives may serve as the primary strength stimulus due to their overload potential while incorporating lighter catching or pulling variations to enhance RFD. Finally, when training to peak RFD and power characteristics (Table 5), catching and pulling derivatives may be incorporated using load ranges that optimize power for strength-speed and speed-strength exercises. In addition to the propulsive stimulus, strength and conditioning coaches may consider implementing a variety of catching and pulling derivatives so that athletes experience a spectrum of load acceptance conditions, as outlined above. This may then enhance the athlete's ability in a variety of deceleration tasks (e.g., hard vs. soft angle change of direction and different entrance velocities into changes of direction).

TABLE 1. CATCHING DERIVATIVE IMPLEMENTATION STRATEGIES WHEN USING PULLING DERIVATIVES AS A PRIMARY STIMULUS

STRATEGY	DESCRIPTION	TRAINING EMPHASIS	EXAMPLE
Within-set complexes	Combining multiple lifts that train different aspects of an entire exercise within one set	Isolated technique of multiple components of a full weightlifting movement	Clean pull from floor + Hang power clean + Front squat
Drop set(s)	An additional set or sets completed with lighter loads following the working sets	Working sets as the primary strength-power stimulus Drop set for technique and rapid force stimulus	**Working sets:** Clean pull from the floor 3 x 5 at 90% 1RM **Drop set:** Power clean from the floor 1 x 5 at 70% 1RM
Between-set complexes	Combining multiple lifts that train different aspects of an entire exercise between several sets	Varied working sets as the primary strength-power stimulus Introductory working set of higher load catching variation Drop set for technique and rapid force stimulus	**Working sets:** Clean pull from the floor 1 x 3 at 100% 1RM Power clean from the floor 1 x 3 at 80% 1RM Clean pull from the floor 1 x 3 at 105% 1RM **Drop set:** Power clean from the floor 1 x 5 at 60% 1RM
Complete sets	Traditional exercise sets using a single lift	Working sets as the primary strength-power stimulus	Power clean from the floor 3 x 3 at 85% 1RM

Notes: The theoretical 1RM loads are based on the 1RM power clean of the individual

TABLE 2. EXAMPLE STRENGTH-ENDURANCE PHASE (3 X 10) INCORPORATING WEIGHTLIFTING DERIVATIVES

EXPERIENCE LEVEL	DAY 1	DAY 2	DAY 3
Beginner	Back squat	*CG pull to knee*	SG shoulder shrug
	Military press	CG shoulder shrug	Back squat
	Split squat	Stiff-legged deadlift	Incline bench press
	Bench press	Pull-up	Bent-over row
Intermediate	Back squat	*CG pull from floor**	*SG pull from floor**
	Military press	Stiff-legged deadlift	Back squat
	Split squat	Bent-over row	Incline bench press
	Bench press	Pull-up	Bent-over row
Advanced	Back squat	*CG pull from floor‡*	*SG pull from floor‡*
	Military press	Stiff-legged deadlift	Back squat
	Split squat	Bent-over row	Incline bench press
	Bench press	Pull-up	Bent-over row

*Notes: Italics exercise = the use of cluster sets is advised to maintain technique integrity; CG = clean grip; SG = snatch grip; * = performed with moderate-moderately heavy loads (50 – 70% 1RM power clean); ‡ = performed with moderately heavy-heavy loads (70 – 85% 1RM power clean)*

TABLE 3. EXAMPLE MAXIMAL STRENGTH PHASE (3 X 5) INCORPORATING WEIGHTLIFTING DERIVATIVES

EXPERIENCE LEVEL	DAY 1	DAY 2	DAY 3
Beginner	Push press	CG mid-thigh pull#	SG mid-thigh pull#
	Back squat	Clean deadlift	Front squat
	Bench press	Glute-ham raise	Incline bench press
	Lunge	Pull-up	Bent-over row
Intermediate	Push press	CG mid-thigh pull^	SG mid-thigh pull^
	Back squat	CG pull from floor#	Front squat
	Bench press	Glute-ham raise	Incline bench press
	Lunge	Pull-up	Bent-over row
Advanced	Push press	CG mid-thigh pull^	SG mid-thigh pull^
	Back squat	CG pull from floor^	Front squat
	Bench press	Stiff-legged deadlift	Incline bench press
	Lunge	Pull-up	Bent-over row

Notes: CG = clean grip; SG = snatch grip; # = performed with heavy-near maximal loads (85 – 100% 1RM power clean); ^ = performed with supramaximal loads (> 100% 1RM power clean)

TABLE 4. EXAMPLE ABSOLUTE STRENGTH PHASE (3 X 3) INCORPORATING WEIGHTLIFTING DERIVATIVES

EXPERIENCE LEVEL	DAY 1	DAY 2	DAY 3
Beginner	Power jerk Back squat Bench press Squat jumps	CG hang high pull† CG pull from floor* Stiff-legged deadlift Bent-over row	SG countermovement shrug* Front squat Incline bench press Pull-up
Intermediate	Power jerk Back squat Bench press Squat jumps	Mid-thigh power clean* CG pull from floor^ Stiff-legged deadlift Bent-over row	Mid-thigh power snatch* Front squat Incline bench press Bent-over row
Advanced	Power jerk Back squat + Squat jumps Bench press	Power clean from floor‡ CG mid-thigh pull^ Stiff-legged deadlift Bent-over row	Mid-thigh power snatch* Front squat Incline bench press Bent-over row

*Notes: CG = clean grip; SG = snatch grip; † = performed with light-moderate loads (30 – 50% 1RM power clean); * = performed with moderate-moderately heavy loads (50 – 70% 1RM power clean); ‡ = performed with moderately heavy-heavy loads (70 – 85% 1RM power clean); ^ = performed with supramaximal loads (> 100% 1RM power clean)*

TABLE 5. EXAMPLE STRENGTH-SPEED/SPEED-STRENGTH PHASE (2 – 4 X 2 – 3) INCORPORATING WEIGHTLIFTING DERIVATIVES

EXPERIENCE LEVEL	DAY 1	DAY 2	DAY 3
Beginner	Power jerk Back squat Bench press Countermovement jumps	Mid-thigh power clean* CG jump shrug†	Power jerk SG hang high pull†
Intermediate	Power jerk Back squat + Countermovement jumps Bench press	Hang power clean* CG jump shrug†	Power jerk SG hang high pull†
Advanced	Power jerk Back squat + Countermovement jumps Bench press + Bench press throws	Hang power clean* CG jump shrug†	Power jerk SG hang high pull†

*Notes: CG = clean grip; SG = snatch grip; † = performed with light-moderate loads (30 – 50% 1RM power clean); * = performed with moderate-moderately heavy loads (50 – 70% 1RM power clean)*

CONCLUSION

It is important to provide the best training methods for our athletes and avoid the rationale of "This is the way we have always done it." Using evidence-based training methods will improve our programming and allow us to answer the question: "Why am I using this exercise?" When programming weightlifting movements, we should individualize training programs by implementing exercise and load combinations that allow our athletes to optimally meet their training goals for each phase. While some performance characteristics may be trained using catching variations, these same characteristics may also be trained using pulling variations and possibly, to a greater extent. By considering the use of both weightlifting catching and pulling derivatives, we acknowledge the gray area and expand our coaching toolbox. Furthermore, by using the tools that are available to us, we may be able to provide unique stimuli for our athletes when it comes to improving the strength and power characteristics that underpin athletic performance.

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STRENGTH AND CONDITIONING FOR COLLEGIATE TRAMPOLINISTS

CALLUM BLADES, MSC, CSCS

INTRODUCTION

Trampolining is a form of gymnastics whereby athletes propel themselves air bound to execute three separate artistic routines. Routine one occurs in the preliminary competition round and involves executing a set sequence of eight skills, which include various jumps and rotations. In contrast, routines two and three have no set structure and happen during the preliminary and final competition rounds. Judges award routines points for the degree of difficulty, execution, and time of flight. The trampolinist who receives the highest number of points is declared the winner. Trampolining is relatively new to competitive gymnastics, so there is a limited body of sport science that can be used to inform strength and conditioning programs. This article therefore provides guidance on designing strength and conditioning programs for male collegiate trampolinists by combining the available sport science with practical coaching experience.

NEEDS ANALYSIS

The first step in program design is undertaking a needs analysis to understand the physiological, biomechanical, and injury demands associated with trampolining. Approximately 252 + 16 jumps are completed during a competition, all of which must be at a near maximum height of 8 – 9 m to enable sufficient airtime for proper routine execution (18). Trampolinists must therefore possess adequate leg strength to maximize jump height, evidenced by a significant positive correlation between one repetition maximum (1RM) leg press and trampolining jump height (7). Based on this evidence, trampolinists should aim to achieve a leg press 1RM in excess of 210 – 240 kg (7). However, the need for strength extends beyond the legs to the shoulders and upper trunk, which are both also highlighted within the literature as determinants of trampolining performance (30). Upper trunk power is required to generate and resist the rotational forces that occur during the execution of trampolining routines (30). Likewise, shoulder strength further contributes to the generation of rotational forces (30), while also providing a small, but nonetheless potentially meaningful, increase in jump height (8). Strength and conditioning programs for collegiate trampolinists should therefore include whole body resistance training with a specific focus on increasing strength in the legs, shoulders, and upper trunk.

As trampolinists perform three routines on the day of competition, substantial neural fatigue can develop (18). This neural fatigue is still evident up to 24 hrs after competition, with ground-based countermovement jump (CMJ) height remaining 4.8% lower than the 40.1 + 1.2 cm that trampolinists averaged prior to competition (18). Trampolinists also experience metabolic fatigue during competition with peak blood lactates reaching as high as 6.5 + 0.5 mmol/L after routines (18). This is unsurprising because trampolining routines are typically performed at heart rates approaching 95 – 97% of age predicted maximum heart rate (HRmax) (18). As a consequence of this neural and metabolic fatigue, trampolinists must be able to quickly recover between routines so that overall competition performance is not impaired (18). Such need to quickly recover explains why aerobic capacity has also been highlighted as a determinant of trampolining performance in the literature (30). A suggested aerobic capacity target is a maximum volume of oxygen consumption (VO_2max) in excess of 42.30 + 5.40 ml/kg/min, which was the average of competitive trampolinists (30). Thus, strength and conditioning programs for collegiate trampolinists should contain endurance training that specifically develops aerobic capacity.

Interestingly, body fat appears to minimally influence trampolining jump height in adolescents (11), despite research in other athletic populations demonstrating an inverse relationship between body fat and ground-based jump height (2). Specifically, adolescent trampolinists average a body fat of 14.04 + 3.90% without any apparent effect on trampolining jump height (25). This could suggest that the determinants of jump height are different when taking off from the trampoline bed in comparison to the ground, but this requires further investigation before a definitive conclusion can be made. Caution is also needed when extending body composition findings from adolescents to collegiate trampolinists because body fat significantly changes throughout puberty (5). Thus, the importance of maintaining low body fat in collegiate trampolinists cannot be discounted until further evidence on its relationship with trampolining jump height is gathered. It therefore currently remains logical that collegiate trampolinists should maintain low body fat levels, but this probably does not need to be the strength and conditioning program's primary goal.

The lower limbs appear most susceptible to injury during trampolining, accounting for 49.1% of all injuries (13). This was followed by the spine and upper limbs, which respectively accounted for 32.3 and 18.6% of all injuries reported during trampolining (13). Specific injury prone sites, which should be included within a trampolining prehabilitation routine, include the knee, ankle, lower back, and foot that respectively account for 19.9%, 15.5%, 16.8%, and 6.2% of all injuries (13). This prehabilitation should therefore be integrated into a strength and conditioning program for collegiate trampolinists, alongside whole-body resistance training and aerobic capacity development. However, to monitor the effectiveness of any such strength and conditioning program, bespoke performance testing must be regularly completed.

PERFORMANCE TESTING

Based on the needs analysis, performance tests for trampolining should evaluate jump ability, leg and shoulder strength, body composition, upper trunk power, and aerobic capacity (Table 1). As few tests have been directly validated against trampolining performance, a logical approach to test selection should be used whereby all tests fulfil two criteria. These criteria are having face validity in relation to trampolining and criterion validity in relation to the characteristic being measured. Face validity describes whether a test appears to be related to trampolining based on any obvious similarities between the test protocol and trampolining (24). In comparison, criterion validity describes the extent to which a test correlates against a known gold standard measurement (20). To contextualize these criteria, a CMJ requires athletes to jump vertically for maximum height, which is similarly a key trampolining objective. Measuring CMJ height with an Opto Jump also strongly correlates with a gold standard force plate (12). Based on this, the similarities to trampolining fulfil face validity and the correlation with a gold standard fulfils criterion validity. It is therefore suggested that a CMJ using an Opto Jump be completed at the start of every strength and conditioning session to monitor jump ability.

