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Integrating Balance and Postural Stability Exercises into the Functional Warm-up for Youth Athletes

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SUMMARY

THE GOAL OF THE FUNCTIONAL WARM-UP IS TO STIMULATE SENSORY AND MOTOR COMPONENTS RELATED TO PREPARATORY (FEED-FORWARD) AND REACTIVE (FEED-BACK) SYSTEMS THROUGH FUNCTIONALLY INTEGRATED MOVEMENT PATTERNS. THIS ARTICLE PRESENTS BALANCE AND POSTURAL STABILITY EXERCISES THAT ARE EASILY IMPLEMENTED INTO THE FUNCTIONAL WARM-UP AS A MOVEMENT PREPARATION STRATEGY FOR YOUTH ATHLETES.

INTRODUCTION

In recent times, there has been a significant interest in the application of balance and postural stability (BAPS) exercise as part of a functional warm-up to enhance neuromuscular activation (16,20). The use of BAPS exercise stems from the field of neuromuscular rehabilitation, with such exercises believed to promote integration of the neuromuscular communication pathway via preparatory (feed-forward) and reactive (feed-back) systems (23,26). That is to say, BAPS exercises enhance proprioceptive input and kinesthetic awareness (15), increasing muscle activation, leading to greater dynamic core stability and postural control (2). For purposes of this article, dynamic core stability is defined as the body's capacity to maintain or resume a relative position of the trunk after perturbation (25).

Conversely, impaired neuromuscular control of core stability and balance may increase the risk of back and lower extremity injuries in athletes (23). From a movement preparation perspective (1,22), the inclusion of BAPS exercises has been shown to enhance proprioceptive input and kinesthetic awareness (18,21). This is of particular importance before strength training because many strength training exercises aimed at enhancing athletic performance, such as the hang power clean and jump squat, are inherently unstable and require neuromuscular control to maintain dynamic core stability and postural alignment (9). During such exercises, neuromuscular control of the trunk is based on reactive (feed-back) control (24). The information concerning the position of each segment in the kinetic chain is fed back and used to modify the descending movement commands. Therefore, deficits in neuromuscular control contribute to unstable or faulty movement patterns throughout the kinetic chain (25).

Strength and conditioning coaches often prescribed BAPS exercise as part of neuromuscular training programs, with injury prevention/prehabilitation (6,19) and balance/core training (4,6,19) described as key areas of development.

Published surveys indicate that 40% of strength and conditioning coaches associated with the National Basketball Association (19), 17% associated with the National Hockey League (4), and 9% associated with Great Britain

KEY WORDS:
balance and posture; functional warm-up; youth athletes; warm-up; dynamic; balance; postural stability

Rowing (6) prescribe BAPS exercises. However, there is little information available regarding the use of BAPS exercise as a movement preparation strategy within the functional warm-up (7). The goal of BAPS exercise is to enhance an athlete's movement preparation strategy by improving hip/pelvis/trunk stability and coordination in an attempt to control force, maintain balance and posture (2), and subsequently regenerate force in the desired direction (17).

BAPS exercise trains key components of the force interplay continuum (Figure 1), which enhances the ability of the neuromuscular system to reduce/produce force and dynamically stabilize the kinetic chain during movements. Cressey et al. (3) suggest that activities that constantly challenge an athlete's center of gravity within the base of support over time promote a training effect that enhances the ability to regain stability in athletic contexts. To this end, BAPS exercise may contribute to a heightened sense of lumbar spine position and pelvic orientation during dynamic movements (5).

The relevance of BAPS exercise for youth athletes may be inferred from the recent works of Myer et al. (11,12), who emphasize the importance of integrative neuromuscular training as part of a comprehensive strength and conditioning program. Enhancing movement mechanics and functional strength characteristics (Figure 2) are potential strategies for reducing sports-related injuries in youth athletes (13,14). As such, the authors have extensively used BAPS exercise as a movement preparation strategy within the functional warm-up for pre-elite youth athletes at the Western Region Academy of Sport. The ideal BAPS intervention for youth athletes is of shorter duration, containing predominantly dynamic balance exercises to better simulate the challenges faced during training and competition (18). This article presents BAPS exercise progressions, with demonstration through video clips.