Although the needs analysis indicates that leg press 1RM relates to trampolining jump height, leg press machines are not always available. Furthermore, as many collegiate trampolinists have limited prior strength and conditioning training history, substitute 1RM lifts like the back squat or deadlift are likely to be similarly unsuitable. Instead, leg and shoulder strength could be monitored by predicting a 1RM for all exercises straight after every strength and conditioning session. A predicted 1RM can be calculated using the highest load lifted by the trampolinist and subjective repetitions in reserve provided by them after the set (15). The predicted 1RM for each exercise can then be used to prescribe target loads for subsequent strength and conditioning sessions; therefore, training and testing inform one another (15).

It is also advised that tests for body composition, upper trunk power and aerobic capacity be completed at the end of each training mesocycle, as all these characteristics are highlighted by the needs analysis as determinants of trampolining performance (4,30). Body composition may be tested with a bioelectrical impedance Tanita Scan, which demonstrates adequate criterion validity with respect to a gold standard dual energy x-ray absorptiometry (DEXA) scan (19). Upper trunk power may also be assessed with a seated medicine ball throw, whereby trampolinists sit with their back against a wall and throw a 5-kg medicine ball from chest height for maximum distance as quickly as possible (32). Finally, aerobic capacity can be evaluated with a treadmill maximum aerobic speed (MAS) test to estimate VO_2max, where trampolinists run for as long as possible on a treadmill starting at 10 km/hr (10). Speed is increased every 2 min by 1 km/hr, with the speed achieved during the final fully completed 2 min stage being considered MAS and this then being multiplied by 3.5 to estimate VO_2max (10).

Prior to starting any strength and conditioning program, trampolinists should undergo initial evaluations for injury risk, movement quality, and tissue capacity to ensure a robust training foundation. Considering trampolinists' susceptibility to lower extremity injury (13), both the weight bearing lunge and Y balance tests should be completed because they are predictive of ankle and knee injuries (16,26). The overhead squat also provides a basic snapshot into the movement quality of trampolinists, with scores reported to predict performance across the entire functional movement screen (9). Leg power asymmetries should also be measured with a single leg CMJ, as trampolinists usually take off with two legs that should equally contribute to trampolining jump height (28).

As upper trunk power requires a foundation of core tissue capacity, the McGill core endurance testing battery is also suggested for the initial evaluation (22). This battery involves isometrically holding trunk flexion, trunk extension, and side planks for as long as possible, with results able to indicate collegiate athletes' risk of developing lower back pain that is common to trampolining (1). Scores suggesting reduced risk of developing lower back pain are 57.56 + 6.25 s for trunk flexion, 63.20 + 11.57 s for trunk extension, 42.09 + 7.43 for right side plank, and 33.90 + 8.18 s for left side plank (1).

TABLE 1. SUGGESTED PERFORMANCE TESTING BATTERY FOR COLLEGIATE TRAMPOLINISTS

DETERMINANT	TEST	FREQUENCY	TARGET
Jump ability	Countermovement jump	Before sessions	40.1 cm (18)
Leg strength	Predicted leg press 1RM	After sessions	210 kg (7)
Body composition	Tanita scan	After mesocycles	14.04% (25)
Upper trunk power	Seated medicine ball throw	After mesocycles	0.2 m/s (32)
Aerobic capacity	Treadmill maximum aerobic speed test	After mesocycles	42.30 ml/kg/min (30)
Injury risk	Weight bearing lunge	Program baseline	11.9 cm (16)
Injury risk	Y balance	Program baseline	Anterior reach asymmetry <4% (26)
Movement quality	Overhead squat screen	Program baseline	3 points
Tissue capacity	Isometric trunk flexion	Program baseline	57.56 s (1)
Tissue capacity	Isometric trunk extension	Program baseline	63.20 s (1)
Tissue capacity	Isometric right-side plank hold	Program baseline	42.09 s (1)
Tissue capacity	Isometric left-side plank hold	Program baseline	33.90 s (1)

TABLE 2. SUGGESTED PLYOMETRIC TRAINING PROGRAM FOR COLLEGIATE TRAMPOLINISTS

		SETS X REPS			
MESOCYCLE	EXERCISE	WEEK 1	WEEK 2	WEEK 3	WEEK 4
1	**A. Pogo jumps**	2 x 10	3 x 10	4 x 10	2 x 10
	B. Countermovement jump	2 x 5	3 x 5	4 x 5	2 x 5
	C. Broad jump	2 x 5	3 x 5	4 x 5	2 x 5
2	**A. Tuck jump**	2 x 8	3 x 8	4 x 8	2 x 8
	B. Countermovement jump (90°)	2 x 8	3 x 8	4 x 8	2 x 8
	C. Mini-hurdle jumps	2 x 5	3 x 5	4 x 5	2 x 5
3	**A. Drop jump (30-cm box)**	2 x 4	3 x 4	4 x 4	2 x 4
	B. Countermovement jump (180°)	2 x 8	3 x 8	4 x 8	2 x 8
	C. Hurdle jumps	2 x 4	3 x 4	4 x 4	2 x 4

Note: The program is arranged into three mesocycles of four weeks, with all exercises performed as a superset.

PROGRAM DESIGN

A minimum of two resistance training sessions are recommended per week, all starting with a warm-up following the raise, activate, and mobilize, potentiate model (17). The raise phase provides an opportunity to integrate autonomy by allowing trampolinists to self-select activities that increase their body temperature such as cycling, skipping, or jogging (17). This should then be followed by the activate and mobilize phase, which combines prehabilitation exercises with dynamic stretches to lower the risk of injury (17). One suggested prehabilitation exercise is the dead bug, which is noted to counteract lower back pain common to trampolining (23). Meanwhile, dynamic stretches should focus on trunk rotation and stabilization, with an excellent example being a plank with leg kick through. The potentiate phase then concludes the warm-up by providing a link into plyometrics. In preparation for plyometrics, it is suggested that the potentiate phase concentrate on reinforcing good landing mechanics from jumps, bounds, hops, and altitude.

Plyometric exercises should then follow the warm-up because these can significantly increase vertical jump height (21). Plyometric training should be organized over a 12-week strength and conditioning program into three mesocycles that each last 4 weeks (Table 2). Mesocycle one should focus on low impact plyometrics (e.g., pogo jumps), before progressing into medium impact plyometrics in mesocycle two (e.g., tuck jumps) and finishing with high impact plyometrics in mesocycle three (e.g., drop jumps). Within each four-week mesocycle, training load should be progressed across weeks one and three by gradually increasing total foot contacts, before then being reduced in week four. This 3:1 wave loading pattern adheres to the principles of the fitness-fatigue paradigm, by providing a progressive stimulus that induces fatigue and a subsequent recovery period that restores fitness and overall preparedness (29).

Plyometrics should then lead into whole body resistance training, which is periodized according to the principles of Tudor Bompa (6). This involves progressing through preparatory, competition, and transition phases that are organized to peak for a targeted competition (Figure 1). The preparatory phase should be subdivided into general preparation and specific preparation, with the competition phase also subdivided into precompetition and competition (6). General preparation must address any weaknesses highlighted by the initial evaluation for injury risk, movement quality, and tissue capacity that was done before starting the strength and conditioning program. The trampolinist can then progress into the specific preparation subphase, where strength of the legs, shoulders, and upper trunk will be developed. Power can then be trained during the precompetition subphase, which can subsequently be maximized via a taper in the competition subphase. After completing the competition subphase that ends with the targeted competition, a short transition phase can then follow to provide the trampolinist with active rest.

It is suggested from practical experience that resistance training exercises remain constant throughout the preparatory phase, with only the sets, repetitions, and loads changing between the general preparation subphase and specific preparation subphase (Table 4). This allows strength testing to occur over a longer timeframe using the predicted 1RM method and avoids the need for 1RM testing between the subphases to prescribe exercise loads. If strength is still not fully developed after the preparatory phase, contrast training can then be performed during the precompetition subphase (3). This involves pairing a strength exercise with a biomechanically similar power exercise to maximize strength and power (3). In contrast, if strength levels are adequate then Olympic weightlifting derivatives could be used within the precompetition subphase (27). Regardless of whether contrast training or Olympic weightlifting derivatives are used in the precompetition subphase, overall training volume should then be progressively reduced to around 50% over a 2-week taper during the competition subphase (31).

To develop aerobic capacity, interval training should be performed that is based on data collected from the treadmill MAS test (10). In addition to collecting MAS, the trampolinist should wear a heart rate monitor to determine HRmax from the final fully completed

TABLE 3. SUGGESTED RESISTANCE TRAINING PROGRAM FOR COLLEGIATE TRAMPOLINISTS

		SETS X REPS			
SUBPHASE	**EXERCISE**	**WEEK 1**	**WEEK 2**	**WEEK 3**	**WEEK 4**
General Prep	1. Barbell back squat	3 x 10	3 x 10	3 x 10	1 x 10
	2a. Barbell Romanian deadlift	3 x 10	3 x 10	3 x 10	1 x 10
	2b. Chin up	3 x 10	3 x 10	3 x 10	1 x 10
	3a. Barbell calf raise	3 x 10	3 x 10	3 x 10	1 x 10
	3b. Weighted press up	3 x 10	3 x 10	3 x 10	1 x 10
Specific Prep	1. Barbell back squat	4 x 5	4 x 5	4 x 5	1 x 5
	2a. Barbell Romanian deadlift	3 x 5	3 x 5	3 x 5	1 x 5
	2b. Chin up	3 x 5	3 x 5	3 x 5	1 x 5
	3a. Barbell calf raise	3 x 5	3 x 5	3 x 5	1 x 5
	3b. Weighted press up	3 x 5	3 x 5	3 x 5	1 x 5
Precomp	1a. Barbell back squat	3 x 5	3 x 5	3 x 5	
	1b. Barbell jump squat	3 x 3	3 x 3	3 x 3	
	2a. Barbell bench press	3 x 5	3 x 5	3 x 5	
	2b. Medicine ball drop throw	3 x 3	3 x 3	3 x 3	
	3a. Barbell Romanian deadlift	3 x 5	3 x 5	3 x 5	
	3b. Kettlebell swing	3 x 3	3 x 3	3 x 3	
Comp	1a. Barbell back squat	2 x 5	1 x 5		
	1b. Barbell jump squat	2 x 3	1 x 3		
	2a. Barbell bench press	2 x 5	1 x 5		
	2b. Medicine ball drop throw	2 x 3	1 x 3		
	3a. Barbell Romanian deadlift	2 x 5	1 x 5		
	3b. Kettlebell swing	2 x 3	1 x 3		

Note: All sessions should finish with a circuit of core strengthening exercises such as rotational cable chops, kettlebell Turkish get-ups and barbell rollouts. The mesocycles correspond to the subphases within Figure 1. Exercises should be completed as a superset, with the B exercise immediately following the A exercise.

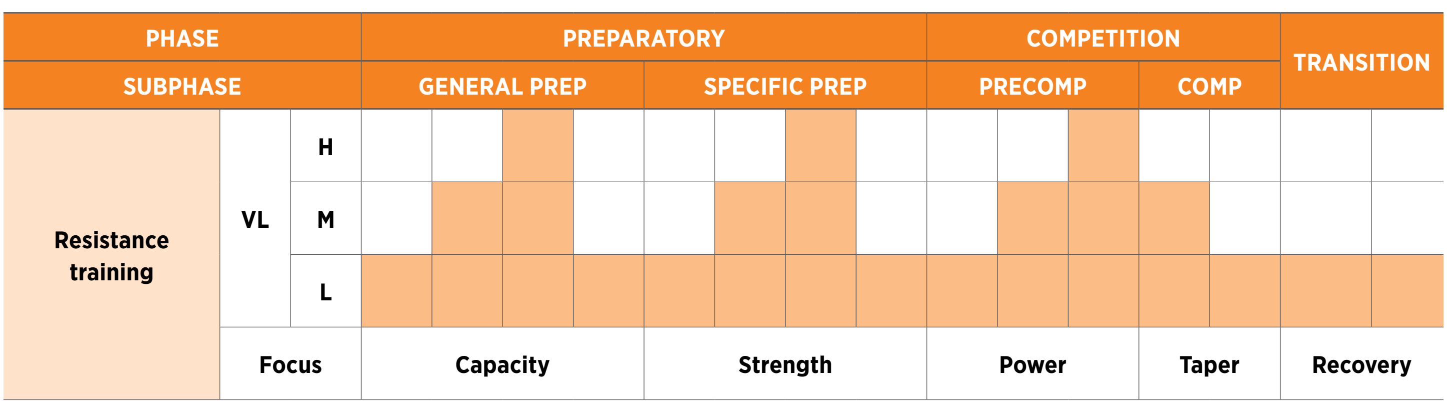

FIGURE 1. SUGGESTED 15-WEEK PERIODIZED RESISTANCE TRAINING PROGRAM FOR A COLLEGIATE TRAMPOLINIST

Note: The targeted competition will occur at the end of the competition phase.
Key: Precomp = precompetition, Comp = competition, VL = volume load, H = high, M = moderate, L = low.