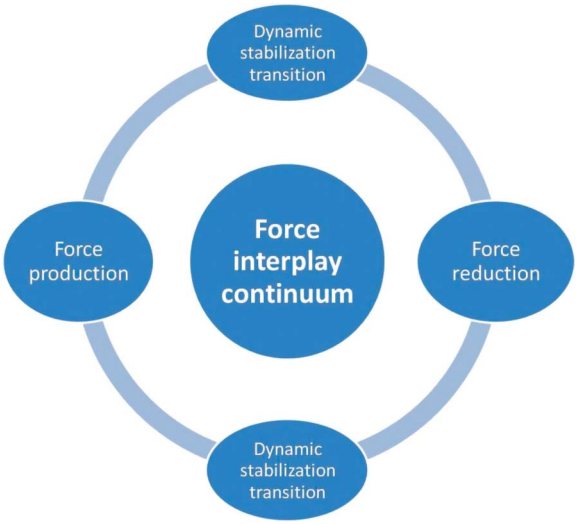

Figure 1. Force interplay continuum. BAPS exercise is intended to train the interplay between force reduction, dynamic stabilization, and force production.

BAPS PROGRAM AND PROGRESSIONS

An example BAPS program is presented in Table 1, with the exercise descriptors and video clips, sets, repetitions, and rest periods listed below. Option "a" is recommended for athletes initially commencing the BAPS program, and option "b" is a more advanced version of each exercise. Athletes should demonstrate movement proficiency in option "a" before progressing to option "b."

1a. Arabesque rotation. Start with the supporting leg straight with the arms wide for balance. Lean forward at the pelvis then rotate the torso in both directions as far as possible (Figure 3). Be sure to maintain an erect torso and do not flex the spine. See Supplemental Digital Content 1a for full execution (Video, http://links.lww.com/SCJ/A22).

1b. Walking arabesque. Start with the supporting leg straight with the arms wide for balance. Lean forward at the pelvis while keeping the neck in line with the spine and then rotate the torso in both directions as far as possible. Be sure to maintain an erect torso and do not flex the spine. See Supplemental Digital Content 1b for full execution (Video, http://links.lww.com/SCJ/A23).

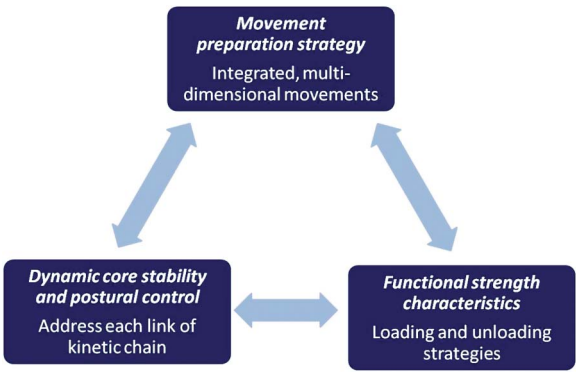

Figure 2. The interaction of movement preparation strategy, functional strength characteristics, and dynamic core stability and postural control may help reduce sports-related injuries in youth athletes.

Table 1 BAPS exercise, progression, and emphasis		
Exercise	**Progression**	**Emphasis**
1a. Arabesque rotation	1b. Walking arabesque	Dynamic core stability
2a. Scapular retraction/protraction	2b. Scapular retraction/protraction on single leg	Scapular rhythm
3a. Torso stabilization rotation	2b. Torso stabilization + push-up rotation	Rotary stability
4a. Supine bridge + single-leg extension	4b. Supine bridge + single-leg/single-arm extension	Lumbo-pelvic-hip control
5a. Rotator cuff external rotation on single leg with theraband	5b. Rotator cuff external rotation on half foam roller with theraband	Scapular rhythm
6a. Torso stabilization rotation with ball throws	6b. Torso stabilization rotation with ball throws on half foam roller	Trunk rotation pattern
7a. Bodyweight squats on half foam roller	7b. Bodyweight squats on stability discs	Eccentric stabilization
8a. Stability disc lunge (forward)	8b. Stability disc lunge (forward and back)	Eccentric stabilization
9a. Supine torso rotation	9b. Supine torso rotation with medicine ball	Rotary stability
10a. Supine hip lifts on step	10b. Supine hip lifts on stability ball	Lumbo-pelvic-hip control
11a. Walking lunge rotation	11b. Walking lunge rotation with medicine ball	Dynamic core stability
12a. Single leg hip hike	12b. Single leg hip hike on half foam roller	Lumbo-pelvic-hip control