2 min stage. An example protocol reported to improve aerobic capacity involves completing two weekly sessions of four treadmill intervals, which alternate between work periods of 4 min at 90 – 95% HRmax and rest periods of 3 min at 70% HRmax (14). Sessions such as this should be used throughout the preparatory period to create an adequate aerobic capacity base (6). Based on coaching experience, this can then progress during the competition phase to repeated sprint training that uses work periods specific to the trampolinist's competition routines (6).

CONCLUSION

The determinants of trampolining performance appear to be leg and shoulder strength, upper trunk power, and aerobic capacity. In addition to this, sites at increased risk of injury during trampolining seem to be the knee, ankle, lower back, and foot. To enhance performance and minimize injury, trampolinists should undertake whole body resistance training, plyometrics, aerobic capacity development ,and prehabilitation routines. These should be integrated into periodized strength and conditioning programs that aim to peak performance for targeted competitions. The progress of these programs should be tested daily with a pre-session CMJ and post-session predicted 1RM for every resistance exercise, alongside intermittent body fat scans, medicine ball throws, and MAS treadmill tests. If such systematic, sport specific, and athlete-centered strength and conditioning programs are completed, the performances of collegiate trampolinists can soar to new heights.

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PLANTAR FASCIITIS—STEPPING IN THE RIGHT DIRECTION

JUAN GONZALEZ, PHD, ANDREA HERNANDEZ, ERIKA HERNANDEZ, D'ANGELA LUCERO, ANDREA BARRERA, SANDRA VEGA, AND SARAHI SUAREZ, SPT

INTRODUCTION

Some athletes work diligently throughout the year on their periodization programs only to learn that they have come down with a debilitating condition, plantar fasciitis (PF), that will essentially end their career. This condition primarily affects athletes who put a significant amount of strain on their plantar fascia. Athletes from any sports that involve heavy use of loads on the feet can be predisposed for an overuse injury such as PF, but it is most commonly diagnosed in runners. It is estimated that one in ten individuals will develop PF in their lifetime (6). The purpose of this article is to show athletes and coaches how PF is diagnosed, treated, and transitioned back to athletic training for the athlete.

DIAGNOSING PLANTAR FASCIITIS

PF is categorized as an inflammation of the foot plantar aponeurosis and is the most usual form of inferior heel pain (16). The plantar fascia, a thickened fibrous aponeurosis originates from the medial tubercle of the calcaneus and goes onward to form the longitudinal foot arch (21). The purpose of the plantar fascia is providing dynamic shock absorption and static support of the longitudinal foot arch (21). Collagen degeneration is the usual cause of pain at the origin of the plantar fascia at the medial tubercle of the calcaneus (21). Degeneration is caused by consistent microtears of the plantar fascia that conquer the ability of the body to restore itself (21).

The condition is reportedly more frequent in military personnel and in individuals that lead an active lifestyle, however it is also seen in sedentary individuals (16). It has been estimated by researchers that the disorder influences essentially 10% of the population throughout the course of a lifetime and that it happens in roughly two million Americans per year (16). The individuals that are at a higher risk for developing PF are those with pes planus (low arches or flat feet) or pes cavus (high arches) (21). The diagnosis of PF should be made by a qualified health professional.

The most habitual cause of PF in athletes is overuse rather than anatomy (21). Ways that a medical doctor can diagnose a patient with PF include checking the patient's medical history, checking for areas of tenderness on the foot, and ultrasonography. Pain and discomfort in the inferior heel area that is exasperated on weight-bearing after an interval of non-weight-bearing is the most frequent symptom correlated with PF (6). In the morning, when getting up from bed, individuals that suffer from PF will frequently take note of agonizing pain, but the pain will gradually abate within 30-45 minutes (6). Extended standing may provoke pain that is at times accompanied by stiffness (21). Cases that are classified as more severe, report that the pain felt at the end of the day was the worst (21). When examined by the medical doctor, the usual point of maximal tenderness for the patient is located at the anteromedial region of the calcaneus (21). For the first appraisal and treatment of PF diagnostic testing is usually not indicated (21). Nevertheless, diagnostic testing is indicated in patients that have heel pain suspected for other causes, in occurrences of a typical PF, or in patients that are not reacting to proper treatment (21).

FOOT MUSCLES INVOLVED WITH PLANTAR FASCIITIS (TABLE 1)

The anatomy of the underlying foot structure entails the bones of the foot, the intrinsic foot muscles, and the plantar fascia (5). Aside from the plantar fascia (aponeurosis), other structures that develop similar symptoms include the abductor hallucis, flexor digitorum brevis, and abductor digiti mini muscles (6). Functional risk factors include tightness and weakness in the gastrocnemius, soleus, Achilles tendon and intrinsic foot muscles (14).

Table 1 illustrates some of the strengthening and stretching activities that an athlete going through physical therapy may be asked to do while rehabilitating. The development of this injury in most of the patients is a result from a combination of either intrinsic or extrinsic factors (6). Extrinsic factors include training errors, such as training on unyielding surfaces, and improper, or excessively worn footwear. On the other hand, intrinsic factors include elements such as obesity, foot structure, reduced plantar flexion strength, and reduced flexibility of the plantar flexor muscles, and torsional malalignment of the lower extremity (6). Restoring muscle strength and flexibility of involved tissues has been identified as one of the three categories of nonsurgical management for the treatment of the symptoms and discomfort associated with PF (6). Many experts on the subject agree that the restoration of flexibility to the involved tissues is an important component of the overall treatment program; hence the importance of gastrocnemius and soleus muscle stretching is most frequently recommended among these treatment programs (6). Researchers investigated the efficacy of muscle stretching on reducing the symptoms associated with PF in 236 individuals (6). They found that 72% of the subjects who only stretched for the 8-week treatment period showed an improvement in their symptoms (6).

TABLE 1. INTRINSIC FOOT MUSCLE REHABILITATION

	EXERCISES	FIGURE(S)	MUSCLES USED	TIME
1.	**Calf/Soleus Stretch**	Figures 18 and 19	Gastrocnemius and Soleus	3 sets x 2 min
2.	**Resisted Dorsiflexion**	Figures 22 and 23	Tibialis Anterior, Extensor Digitorum Longus, Extensor Hallicus Longus, Extensor Digitorum Brevis, Fibularis Tertius	3 to 4 sets x 15 to 25 reps
3.	**Resisted Plantar Flexion**	Figures 24 and 25	Gastrocnemius, Soleus, Plantaris, Flexor Hallucis Longus, Flexor Digitorum Longus, Tibialis Posterior, Peroneus Longus, Peroneus Brevis	3 to 4 sets x 15 to 25 reps
4.	**Resisted Eversion**	Figure 26	Peroneus Longus, Peroneus Brevis	3 to 4 sets x 15 to 25 reps
5.	**Resisted Inversion**	Figure 27	Tibialis Anterior, Tibialis Posterior	3 to 4 sets x 15 to 25 reps
6.	**Toe Curls on Towel**	Figures 20 and 21	Flexor Hallicus Brevis, Flexor Hallicus Longus, Lumbricals, Flexor Digiti Minimi Brevis, Flexor Digitoum Longus, Flexor Digitorum Brevis, Abductor Hallcuis, Quadratus Plantae	3 to 4 sets x 15 to 25 reps
7.	**Small Toes Raises**	Figure 28	Flexor Hallucis Brevis, Adductor Hallucis. Lumbricals, Extensor Digitorum Brevisu	3 to 4 sets x 15 to 25 reps
8.	**Alternating Big Toe Raises**	Figure 29	Extensor Hallucis Brevis, Extensor Hallucis Longus	3 to 4 sets x 15 to 25 reps

PHYSICAL THERAPY EVALUATION OF PLANTAR FASCIITIS (FIGURES 1 – 8)

Evaluation usually takes place during the first visit to the physical therapy clinic. There is a case history that usually takes place initially in which the physical therapist will ask the following questions:

1. How long have you had this discomfort/pain?
2. On a scale of 1 to 10 (10 being very uncomfortable) what is your pain level right now?
3. Can you point specifically to the area where your greatest pain is felt?
4. Is there pain with the first couple of steps in the morning after getting up?
5. What was your current level of training before you got diagnosed with plantar fasciitis?
6. Do you currently wear orthotics in your training/running shoes?

The physical therapist will then take physical measurements of the foot and ankle area. These measurements will later be used for comparison after the treatment sessions have concluded. The typical measurements will include the following assessments with a goniometer, which are recorded in degrees and are illustrated by Figures 1 – 8:

1. Eversion
2. Inversion
3. Plantar Flexion
4. Plantar Dorsiflexion

FIGURE 1. LEFT FOOT DORSIFLEXION

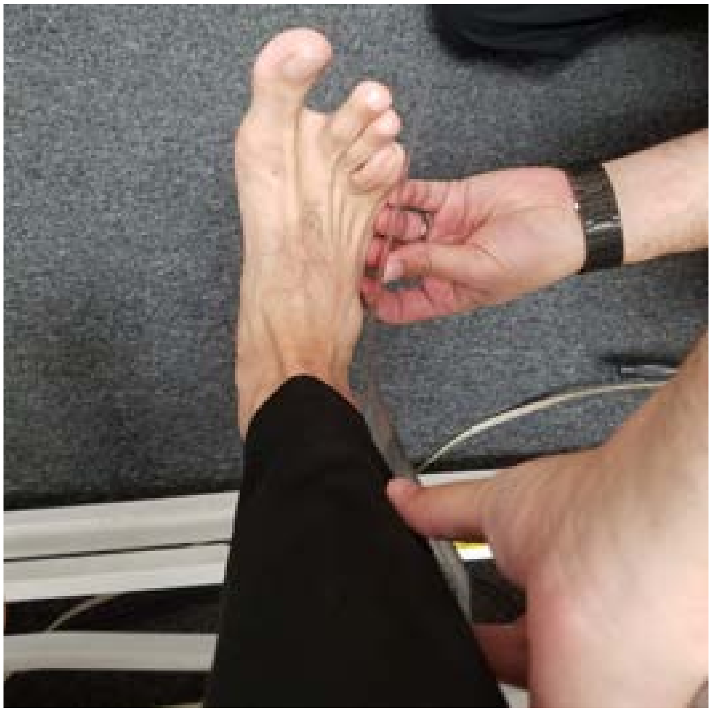

FIGURE 2. RIGHT FOOT DORSIFLEXION

FIGURE 3. RIGHT FOOT DORSIFLEXION

FIGURE 4. LEFT FOOT PLANTARFLEXION

FIGURE 5. LEFT FOOT EVERSION

FIGURE 6. RIGHT FOOT EVERSION

FIGURE 7. LEFT FOOT INVERSION

FIGURE 8. RIGHT FOOT INVERSION

PHYSICAL THERAPY TREATMENT (FIGURES 9 – 17)

The initial phase of physical therapy treatment consists of exercises to address specific intrinsic foot muscle weaknesses, ankle, and calf. Typically, physical therapy treatment may consist of 1.5-hour sessions consisting of exercises, followed by treatment modalities as illustrated by Figures 9 – 17. These modalities may consist of deep tissue massage of the plantar muscles, ultrasound, and transcutaneous electrical neuromuscular stimulation (TENS) of the affected area(s). If the physician prescribed an iontophoresis, which is a type of electrical stimulation with a steroid patch, then the therapy session will be concluded with the application of these steroid patches (14). The steroid patches are medicated patches that allow the physical therapist to inject dexamethasone into the patch. Dexamethasone is a corticosteroid that aids in reducing pain and inflammation. A common treatment with iontophoresis can include the use of acetic acid, a two-carbon carboxylic acid, instead of using steroids (7). The use of acetic acid with iontophoresis has proven to be as effective as using steroids (7).

The following exercises are specific to the intrinsic foot muscle, ankle, and calf rehabilitation (Table 1). The goal of all these activities are to stretch and strengthen the complete musculature of the foot during rehabilitation prior to the transition to their performance-based training in progressions.

1. As shown in Figures 18 and 19, the calf and soleus stretch are held for two minutes in duration for the affected limb/foot. These are done for three sets on the affected limb/foot. Typically, individuals with PF have tight calf and soleus muscles.

2. The next two exercises are resisted dorsiflexion and plantar flexion. These are typically done with a resistance band as illustrated by Figures 22 – 25. The physical therapist usually will set the resistance value of the band. Different color resistance bands hold different levels of resistance. These exercises are done for three sets of 25 repetitions.

3. As indicated by Figures 26 and 27, resisted plantar flexion with eversion and inversion are done with the use of a resistance band and are done for three sets of 25 repetitions. Resisted eversion and inversion are important because of how the foot and ankle structure move during a typical landing motion.