2a. Scapular activation. Start standing, facing a wall with one shoulder flexed 90° and the hand on the wall. Without bending elbow, lean on the wall under control, retracting shoulder blade (Figure 4). Push off from wall by protracting shoulder blade. See Supplemental Digital Content 2a for full execution (Video, http://links.lww.com/SCJ/A24).

2b. Scapular activation–single-leg stance. Start standing in a single-leg stance, facing the wall with one shoulder flexed 90° and the hand on the wall. Without bending elbow, lean on the wall under control, retracting shoulder blade. Push off from wall by protracting shoulder blade. See Supplemental Digital Content 2b for full execution (Video, http://links.lww.com/SCJ/A26).

3a. Torso stabilization rotation. Start in push-up position with hands slightly wider than shoulder width. Rotate torso 90° onto one arm and foot (side-support), keeping the upper leg abducted (Figure 5). Return to starting position and then repeat sequence to the other side. See Supplemental Digital Content 3a for full execution (Video, http://links.lww.com/SCJ/A27).

3b. Torso stabilization + push-up rotation. Start in push-up position with hands slightly wider than shoulder width. Perform push-up then rotate torso 90° onto one arm and foot (side-support), keeping the upper leg abducted. Return to starting position and then repeat sequence to the other side. See Supplemental Digital Content 3b for full execution (Video, http://links.lww.com/SCJ/A28).

Figure 3. Arabesque rotation.

Figure 4. Scapular activation.

Figure 5. Torso stabilization rotation.

4a. Supine bridge + single-leg extension. Start in supine position with feet on the ground and arms by your side. Lift the pelvis off the ground, finishing in a bridge position. Extend one leg so that it remains in line with the torso. Return the leg to the start position and lower the pelvis returning to the ground (Figure 6). Repeat the movements on both sides. See Supplemental Digital Content 4a for full execution (Video, http://links.lww.com/SCJ/A29).

4b. Supine bridge + single-leg/single-arm extension. Start in supine position with feet on the ground and both arms straight up in the air. Lift the pelvis off the ground, finishing in a bridge position. Extend one leg so that it remains in line with the torso. Return the leg to the start position and lower the pelvis returning to the ground. Repeat the movements on both sides. See Supplemental Digital Content 4b for full execution (Video, http://links.lww.com/SCJ/A30).

5a. Rotator cuff external rotation on single leg with elastic band. Start in single-leg stance, standing on one end of an elastic band. While holding the other end of the elastic band, externally rotate the shoulder as far as comfortable, keeping the elbow flexed 90° (Figure 7). Maintain a stable scapula throughout the exercise. See Supplemental Digital Content 5a for full execution (Video, http://links.lww.com/SCJ/A31).

5b. Rotator cuff external rotation on half foam roller with elastic band. Start in single-leg stance with foot and one end of an elastic band on the flat surface of a half foam roller. While holding the other end of the elastic band, externally rotate the shoulder as far as comfortable, keeping the elbow flexed 90°. Maintain a stable scapula throughout the exercise. See Supplemental Digital Content 5b for full execution (Video, http://links.lww.com/SCJ/A35).

Figure 6. Supine bridge + single-leg extension.

Figure 7. Rotator cuff external rotation on single leg with elastic band.