4. The next exercises include toe curls, big and small toe flexion exercises as shown by Figures 20, 21, 28, and 29. These exercises should also be done using a resistance band. These exercises will also be done for three sets with 25 repetitions. Similarly, there is a collection of exercises called toe yoga by physical therapists. The first one is done with the big toe up with the little toes down. Next, the big toe is held down while the little toes are raised up. Lastly, it will take practice to be able to alternate on keeping either the small toes or big toe down while the other is being raised. If both feet are being treated for PF, then you continue the alternating toes from one foot to the other.

FIGURE 9. MASSAGE

FIGURE 10. ULTRASOUND

FIGURE 11. TENS

FIGURE 12. TENS

FIGURE 13. LONOTO PATCH

FIGURE 14. ACETIC ACID PATCH

FIGURE 15. DEXAMETHOSON

FIGURE 16. PATCH PLACEMENT

FIGURE 17. PATCH PLACEMENT

TRANSITIONING FROM PHYSICAL THERAPY TO PERFORMANCE BASED TRAINING

The purpose of this transition program is to provide a guide that will assist an athlete to return to their sport activities after rehabilitation and prevent them from getting re-injured. There is no specific criteria for the return of an athlete with PF as every athlete is different with their particular experiences with PF (2). Usually after 3 – 6 weeks of active rest and treatment, the athlete can start treadmill or outdoor running conservatively (2).

A problem often arises when the athlete starts training too hard or too fast when they are just returning from rehabilitation. This increases the risk of the athlete getting re-injured. In order to prevent or minimize the risk of getting reinjury or acquiring another injury, it is recommended for the athlete to start off with a 5 – 10 min warm up, conclude training with a cool down, and go through a series of stretches specific to PF (5). Like any transition, the athlete must start off slow and then gradually progress the training volume. As the athlete progresses in the training, the athlete will rebuild their flexibility, strength, and endurance, which may have diminished during the rehabilitation period. It is recommended to first start off with power walking at 3.0 mph to 3.5 mph on a treadmill (5). It is advised that the athlete integrate some light short duration jogging in between some powerwalking activities to reintroduce the running movement. As the athlete builds time in minutes, the introduction of jogging activities will increase in time and/or distance. The ultimate aim is to move away from the powerwalking and move into more of the running activities while still maintaining all their rehabilitation strengthening and stretching activities now built into their sports training routines.

CALF STRETCH ON A STEP AND SOLEUS STRETCH (FIGURES 18 AND 19)

Securing the unaffected foot flat on the step as illustrated by Figure 18, place the affected foot's heel at the edge of the step and allow for the heel to be lowered down until a stretch in the calf muscles is felt. Hold the position for three minutes, relax, and repeat 2 – 3 times. It is recommended to complete this exercise three times a day (20). While sitting down with the knee bent at 90 degrees, reach forward and pull the toes back to perform a dorsiflexion movement until a good stretch is felt, as shown in Figure 19. Hold for three minutes, relax, and repeat 2 – 3 times.

FIGURE 18. CALF STRETCH

FIGURE 19. SOLEUS STRETCH

TOE CURLS WITH TOWEL (FIGURES 20 AND 21)

These exercises are an extension of the physical therapy exercises that are now carried over to prehabilitation exercises. Using a small towel and the affected foot, place the towel on the floor and use the toes only to curl the towel as exemplified by Figures 20 and 21. Relax and repeat the steps 10 times. It is recommended to do this exercise three times a day (20).

FIGURE 20. TOE CURLS

FIGURE 21. TOE CURLS

PLANTAR FLEXION/DORSIFLEXION (FIGURES 22 – 25)

In a seated position, the athlete will use a resistance band of moderate strength/resistance to go through the motion of plantar flexion and dorsiflexion as shown in Figures 22 – 25. These exercises are targeting the tibialis anterior and gastrocnemius muscles. These are high volume exercises; thus, it is recommended that athletes do three to four sets of 15 – 25 repetitions. The objective of these exercises is to strengthen these foot/lower leg muscles. The athlete should do three sessions per day (20).

FIGURE 22. DORSIFLEXION

FIGURE 23. DORSIFLEXION

FIGURE 24. PLANTAR FLEXION

FIGURE 25. PLANTAR FLEXION

EVERSION/INVERSION RESISTANCE BAND EXERCISES (FIGURES 26 AND 27)

In a seated position, the athlete will use a resistance band of moderate resistance and place it around one foot to provide the appropriate angle of resistance for the foot that will be targeted during the exercise as illustrated by Figures 26 and 27. These are high-volume exercises thus; the athlete should do three to four sets of 15 – 25 repetitions. The goal is to fatigue these muscles to the point of tolerable burn as it will indicate that the muscles have reached a near maximal effort. The athlete should do three sessions per day (20).

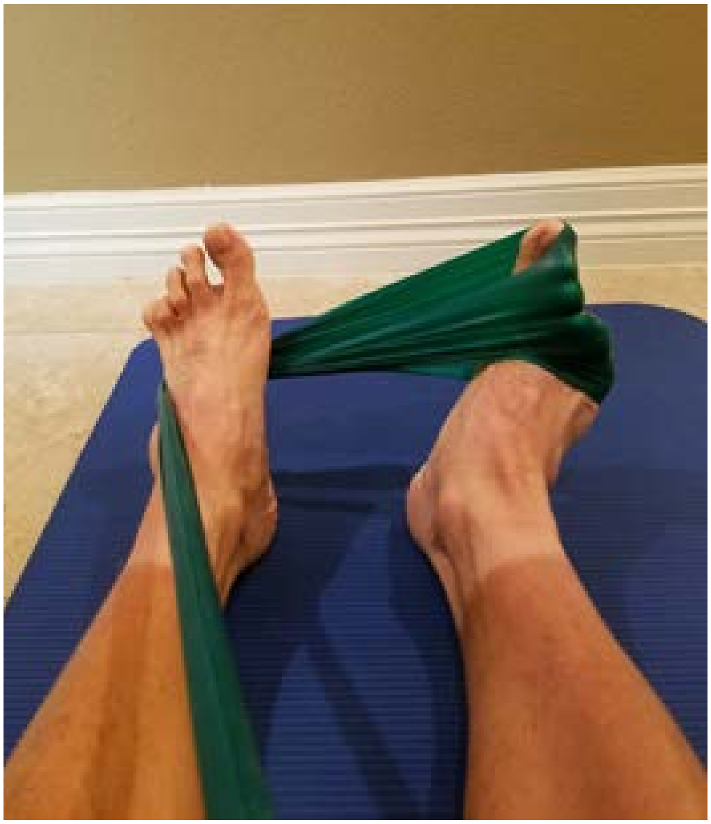

FIGURE 26. EVERSION

FIGURE 27. INVERSION

TOE EXERCISES (FIGURES 28 AND 29)

The following toe exercises are illustrated by Figures 28 and 29. The goals of these exercises are to strengthen the individual intrinsic foot muscles that are responsible for toe flexion and extension. The athlete places his/her feet on the floor flat. The next step is to press down with both the big left and right toes. The second step is while applying pressure with the big toes, the athlete lifts the little toes of the right and left feet. It is important to make sure that the big toes remain in a static position while the little toes are raised. These are also high-volume exercises that should be completed in three to four sets of 15 – 25 repetitions. The goal is high volume, but done correctly, thus patience is required for this exercise to be effective. The athlete should do three sessions per day (20).

FIGURE 28. ALTERNATING LITTLE TOE RAISES EXERCISES

FIGURE 29. ALTERNATING TOE RAISES EXERCISES

POWERWALKING (TABLE 2)

Powerwalking was selected as the first step in rebuilding that athlete's cardiovascular conditioning based on its low impact on the feet. The athlete should begin powerwalking at a comfortable pace (3 mph – 3.5 mph at 12 min – 11 min/mile). These speeds and pace were selected as the goal is to gradually increase the intensity of the cardiovascular training while minimizing the impact on the foot. Gradual integration of cardiovascular training should follow a three-week powerwalking program while carefully evaluating each week in terms of intrinsic foot muscle tightness after each session. It is recommended that after three weeks of careful pre-habilitation and powerwalking activities that a decision be made by each athlete to integrate some light jogging within each powerwalking session. This should be followed for the next three weeks.

Table 2 provides a recommended training schedule that uses both powerwalking and jogging to gradually build up the athlete. It is not advisable for a athlete to jump right into light jogging activities without following an appropriate progression that allows for careful monitoring of the intrinsic foot muscles. It is also highly recommended that the athlete powerwalk, jog, and run on a soft surface such as crushed granite trails or soft track surfaces to minimize the pounding on the plantar muscles. The total transitioning cardiovascular training program is a nine-week program that could be adjusted in speed and duration depending on the progress of each individual athlete.

TABLE 2. CARDIOVASCULAR TRAINING-POWERWALKING, JOGGING AND RUNNING

WEEK	EXERCISES	SPEED (MPH)	MINUTE PER MILE	FREQUENCY
1.	**Powerwalking**	3.0 to 3.5	12:00 to 10:00	Monday/Wednesday/Friday
2.	**Powerwalking**	3.0 to 3.5	12:00 to 10:00	Monday/Wednesday/Friday
3.	**Powerwalking**	3.0 to 3.5	12:00 to 10:00	Monday/Wednesday/Friday
4.	**Powerwalking/Jogging**	3.0 to 3.5 3.5 to 4.0	12:00 to 10:00 10:00 to 8:00	Monday/Wednesday/Friday
5.	**Powerwalking/Jogging**	3.0 to 3.5 3.5 to 4.0	12:00 to 10:00 10:00 to 8:00	Monday/Wednesday/Friday
6.	**Powerwalking/Jogging**	3.0 to 3.5 3.5 to 4.0	12:00 to 10:00 10:00 to 8:00	Monday/Wednesday/Friday
7.	**Running**	4.0 to 6.0	8:00 to 6:00	Monday/Wednesday/Friday
8.	**Running**	4.0 to 6.0	8:00 to 6:00	Monday/Wednesday/Friday
9.	**Running**	4.0 to 6.0	8:00 to 6:00	Monday/Wednesday/Friday

ICE MASSAGE ARCH ROLL (FIGURE 30)

As illustrated by Figure 30, using a frozen water bottle, place the bottle under the affected foot and roll the foot back and forth applying enough pressure as the athlete feels comfortable in using the frozen water bottle. Continue this movement for 10 – 15 min. As the athlete is rehabilitating back into shape, it is recommended that this be done four times a day (20). This should be done daily at the end of the athlete's rehabilitation exercises and/or training because there may be small tissue tears and inflammation after each session. Ice aids in reducing inflammation and relieving pain (17).

FIGURE 30. ICE MASSAGE ARCH ROLL

CUSTOM ORTHOTICS (FIGURES 31 – 35)

Typically, when a physician evaluates an injured athlete with suspected PF, the physician will evaluate the lower body mechanics to see if a custom foot/shoe orthotic is warranted. Based on their evaluation, if the physician recommends that a foot orthotic would aid in minimizing or preventing the occurrence of further trauma to the foot structure, a prescription will be made to see an orthotist. An orthotist is a medical specialty that focuses on the design and application of orthoses (shoe inserts). In this article, our hypothetical athlete was diagnosed as a supinator that warranted an orthotic that minimizes for this and/or corrects it. Figures 31 – 35 illustrate how a custom orthotic is made with the final orthotic based on the athlete's individual foot structure.

There is a gradual progression that the orthotist will recommend for using an orthotic for the first time. Generally, the athlete will be instructed to wear the new orthotics for 30 min for the first day and gradually add more time with each new day until the athlete feels comfortable wearing the new orthotics continuously. It is useful to keep in mind that orthotists are able to make continuous adjustments to the athlete orthotic to modify any discomforts and provide comfort to the individual. Thus, it is vital for an athlete to share their experiences with the orthotist regarding the feel and functionality of the new orthotics.

FIGURE 31. EVALUATION

FIGURE 32. CUSTOM FOOT MOLD

FIGURE 33. FOOT IMPRESSION

FIGURE 34. CUSTOM ORTHOTICS

FIGURE 35. CUSTOM ORTHOTIC

CONCLUSION/RECOMMENDATIONS

PF is a prevalent condition among athletes from many sports, but athletes that put an increased load on their feet are more susceptible to this particular injury. Once an athlete gets afflicted with this overuse injury, PF is difficult to heal if not properly diagnosed and managed. Most diagnoses are made by the physician based on symptoms, but ultrasound and digital imaging are among the most common diagnostic procedures available to confirm the diagnosis of PF. Strength and conditioning coaches should not try to treat PF; it is not in their scope of practice. Strength and conditioning coaches can modify exercise and training while taking action to prevent further injury. A physical therapist is the most appropriate allied healthcare professional that is recommended for the treatment and rehabilitation of this condition.

A nonsurgical therapeutic approach entails increasing muscle strength and flexibility of the plantar flexor muscles coupled with constant stretching of the gastrocnemius and soleus muscles. Steroidal and non-steroidal approaches are available to the physical therapist in treating PF. The non-steroidal approach has been proven to be just as effective in treating PF and may be the route to take for athletes who are monitored for the use of steroids. Lastly, many times if deemed necessary by a physician, custom orthotics are made to help minimize or correct a biomechanical problem with the kinematic chain of running. Orthosis can then be easily made for the individual foot structure of the athlete and then inserted into their training or competition shoes. This article has illustrated that physical therapy plays an important role for an athlete's rehabilitation from PF. The evaluation techniques and treatments within this article are typically conducted in a physical therapy environment. The key to a successful treatment relies on merging therapeutic exercises with functional training to restore the athlete as safely as possible to their chosen sport and event in time.

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CREATING POWER—ALTERNATIVE BILATERAL AND UNILATERAL TRIPLE EXTENSION EXERCISES

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INTRODUCTION

The idea of focusing on the improvement of an athlete's ability to explosively triple extend (ankle, knee, hip) vertically and horizontally, as well as bilaterally and unilaterally, is a well-recognized component of performance enhancement for athletes in many sports (7). Commonly, strength and conditioning professionals will employ weightlifting exercises and their variations to train this physical component. While the implementation of weightlifting exercises and their variations is certainly beneficial for enhancing an athlete's triple extension, they have limitations (4). Weightlifting exercises are technique extensive, require significant base-line strength, sufficient instruction, and training time for progressions. Unless proper technique is taught with a broomstick or dowel rod to very young athletes, weightlifting exercises may be difficult to effectively coach with novice athletes or large groups.

Orthopedic issues can also impact the effectiveness of some weightlifting exercises, their derivatives, and other resistance training exercises. For example, depending on the disability, some Paralympic athletes may not be able perform key parts of weightlifting movements. Many Paralympic and able-bodied athletes have musculoskeletal imbalances, which can limit the use of some weightlifting exercises. This can result in severely restricted enhancement of power or limited sport performance (5). During in-season periods some athletes have many issues that arise on a weekly basis from being in a contact sport, so the day-to-day or week-to-week nature of sport injuries can impact programming on an individual basis, which is why exercise variations are important. Alterations or adaptations in technique, caused by orthopedic issues such as poor wrist and shoulder mobility, inhibit safe catches for clean variations and shoulder stability issues may affect snatch and jerk catch positions. Technical flaws in weightlifting derivatives can sometimes lead to decreased bar velocity, which impacts the effectiveness of the exercise.

Weightlifting exercises are technique intensive. Depending on the athlete's training age, strength level, and frequency of training, it can take anywhere from 4 – 12 weeks to matriculate through the various progressions before an athlete is proficient with a given exercise (2). This may not fit into the training cycle prescribed to the athlete. Further, the time-cost of teaching weightlifting technique is substantial given an athlete's limited time in the weight room. Every minute utilized teaching advanced technique can naturally detract from time that could be utilized to train performance. Similarly, these exercises require the strength and conditioning professional to provide sufficient instructional time, supervision, and feedback to the athlete. Unfortunately, this is difficult considering some high schools and lower-level collegiate programs may have budgetary limitations that may not allow adherence to the guidelines for proper professional supervision. According to guideline 3.1 in the Strength and Conditioning Professional Standards and Guidelines, the recommended professional-to-participant guidelines are 1:20 for high school and 1:15 for college (3). Outside of well-resourced collegiate conferences and professional settings, adherence to these recommendations is sometimes a challenge, and anecdotal evidence from strength and conditioning coaches suggests in large group settings that sometimes the professional-to-participant ratio can be 1:60 or higher. This means that many novice lifters will not receive sufficient supervision and feedback regarding critical aspects of these technique-intensive lifts. Furthermore, many novice lifters lack the pre-requisite strength necessary to complete an Olympic exercise variation with the necessary velocity to achieve optimal performance transfer. As aptly put by sport scientist, "a fundamental relationship exists between strength and power that dictates that an athlete cannot possess a high level of power without first being relatively strong" (1).

Recent evidence suggests that weightlifting exercises and their variations necessitate that triple extension be performed at specific velocities to optimize transfer to the field or court. For instance, it is recommended that the hang clean exercise be performed at 1.4 m/s to optimize performance in the vertical jump (6). The addition of this recent evidence suggests that simply performing weightlifting exercises and their variations will not necessarily enhance performance. Rather, the athlete must possess a relative strength level wherein they not only produce force, but produce force rapidly. This is a significant limitation for implementing weightlifting exercises with novice lifters.

Many of the aforementioned limitations regarding weightlifting exercises can be mitigated by utilizing the exercises listed below. Each of these exercises places a focus on the mechanics of triple extension and the ability to produce force rapidly. Due to the simplified nature of the exercise technique, most of these exercises can be effectively taught and implemented into a training session on the same day. These less technique-intensive exercises are effective and enable strength and conditioning professionals to more adequately supervise and instruct large groups. Additionally, most of the exercises require the athlete to use either bodyweight, a medicine ball, or a lightweight vest. This allows an athlete to modify the exercise to their specific strength level and perform the exercise with the requisite strength and velocity necessary to elicit optimal transfer of performance. The potential limitation to this training method is that advanced athletes with higher relative strength levels will not have sufficient external load to optimize performance. In order to modify these exercises for athletes who are already exceptionally powerful, a wide variety of external load accommodations could be made. For example, each of these exercises could be performed as described while the athlete is wearing a weighted vest. Additionally, resistance to explosiveness could be increased by tethering the athlete with a waist band.

OVERHEAD MEDICINE BALL TOSS

Set-Up: Reach up to the ceiling (on toes) while holding the medicine ball (slightly scoop position, palms underneath the ball). Feet positioned slightly wider than shoulder-width (just wide enough for the ball to pass between the athlete's legs).

Execution: Start the exercise by rapidly flexing the knees and the hips while the medicine ball lowers in the scoop position. Upon achieving this "power position," rapidly extend the hips, knees, and ankles to initiate a high overhead throw.

Equipment Needed: 6 lb - 15 lb medicine ball (athlete dependent)

Key Coaching Cues:

- Initiate the throw by pushing the feet through the ground
- Hips drive the arms; think catapult; avoid whipping the low back and initiating the throw with the arms
- Leave the ground as you triple extend
- Throw a high and far pop-fly

MEDICINE BALL THRUSTER

Set-Up: Stand with a hip-width to shoulder-width stance (vertical jump). Place the medicine ball near the clavicles with the elbows pointed toward the floor.

Execution: Rapidly flex the knees and hips into a half-squat position without allowing the torso to lean forward. Upon achieving this position, rapidly extend the hips, knees, and ankles to drive the medicine ball off the clavicles and straight up into the air.

Equipment Needed: 6 lb - 15 lb medicine ball (athlete dependent)

Key Coaching Cues:

- Initiate the dip phase with a fast-half-squat
- Push the feet through the ground; hips drive the ball off of the clavicles; avoid using the arms to press the ball upward until the hips have extended
- Leave the ground as you triple extend
- Throw the ball straight up in the air

FIGURE 1. MEDICINE BALL THRUSTER - START

FIGURE 2. MEDICINE BALL THRUSTER - FINISH

LANDMINE SQUAT TO PRESS

Set-Up: Stance slightly wider than shoulder width apart. Fasten bar in landmine attachment and position the bar at the upper sternum with the hands stacked on top of one another at the top of the bar.

Execution: Rapidly flex the knees and hips into a squat position. Upon achieving this position, rapidly extends the hips, knees, ankles to drive the bar slightly forward and up off the sternum. As plantar flexion of the ankles occurs, release the lower hand off the bar to finish the extension and take one step forward if needed.

Equipment Needed: Olympic bar; ground-based landmine attachment, weight plates (athlete dependent)

Key Coaching Cues:

- Squat down to parallel or near-parallel depth
- Drive the feet through the floor, pressing upward and slightly forward
- Use the hips to drive the bar off of the sternum
- As the upper arms extend, release the left-hand and plantar flex the ankles; alternate starting hand position and pressing arm

FIGURE 3. LANDMIND SQUAT TO PRESS - START

FIGURE 4. LANDMIND SQUAT TO PRESS - FINISH

TRAP BAR JUMP SQUAT

Set-Up: Stand with a hip-width to shoulder-width stance (vertical jump). Grasp the trap bar with a neutral grip. Brace the core (belly button to spine).

Execution: Rapidly flex the knees and hips into a quarter squat position that mimics the load position for a vertical jump. Once this position is achieved, rapidly extend the hips, knees, and ankles to drive the body off the ground. The triple extension should also cause a locked arm shrug of the arms as the athlete leaves the ground.

Equipment Needed: Trap bar; bumper plates (athlete dependent)

Key Coaching Cues:

- Load into a quarter-squat position
- Push the feet through the ground; hips drive a locked arm shoulder shrug (don't pull with the arms)
- Leave the ground as you triple extend
- Land soft flexing the hips and the knees

FIGURE 5. TRAP BAR JUMP SQUAT - SIDE VIEW

FORWARD AND LATERAL POWER STEP-UP

Set-Up: Place lead-leg on top of bench or blocks with the knee and hips flexed at 90°. Arms placed up and in front of the body at chest-height.

Execution: Raise the lead leg so that the foot leaves the bench or blocks and then rapidly step down and through the bench or blocks while unilaterally extending the hip, knee, and ankle of the lead leg. The athlete should extend so powerfully that the lead leg leaves the bench or blocks after peak plantarflexion. After full triple extension has occurred, the athlete should switch legs mid-air and land with leg that started as the back leg on the bench or blocks. This switching motion will occur on the same side of the bench for the forward power step-up, but on the other side of the bench or blocks for the lateral power step-up.

Equipment Needed: Bench or blocks at the height of the athlete's tibial tuberosity (just below the knee cap); weight vest (athlete dependent).

Key Coaching Cues:

- Athlete should think knee up, toe up when initiating the movement with the lead leg on the bench or blocks
- Cock the arms back
- Rip the arms upward; drive the foot through the bench or blocks
- Triple extend and reach the hands to the ceiling; "grab the money"
- Switch feet in the air
- Land soft with alternate lead leg on the bench and back leg on the floor

REAR-FOOT ELEVATED 1-LEG SQUAT JUMP

Set-Up: Place feet in a lunge stance and elevate the back leg on a roller pad (ideally) or a bench. Place balance disc on the floor directly below the knee of the rear-foot elevated leg. Arms should be placed up and in front of the body at chest-height.

Execution: Rapidly flex the knee and hip of the lead leg until the rear-knee is 1 – 2 in. from the ground. Once this position is achieved, rapidly extend the hip, knee, and ankle of the lead leg until peak plantarflexion causes the athlete to leave the ground. Special attention should be paid to the landing component of this exercise. The athlete will be landing on the lead-leg with the rear-foot still positioned on the roller pad or bench. The athlete should have good landing mechanics and the ability to absorb high levels of force unilaterally before performing this exercise.

Equipment Needed: Roller pad or bench; balance disc; weight vest (athlete dependent)

Key Coaching Cues:

- Load into a position with the thigh of the lead-leg approximately parallel to the ground with the trailing knee 1 – 2 in. from the ground; cock the arms back
- Rip the arms toward the ceiling; push the lead leg through the ground
- Triple extend and leave the ground
- Land softly flexing the knee and hip of the lead leg

The inclusion of these exercises is recommended in the strength/power phase of a traditional periodization model. If a daily undulating periodization model is being employed, it is recommended that these exercises be incorporated in the workout of the week that is power focused. Regardless of the periodization model chosen, these exercises should receive priority and be completed at the beginning of the training session to ensure that the fatigue of subsequent exercises does not compromise the athlete’s maximum rate of force development. It is recommended that these exercises be prescribed for 3 – 5 sets with a repetition range of 3 – 5 repetitions per set. The suggested rest time is 2 – 5 min between sets (2).

PLYOMETRIC CONCENTRIC BOX JUMP

Set-Up: Stand in an upright stance facing the box with the feet hip-width to shoulder-width apart. The arms should be extended overhead.

Execution: In a simultaneous motion, rapidly swing the arms back and down while flexing the knees and hips into a quarter squat position. Once this position is achieved, without pausing, rapidly swing the arms upward while extending the hips, knees, and ankles to drive the body off the ground. The landing on the box should include rapid flexion of the hips, knees, and ankles in a half squat position. The technique of a plyometric box jump does not have a high level of difficulty; however, there should be a focus on proper landing mechanics when it is implemented, and these skills should be mastered before the exercise is progressed. In the ideal landing position, the ankles, knees, and hips are flexed with the shoulders over the knees and the knees over the toes (2). The plyometric box jump can be progressed by increasing the height of the box or adding a weighted vest. The exercise can also be progressed to more intensive lower-body exercises, such as depth jumps, lateral box jumps, or a bounding/hurdle series that conclude with a box jump.

Equipment Needed: Adjustable plyometric box set ranging from 6 – 42 in. (preferably with a foam or rubberized landing surface to reduce the risk of injury with a failed jump attempt).

Key Coaching Cues:

- Rip the arms down
- Then rip the arms toward the ceiling; pushing the feet through the ground
- Triple extend and leave the ground
- Land softly flexing the knees and hips

CONCLUSION

Weightlifting exercises and their derivatives are commonly employed by strength and conditioning professionals to enhance explosive power. While the implementation of weightlifting exercises can be beneficial as they stimulate greater motor unit synchronization and therefore improve the ability to generate power, there are several disadvantages to exclusively practicing weightlifting for power development that should be considered when designing an effective training program. The aforementioned exercises are safe and require less skill to perform at maximal output. As such, strength and conditioning professionals should consider alternative exercises that are not technique-intensive exercises for novice lifters, large groups, and athletes with orthopedic limitations.

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THE TRIBE MINDSET—DEVELOPING A MEANINGFUL TEAM CULTURE

JUSTIN KILIAN, MED, CSCS, AND ALLISON SCHAEFER, CSCS

Athletes desiring to compete in team sports are required to be teamed up with other athletes. Teams are necessary groupings of athletes based on the requirements of each sport, yet unifying athletes under a team name does not guarantee cultural unity—inter-squad divisions are prevalent despite the theoretical unification of individuals under a team name. Alternatively, a tribe mindset is more than wearing the same jersey as someone else. The alignment of all athletes on a team to be unified by a team culture has been reported as an essential element for success (4). There is a shift in perspective where each member of the tribe aligns him or herself with a set of core assumptions, values, and common goals that are more about the success of the team than individual accomplishments. When athletes internalize these values and goals into a meaningful team culture, they can be unified in purpose and mission, which has the potential to elevate the ceiling for what a team can accomplish athletically (4). Being a part of a team is a requirement of athletics. Voluntarily buying into the cultural expectations within a team is what the tribe mindset adds to the experience.

While the anthropological term of "tribe" is fairly well understood due to its worldwide use both now and throughout history, a tribal mindset is harder to grasp. Numerous definitions and applications exist, but for this article, a tribe can simply be defined as a collection of athletes with a united set of beliefs and values, which influences behavior beyond the surface categorization of a sports team (9). A tribe mindset opens up the value of membership to all internal and external social interactions and decisions, whether directly related to athletic performance or not. Concurrently, the tribe mindset refers to the collective acceptance of team culture, which influences the day to day behaviors that benefit the team culture and support optimized performance outcomes (6).

To develop a tribe mindset that perpetuates a meaningful team culture, each team needs to first identify what type of social grouping they are on a continuum from individualistic to collectivistic. If a team can embrace a collectivistic mindset, they are ready to develop their team culture by intentionally defining their core values and exemplifying those core values consistently in a way that demonstrates value to each member of the tribe. The purpose of this article is to highlight some practical methods to develop a collectivist mindset, unified around core team values, and translate those theoretical constructs into actionable development of a meaningful team culture.

SOCIAL GROUPINGS

A first distinction to make when discussing social groups is between individualism and collectivism, which can be categorically defined as an inclination towards autonomy and independence or group solidarity, respectively (3). Individualistic mindsets will be focused on the separation and uniqueness of each athlete rather than the overarching value of the team or school. On the other end of the continuum is collectivism, which emphasizes the equal value of each athlete, based on their unique contributions to the team as a whole.

Many coaches fight the ego-driven culture killer of the individualistic athlete with catchphrases such as "we before me" or "there's no 'I' in team." While the sentiments behind these sayings are well-intentioned, they fail to direct the athlete towards a mindset on the collectivist side of the continuum. Instead, the athlete might feel a sense of personal loss if the celebration of individual accomplishments is minimized, despite the drive for personal success not necessarily being a bad thing. A true tribal mindset captures the heroics of every athlete in a way where personal accomplishments can be shifted from isolated acts of an individual to contributions of an individual toward a collective goal.

Celebrating a person in the context of how their efforts directly contributed to the success of the team is one way to develop the meaningfulness of the social group for everyone involved. A tribe mindset expands the value of athletes beyond the top playmakers to include every person associated with the team, thus creating a broad cultural foundation to build success on (4). Expanding congratulatory remarks beyond standard metrics is another way a forced social group of a team can be transformed into the cultural paradigm of a tribe. A tribal mindset adopts the notion that win, lose, or draw, the outcome is a team effort and will not be attributed solely to the individual efforts of any particular athlete. In this way, teams can avoid the win together/lose alone mindset because the value of the tribe is defined by their culture rather than just wins and losses (4).

In the weight room, coaches may choose to highlight measures including improvements in one-repetition maximum (1RM) to draw attention to the value of contributions made from team members who may not be the strongest, yet work hard for the team. A tribe mindset is displayed when the hype man on the sidelines who does not see a minute of playing time is recognized for embracing his role in the same post-game meeting that the game ball is handed to the player who scored the winning point.

While absolute performance is important, coaches must maintain awareness that during practice, teams compete against themselves. If only high-minute players feel valued, who will push them during practice to potentially increase their levels of performance? Alternatively, when every member of the tribe has a role and feels valued in that role—whether it be a leading or supporting role—a shift can be made from the individualistic mindset to the collectivist tribe mindset. This shift is the foundation for developing the intended team culture because it is a unifying transition from individualistic to collective efforts.

BE RELATIONAL

Once a collectivist orientation is created, the first step to developing a tribe mindset is to be relational by forging genuine connections with people. Connecting with athletes on a personal level is what enables coaches and other leaders to meet each member of the team where they are and facilitate buy-in by fulfilling each individual's innate need for belongingness and connection. As a behavioral model, self-determination theory posits that people require a basic sense of connection with those around them before they can optimally translate inner abilities to external behavior (1). A coach can figure out what is going on behind the scenes by asking probing questions that do not show up on an athlete readiness questionnaire. Subjective assessment tools are great to integrate into a training session.

However, these tools need to be used wisely to develop and maintain meaningful relationships with athletes. If an athlete has reduced sleep quality or quantity, steps need to be taken to inquire for specific information regarding why the athlete is not sleeping. If a meal was skipped, determine the circumstances that caused the athlete to go without food. If a training session is mediocre, ask about circumstances outside of training, such as school or social stress, instead of simply telling athletes to work harder based solely on data from athlete monitoring tools. When people feel valued and understood, they are more likely to reciprocate efforts to connect because they have a greater intrinsic motivation to act in a way that produces positive performance-related outcomes (1). If athletes are treated more like autonomous people and less like a position, they will be empowered to have a greater sense of self, which leads to a better connection with their team and better performance outcomes. Without a relationship, developing a team culture becomes too much of an externally regulated process (team expectations) and not enough of a democratic participation in a social grouping (tribe mindset).

It is important not to confuse caring-for and caring-about an athlete. Caring-for an athlete entails making sure he or she has all the physical tools in place to perform optimally. Caring-for an athlete includes *what* ought to happen to optimize training. Applying Schein's Model of Organizational Culture, caring-about *why* an athlete is training in the first place is far more important (6). In Schein's model, three fundamental layers explaining organizational dynamics are assumptions, values, and artifacts. The central tenet of this model is assumptions, which are intrinsic beliefs explaining the "why" underpinning the behaviors of each athlete. These intrinsic characteristics are the cultural DNA of an individual and are the presuppositions by which athletes choose to act (7). Values, then, are the shared expression of internally held beliefs common to a group of people. Values explain how a team prioritizes personal characteristics and behaviors of involved athletes. The philosophy underpinning team culture is explained by team values. The outer shell of this model is labeled as artifacts, or the "visible cultural products" of what a team does (7). Artifacts are the visible applications of invisible values.

If coaches can foster genuine relationships with athletes, the opportunity arises to transition athletes from external conformity within the artifacts layer back to the internal buy-in of team values in the assumptions layer (6). An athlete on a team may conform to external standards of behavior without fully committing to those standards (4). Alternatively, the tribe mindset is one where not only are certain behaviors expected (i.e. artifacts), those behaviors are fully adopted by athletes because they have internalized those behaviors as presuppositions (i.e. assumptions) underpinning all behavioral decisions. This level of unification far surpasses the simple organization of an athlete on a team and explains the next level of depth afforded by a tribe mindset.

For many athletes, sharing why they are competing is a challenge because innate values are hard to articulate. A surface relationship based on a workout sheet will always be inadequate for uncovering an individual's why (internal assumptions), let alone leading that individual to align with the mindset of the team. Leading a team towards a meaningful team culture is a tricky balance between understanding the why of each member and helping align each why with the core values of the team (i.e. the team why). When coaches understand the value system that drives their athletes to compete, it is easier to develop unity around shared values and create well-developed and sustained assumptions. These assumptions are the foundation for a meaningful team culture via enhanced connectedness; the glue that holds a tribe together and provides the foundation for elevated performance (1).

BE INTENTIONAL

Developing a *meaningful* team culture does not happen by accident. Without proper cultivation, a team culture will develop, but it is unlikely to be the culture desired by the coaching staff. Purposive actions initiated by coaches and team leaders are the foundation for creating a tribe mindset that players can understand and get behind (4). These actions must be evaluated in terms of their effectiveness for communicating what has been called the core values or "most valuable characteristics" (5). To borrow a military term, "vital ground" is a location that must be retained at all costs for a mission to succeed. "Cultural vital ground" can then be understood as the non-negotiable core assumptions the team must retain at all costs if they are to succeed in their mission. Cultural vital ground has to be defined and intentionally translated from a concept to a framework for future behavior—a team "why." It is easy to come up with a cliché catchphrase that looks good on a t-shirt or a locker-room wall, but the integration of the philosophy underpinning that statement requires a great deal of intentionality.

As an example, for one collegiate lacrosse program, gratitude is the vital ground necessary to provide the foundation for the entirety of the team culture. Through this lens, athletes are encouraged to view all of their behaviors, both on- and off-the-field. They enter the weight room grateful for the opportunity to train in exceptional facilities. They enter the locker room grateful to be surrounded by a band of teammates who have a unified purpose for entering that domain. With gratitude, they don their jerseys on game-day, proud to represent their school and their program. Coaches and staff intentionally provide reminders for the team to be grateful. For example, the vital ground is written on the walls and integrated into practice plans, community service projects, and pre-game speeches to ensure the theme of gratitude is intentionally present and continually relevant. The very fabric of the team is intentionally described using the core concept defined by this particular team.

BE EXEMPLARY

When the vital ground is clearly defined, a social group can rally around the core value system to make the transition from a collection of people to a tribe with not only a common goal, but also a common plan for how to reach that goal. However, intention can easily be overridden by a lack of action. Ideas without implementation quickly eradicate any benefits from the ideas because the implementation is what causes change, not just having a notion of what could be. The easiest way to freeze cultural development is when nobody can exemplify what the vital ground looks like in practice. Philosophy without supporting action is the difference between the values layer and the artifacts layer of Schein's Model of Organizational Culture (7). Exemplary behavior should be built on the core values of the team and modeled by the coaches and encouraged in the athletes instead of situations where values and behaviors are disparate systems.

Leaders should lead by example, devoid of hypocrisy. A team that chooses respect as their vital ground cannot have coaches, captains, seniors, or any other player being disrespectful to other team members. If integrity is the vital ground, players should be owning up to their mistakes on and off the field instead of shifting blame to someone else. If work ethic is defined as the vital ground for a team, maybe the seniors should take care of setting up practice by bringing water or equipment out to demonstrate what the team culture of work looks like to newer players. Regardless of what value(s) a team exemplifies, each coach and player should be above reproach, demonstrating what the vital ground looks like in practice—this is the difference between a philosophical value and an intrinsically held assumption (7).

BE CONSISTENT

The hard part about being exemplary is consistency. Once the vital ground is defined and the team gets the hang of exemplifying the vital ground, there has to be a deeper conviction beyond temporary excitement or passive compliance. A tribe mindset internalizes team standards and implements them into practice. The famed boxer, Mike Tyson, once told a reporter that "everyone has a plan until they get punched in the mouth" (2). It is easy enough to get on board with a team culture when things are easy; however, when things get hard and emotions of competition start to take over, consistency can become a challenge. Despite an intentionally developed culture, lack of consistent implementation gets in the way of success (4). Teams have rules, tribes have integrated culture.

For this reason, the best method for consistency is the daily adherence to the practical application of the assumptions and values defined as the team's vital ground. Cole and Martin referred to these consistent informal expressions of team culture as "rituals," which were simple behaviors with deep-seated roots back to core values and assumptions (4). By being purposeful in everyday actions when very little is on the line, teams can reframe their perspectives to create a new baseline for behavior. Behavior can be reinforced with accountability, where every member of the team holds every other member of the team to the same standard. Attention to the consistent application of the cultural vital ground is not something that will all of a sudden appear on game-day. Under pressure, most people tend to fall back to their normal habits. If the vital ground has been consistently established as a habit, it is more likely to be present during the pressures associated with competition.

For example, if a team has not learned respect before the conference championship when the team is down by two points and mistakes are made on the field, little will be accomplished by a coach reminding players to develop respect for one another and work as a team to fix the mistakes and rally. Instead, players are more likely to succumb to the emotions and stress of the situation, which do not always lead to productive behaviors. Times of stress are not times to develop character. Rather, these stressful circumstances reveal the character that has been consistently developed before that moment. Therefore, coaches especially, have a great responsibility and opportunity to pour into their athletes to develop the team culture through positive reinforcement and democratic implementation of team values (1).

As an example, when players act in a way that aligns with the team culture there can be informal recognition of their success. Even formal recognition of exemplary behavior can take the form of post-practice shout outs or weekly character awards. The democratic part of this process is to include players in the celebration of their teammates' success. Not all recognition needs to come directly from the coaches. In this way, everyone involved has a vested interest in the development of the team, with the intent to translate the fundamental culture into optimized conditions for peak performance.

CONCLUSION

Ideally, each member of a team wants to identify with a tribe that represents who they are and why they do what they do. Ideally, each athlete is compliant and eager to be identified with the team culture and adopt a tribe mindset to promote success for the team. In reality, overcoming less than ideal circumstances is generally the norm. Most good things take hard work to develop, which is not a bad thing. Working diligently to develop a tribe mindset increases the value of the tribe beyond simply a group of athletes on a team and helps to internalize the associated mindset, making it into a lasting culture rather than just another catchphrase.

When each athlete finds identity as a valuable part of their tribe rather than solely a roster spot, they are less likely to be resistant to the influence of proximal relationships. To capitalize on the existing social structure of a team, coaches should intentionally choose vital ground that defines the core assumptions and values of the team and sets expectations for behavior. Supportive behaviors should be exemplified by team leaders to provide a consistent model for the rest of the team. However, developing a tribe mindset has to be in the context of interpersonal relationships among players and coaches. Without personal connections, athletes are simply spots on a roster. With a tribe mindset founded on a meaningful culture, teams are poised to achieve their greatest potential (4).

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INCREASE HIP AND TRUNK STABILITY WITH LOADED CARRIES FOR INJURY PREVENTION, REHABILITATION, AND PERFORMANCE

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INTRODUCTION

Core strength is a popular topic in the fields of strength and conditioning and rehabilitation as it can aid in both athletic performance and injury prevention. The term "core strength" or "core stability" has many definitions in the literature, including the ability to maintain proper trunk position over the pelvis to efficiently produce, control, and transfer force during any athletic activity (14). The definition of "core" includes all muscles that attach or insert between the shoulder girdle and pelvis because they all impact the axial system and control of trunk and torso muscle activity (18).

Core strength can effectively be developed through exercises that are mat-based, ball-based, and whole-body (14). One of the most effective ways to develop core strength is through loaded carries, a whole-body exercise. Loaded carries are movements that consist of "loading" oneself with a weighted implement and walking for a predetermined distance or time. As an effective, yet simple exercise variation, loaded carries can develop and enhance muscle strength, as well as training proper movement patterns (1).

There are several variations of loaded carries that are used to target different parts of the body. These variations of exercises challenge the body's stabilizing system to possibly find weak links in the body that can lead to either suboptimal athletic performance or injury (10). There are two variations that will be the focus of this article: the traditional (bilateral) farmer's walk (Figure 1) and the unilateral famer's walk (Figure 2). Winwood et al. suggest that the farmer's walk exercise is a valuable training implement that requires the use of unstable and awkward resistances that stabilize uniplanar and multiplanar motions (17). Programming this exercise may have the potential to increase anaerobic endurance, back endurance, and grip strength. Other variations of loaded carries include the yoke walk (weight across the upper back), rack carries (Figure 3), Zercher carries (Figure 4), and unilateral overhead carries (Figure 5) (10). Dumbbells are a common implement to use as the load; however, kettlebells, barbells, and weight plates can be used as well.

These variations of exercises require the body to maintain posture through coordination of trunk and hip musculature activation (6). It is important for strength and conditioning professionals to understand why and how to properly implement loaded carry exercises for the safety and development of the athlete. There is currently little research on loaded carries in the fields of strength and conditioning and rehabilitation. Therefore, the goal of this article is to understand contralateral and ipsilateral loading, how to set-up exercises, EMG activity during exercises, and how to apply these exercises into the strength training program. Better understanding of these areas will help coaches better select exercises based on the needs of their athletes and corresponding sport demands.

FIGURE 1. FARMER'S WALK

FIGURE 2. UNILATERAL FARMER'S WALK

FIGURE 3. RACK CARRY

FIGURE 4. ZERCHER CARRY

FIGURE 5. UNILATERAL OVERHEAD CARRY

FIGURE 6. BOTTOMS-UP CARRY

CONTRALATERAL AND IPSILATERAL LOADING

One reason that exercise selection is particularly important with loaded carries is because it impacts the position of the load. One muscle that is heavily impacted by the carrying position is the gluteus medius. When carrying the dumbbell on the contralateral side there appears to be greater gluteus medius and vastus lateralis muscle activity compared to very minimal activation when carried on the ipsilateral side (10). However, there is the possibility of cross education; the contralateral strength gain following unilateral training of the ipsilateral limb (4). It is currently believed that neural mechanisms are responsible for the cross education of contralateral musculature as there is no hypertrophy in the untrained side (2). A recent large review of unilateral training studies reported cross education strength gains of 18% in young adults, and 29% in a rehabilitation setting (4). Therefore, cross education is of clinical importance for rehabilitation and strength and conditioning professionals.

EXERCISE SET-UP

There are many ways to implement the loaded carry. A general rule of thumb for these exercises is to maintain an upright torso, walk slow and controlled, and to avoid any lateral bending of the spine for unilateral exercises. All exercises that are described can be programmed as either timed exercises or over a set distance. A good starting point for someone who is deconditioned or coming back from an injury would be the farmer's walk carrying equal weight in each hand. From there, the practitioner can decide to implement unilateral farmer's walks, otherwise known as suitcase caries, where weight is carried on one side. Suitcase carries can progress into advanced, loaded carry variations.

The waiter's walk challenges stabilizing muscles in the shoulder and is performed by carrying weight overhead in one hand. Rack carries are performed by placing two kettlebells or dumbbells on the anterior portion of the shoulder and upper chest. The bottoms up walk (Figure 6) is preferably performed with a kettlebell and challenges stabilizer muscles of the wrist and shoulder by holding the kettlebell upside down by the "horn" with the shoulder flexed at 90 degrees and the wrist staying neutral. Loaded carries can be placed into the beginning of a workout to potentiate the neuromuscular system or at the end of a workout session as a form of conditioning (1).

EMG RESEARCH

The use of loaded carries became popular through the sport of strongman. Strongman events represent functional movements in multiple planes that challenge the entire body. As a result of increasing popularity in strongman events, strength and conditioning professionals are now using these movements in their programming. McGill et al. compared muscle activation of different strongman events showing the importance of the lateral spine muscles, such as the quadratus lumborum and the lateral abdominal wall, during the suitcase carry as they have been found to stiffen the pelvis to prevent it from bending toward the side of the leg swing (9,10). Pelvic stiffening helps the hip abductors create a stable platform for the spine. During the farmer's walk, peak muscular activation of the abdominals and rectus femoris occurred during the stance phase, and peak activation of the latissimus dorsi, thoracic and lumbar erector spinae happened during the swing phase (10).

Walking, with or without loads, is a fundamental occupational activity and needs to be investigated at submaximal loads. It is also useful to compare the differences in carrying weight in one hand versus two. McGill et al. found that carrying a load in one hand generates a greater spine load than if the load were split between two hands (8). When carrying the load in only one hand, compared to having a balanced load in each hand, there was a greater spinal load even though twice as much weight was carried when both hands were loaded. It is also valuable to examine muscles of the lower body when performing the farmer's walk. Previous research has reported that individuals with a hip abduction to hamstring strength ratio (HAB:H) of less than one have greater activation of gluteus medius activity during exercises such as the farmer's walk. This could be of importance when programming for injured or previously injured athletes (16).

Other loaded carry styles that have been examined are the "racked" and "bottoms up" carry. McGill et al. reported that torso and hip activation were very low for both styles of carries, with 0.1% maximum voluntary contraction (MVC) for the racked group and 14.3% MVC for the bottoms up group (8). These trials were compared to normal walking. However, low activation for the hips does not mean that these exercises are useless, but it does mean that they would not aid in developing hip or trunk stability.

PRACTICAL APPLICATION

Core muscle training and health are highly important in strength and conditioning and rehabilitation settings. Core strength helps maintain proper core stabilization and force transmission. During dynamic, loaded movements in sports, athletes are required to maintain stability while also performing the necessary skill. As previously mentioned, core stability has many definitions, but can be defined as the ability to maintain proper trunk position over the pelvis to efficiently produce, control and transfer force during any athletic activity (14). These sporting activities require force transmission from the ground to be transferred to the core muscles to the distal segments. If the core muscles are strong, then force transmission is efficient and little energy is wasted (14). It is very common for athletes with weak hip musculature, especially the gluteus medius, to later develop associated knee pathologies (12). Unsurprisingly, weakness at the hip can also contribute to upper body injuries such as shoulder labral tears (7). This associated injury risk shows the importance to consider loaded carries as a training tool to reduce injury risk and ensure proper force transmission.

When programming loaded carries for sports, we can evaluate the role of core strength when it comes to running and cutting. Running and cutting are quick movements, and any spine bending that results with a drop in the pelvis on the swing leg side can be described as an energy leak leading to an inefficient system that requires the athlete to use additional energy stores to produce the same amount of movement (8). One particular problematic area to look for is the presence of valgus collapse at the knee. This is a known risk factor for ACL tears, as well as generalized knee pain. Because non-contact ACL tears are common in female athletes, with Q angle (i.e., the relationship between the anterior superior iliac spine and intercondylar ridge) being reported as a contributing factor, loaded carries may be one way to help strengthen the gluteus medius to prevent excessive valgus collapse (7,13).

When considering the shoulder, these exercises could also benefit athletes who spend a lot of time overhead such as basketball players, throwing athletes, and wide receivers. Many of the thoracic muscles are activated during loaded carries and can help maintain proper scapulothoracic function. In addition to maintaining proper subacromial space, these exercises would add an additional stability aspect when the athletes are reaching overhead. Maintaining proper subacromial space and glenohumeral stability is important for athletes that spend a lot of time in an overhead position (i.e., throwing athletes, swimmers, and lacrosse players). Glenohumeral stability is especially important for wide receivers who need to jump with their arms extended and are often hit in this position.

These exercises can also be applied in rehabilitation settings. As previously mentioned, a cross education effect appears to occur with the contralateral side. Although most of the movements require ambulation, it is possible to have them just hold a designated position to strengthen the muscles, along the lines of Trendelenburg's test. Trendelenburg's test is designed to determine if there is a weakness in the gluteus medius. It is accomplished by have the individual flex one hip to 30° and looking for a drop in the unsupported limb (5). These exercises can also be used with individuals who have undergone ACL repairs. Depending on if any meniscal damage was repaired, these individuals are usually allowed to weight bear and walk fairly early in their recovery process. Once a normal gait pattern is restored, these exercises could be added to develop hip strength in a weight bearing position without adding stress to the knee.

Because there is currently limited research available on loaded carries, there are few recommendations on number of sets, time under tension, and distance covered for safe programming. However, Holmstrup at al. were the first to present safe maximal loading parameters for the unilateral farmer's walk (UFW) (6). The parameters used were fat free mass (FFM) and the Balance Error Score System (BESS) test. FFM includes all tissue in the body that is not composed of fat (i.e., lean muscle mass, organs, connective tissue, bones, and water). The BESS test involves counting "errors" or times of lost stability the individual encounters during a 30 second period. All tests are conducted with the eyes closed and the hands on the iliac crests. The three testing positions are 1) standing on both feet with them touching, 2) on the non-dominant foot only, and 3) feet in tandem with the non-dominant foot in the back (3). These standards are set at UFW = (0.819 x FFM) + (0.482 x BESS) – 9.411. While these parameters are not perfect, they give the training professional a practical, evidenced-based approach to determine load for the unilateral farmer's walk.

Due to a lack of scientific evidence, anecdotal evidence from fitness professionals presents the next best evidence. Butcher et al. suggest 2 – 4 rounds for 10 – 20 s with a weight that is challenging (1). For measures of functional strength, these researchers have also provided metrics for performance across different populations including:

- Rehabilitation: 50% of bodyweight carried for 30 s
- General fitness: 100% of bodyweight carried for 30 s
- Elite sports performance: 200% of bodyweight carried for 30 s

These recommendations are based on the bilateral farmer's walk, but can provide a foundation for many other exercises as well.

CONCLUSIONS

A review of the literature shows that the implementation of loaded carries can improve hip and torso muscle function, leading to improved systemic muscular function. Focusing on core strength via loaded carries for athletes can decrease the rate of injury, as well as be useful for rehabilitation. The information provided in this paper adds to the growing body of literature on loaded carries particularly due to strongman events. There is a need for additional future research to develop safe loading patterns and program recommendations for all variations of loaded carries and for specific populations.

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A MINDFUL LIFT—BENEFITS OF MINDFUL MEDITATION IN STRENGTH AND CONDITIONING—PART 1

ELIZABETH HOPE, MA, USAW-2, MEAGAN WILSON, AND BRIAN GEARITY, PHD, CSCS, FNSCA

INTRODUCTION

Over the past several decades, mindful meditation (MM) has been considered a useful mode for optimizing sport performance by strengthening one's focus, attentional control, and body awareness (3,4,5,10,11). As a form of present-moment awareness, MM stems from concepts grounded in Eastern religion and philosophy and has been defined as paying attention in a particular way, on purpose, in the present moment, and without judgment (13). During a successful mindfulness meditation, athletes experience current feelings, thoughts, and bodily sensations with all senses very clearly and plainly, as something that passes by, without judging, evaluating, or having to act on these sensations (4,5,11,13). In a typical mindfulness exercise, meditators aim to focus their attention on a particular experience and become fully aware of this experience, such as one's breath and the sensations it evokes in various parts of the body. Practiced regularly over a more extended period of months and even years, this state of mindfulness is considered to convert into a stable, dispositional tendency to be mindful (1,3,4,11,13,15,16,19).

Although many coaches, trainers, and athletes recognize and appreciate the need for this type of mental training, it is not often given the time or practice warranted (4,13,21,22), leaving untapped potential for athletes and coaches alike. In this article, the first of a two-part series, we will discuss how applying MM in conjunction with strength training can enhance one's attentional control, which then results in a more successful strength and conditioning training session (4,10,11,15,16,25). In part two of this series, we will explore the possible benefits for strength and conditioning coach development and discuss how MM can improve reflective practice and the coach-athlete relationship.

BENEFITS OF MINDFUL MEDITATION

Influenced by Mindfulness-based Stress Reduction (13,14), MM often consists of three primary meditation practices (13,14). These include 1) mindful breathing, in which participants focus their attention on their breathing, body sensations, and their stream of thoughts and emotion; 2) body scan, in which participants sequentially and non-judgmentally focus their attention on parts of the body; and 3) mindful movement, in which participants cultivate mindful awareness of the body while it is moving (6). Athletes that practice MM become more aware, intentional, and purposeful in every movement (3,4,9,10,11).

Research shows that the mechanism of action in mindfulness is improved mental efficiency through the development of greater awareness and acceptance of internal experiences, thus freeing the athlete to focus more attentional resources on his or her performance (1,3,4,11). MM practice builds the athlete's ability to automatically notice and direct their attention to what is absolutely essential, without needing to consciously reduce or control reactions to other potentially distracting experiences to do so (1,4,8,11,21,23). The core belief of a mindful approach is that a person performs best when staying with a nonjudgmental, moment-to-moment awareness and acceptance of one's internal state, with his or her attention focused on what is essential for performance and a consistent, intentional behavioral effort of actions that support what he or she values most (4,11,13,14,21,23). By practicing MM, athletes focus on internal and external information, connecting their minds and bodies more directly to the present moment, which in turn enhances one's athletic performance (4,11,13,14).

ATTENTIONAL FOCUS

Through weightlifting, a key component of strength training for other sports, as well as a competitive sport in its own right, an athlete develops muscle strength, muscle mass, and joint strength (17,18). There are a multitude of lifts an athlete can execute to achieve desired results, depending on the muscles and equipment used during the exercise, as well as the speed, duration, and complexity of the movements (17,18). An athlete's attentional focus has found to play a large part in the level of results as well (15,16,19). Researchers have found that attentional focus can improve the action and the outcome of one's lift (15,16,19,26).

Attentional focus, a well-recognized aspect of motor learning (26), has been studied to discover how internal or external attention affects athletes (15,16,19,26). For example, Wulf and Lewthwaite found that the increased muscular accuracy of force production created by increased attention control allows an athlete to lift the same weight with less muscular effort (26). Whether an athlete is internally focused on squeezing their glutes as they ascend or externally focused on driving the floor away from their body (20), it seems clear that reliable attentional control and awareness are valuable skills when lifting weights during strength training (19,26).

IMPROVED LIFT EXECUTION

Once an athlete has learned to focus their attention through MM practice, the athlete might find that lifting weights and meditation have a way of supporting each other. During a training session, if one is firmly aware, in the present moment, and "in" their body, then they find themselves less distracted, less preoccupied with excessive self-analysis, and entirely centered and focused on the task at hand, which results in an enhanced lift (7). In practicing meditation, the athlete catches their mind wandering; just as in resistance training, the physical feedback and sense of disharmony are immediate and palpable if one is not fully mindful. Humphrey described this acute sensory awareness of the intricate workings and sensations of the body, as the ability to be wholly connected in mind and body (12).

PRACTICAL APPLICATION

This acute sensory awareness and increased attentional control have been experienced by athletes who regularly practice MM, such as breathing meditation, body scans, and mindful movement (4,6,11). There are many audio versions of each of these MM practices that can be found online; however, a written version of each is provided below adapted from Baltzell and Summers' 2017 book that lays out their program, the Mindfulness Meditation Training in Sport (MMTS) (4).

MINDFUL BREATHING

RECOMMENDED BEFORE OR AFTER TRAINING

The athlete first finds a quiet place to sit comfortably or lie down, ensuring the position is sustainable for the whole exercise. Sitting upright or lying down with arms and legs comfortably at the side is recommended. If, at any point, the athlete feels uncomfortable and has the urge to move, they should first become fully aware of the feeling before making a mindful adjustment. Based on what is most comfortable, the athlete chooses to close their eyes or soften their gaze. As the MM begins, the athlete turns their total attention to their breath. If during the practice, the athlete's focus migrates to other thoughts or feelings, the athlete fully and non-judgmentally accepts that all minds wander and redirects their attention back to their breath. One's breath is kept at a comfortable pace and depth, inhaling to the count of four and exhaling to the count of two. The athlete will notice the physical sensation associated with breathing and allow their awareness to rest there. As thoughts, feelings, physical sensations arise, the athlete notices the shift and gently brings their attention back to breathing again (4,6). After three to five minutes, the athlete then slowly opens their eyes and carefully resumes their routine.

BODY SCAN

RECOMMENDED BEFORE TRAINING OR BEFORE EACH LIFT DURING REST PERIODS

Body scan MM practice helps athletes become more attuned to the sensations in their bodies while also strengthening attentional flexibility, as they sequentially shift their attentional focus to various regions of the body (4,6). One such way to use this type of MM practice is as the athlete stands quietly before the upcoming lift, they can quickly complete a body scan, shifting attentional focus from one major muscle to the other. In doing so, the athlete starts from the head and moves gradually down to the toes, focusing attention on the feeling and sensations of each of the major muscles along the way. For example, is the muscle tense, rested, or on fire? The athlete repeats the process throughout the body and all the major muscles (4,6,24). At the very end of the body scan, the athlete then takes three deep breaths as they transfer their focus to the task at hand. By performing a body scan during rest periods of a workout, one can assist the parasympathetic response while building mindful awareness simultaneously (17,18).

MINDFUL MOVEMENT

RECOMMENDED DURING THE ACTUAL LIFT

The practice of MM is a helpful, practical way for an athlete to bring themselves into a fully present state of awareness. Bringing awareness to physical sensations of the muscles that are being worked allows the mind and body to work together to obtain efficient and effective results. One example of how to practice MM during strength training is by having the athlete focus on their feet as they stand before the weights. As the athlete steps up to the equipment, their focus is on how their feet feel against the floor, how the arches of their feet feel versus the balls of their feet, and where they have distributed their weight. As the athlete starts the lift, their attention moves to the muscles as they are engaged. Throughout the lift, there are multiple muscles, feelings, and thoughts the athlete may choose for focused attention, but it is that focus that will lead to heightened attentional control and, thus, enhanced performance (4,6).

CONCLUSION

To be clear, mindful strength training is not about being quiet or peaceful, but about being deliberate with and aware of every action and thought regarding the task an athlete's body is about to perform, whether it is a plank, plyometric jump, or a deadlift. By ritually practicing mindfulness, an athlete can set the stage with enhanced awareness and attentional focus that can increase the efficiency and effectiveness of training, and ultimately enhance one's execution of a more powerful and mindful lift (4,8,11,23). In the next article of this two-part series, we will explore the possible benefits of MM training for coaches. We will explain how the benefits mentioned throughout both articles provide performance enhancement for athletes and coaches, as well as the positive impact that MM can have on the coach-athlete relationship.

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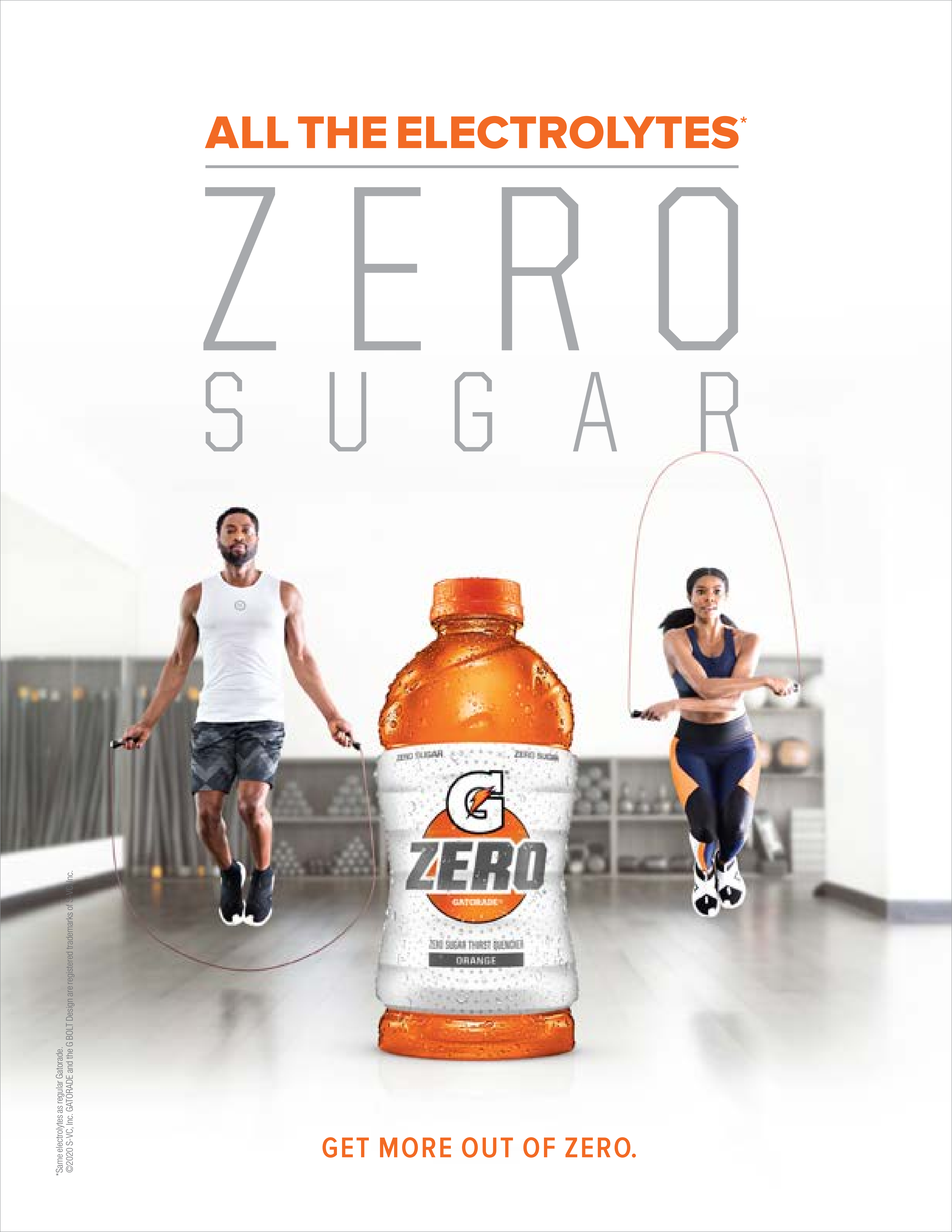

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