6a. Torso stabilization rotation with ball throws. Start in push-up position parallel with a wall. Hold a ball in the hand nearest to the wall. Rotating under control through the torso and hips, throw the ball against the wall and catch it after it rebounds (Figure 8). Keep the torso in line throughout the movement. See Supplemental Digital Content 6a for full execution (Video, http://links.lww.com/SCJ/A36).

6b. Torso stabilization rotation with ball throws on half foam roller. Start in push-up position parallel with a wall, with toes of both feet on the flat surface of a half foam roller. Hold a ball in the hand nearest to the wall and have the opposite leg raised. Rotating under control through the torso and hips, throw the ball against the wall and catch it after it rebounds. Keep the torso in line throughout the movement. See Supplemental Digital Content 6b for full execution (Video, http://links.lww.com/SCJ/A37).

Figure 8. Torso stabilization rotation with ball throws.

7a. Bodyweight squat on half foam roller. Stand with each foot on the flat surface of a half foam roller. Perform a squat with arms in front to help maintain balance (Figure 9). Maintain natural spine curves throughout the squat. See Supplemental Digital Content 7a for full execution (Video, http://links.lww.com/SCJ/A38).

7b. Bodyweight squat on stability discs. Stand with each foot on a stability disc. Perform a squat with arms in front to help maintain balance. Maintain natural spine curves throughout the squat. See Supplemental Digital Content 7b for full execution (Video, http://links.lww.com/SCJ/A40).

8a. Stability disc lunge (forward). Perform a forward lunge onto a stability disc while keeping the shoulders above the pelvis. Lower the body straight down and then press firmly back up to the start position. Place hands on waist for balance. Keep the chest up and

Figure 9. Bodyweight squat on half foam roller.

shoulders back. Knees should track in line with the center of the foot (Figure 10). See Supplemental Digital Content 8a for full execution (Video, http://links.lww.com/SCJ/A41).

8b. Stability disc lunge (forward and back). Place a stability disc in front and behind you so that you can perform both forward and backward lunge onto the discs. Lunge forward onto a stability disc while keeping the shoulders above the pelvis. Lower the body straight down and then press firmly back up to the start position, then perform a backward lunge onto the disc behind. Press firmly back into the start position. Place hands on waist for balance. Keep the chest up and shoulders back. Knees should track in line with the center of the foot. See Supplemental Digital Content 8b for full execution (Video, http://links.lww.com/SCJ/A42).

9a. Supine torso rotation. Start in supine position with hips and knees flexed 90°. With your arms extended, rotate your arms above your head along a 45° vector as you lower your knees in the opposite direction (Figure 11). Keep the shoulders and head on the floor throughout. Do not allow the spine to flex or extend further while rotating. See Supplemental Digital Content 9a for full execution (Video, http://links.lww.com/SCJ/A43).

9b. Supine torso rotation with medicine ball. Start in supine position with hips and knees flexed 90°. Holding onto a medicine ball, rotate your arms

Figure 10. Stability disc lunge (forward).

Figure 11. Supine torso rotation.

above your head along a 45° vector as you lower your knees in the opposite direction. Keep the shoulders and head on the floor throughout. Do not allow the spine to flex or extend further while rotating. See Supplemental Digital Content 9b for full execution (Video, http://links.lww.com/SCJ/A44).

10a. Supine hip lifts on step. Start in supine position with one heel on a step and the other heel placed on top. Lift the pelvis off the ground, maintaining alignment with the torso. Have the arms extended upward so that it minimizes the base of support (Figure 12). Maintain a stable torso throughout and emphasize the contraction in the gluteal muscles. See Supplemental Digital Content 10a for full execution (Video, http://links.lww.com/SCJ/A45).

10b. Supine hip lifts on stability ball. Start in supine position with both heels on a stability ball. Lift the pelvis off the ground, maintaining alignment with the torso. Extend the arms upward to minimize the base of support. Maintain a stable torso throughout and emphasize the contraction in the gluteal muscles.

Figure 12. Supine hip lifts on step.

See Supplemental Digital Content 10b for full execution (Video, http://links.lww.com/SCJ/A46).

11a. Walking lunge rotation. Start in a standing position with arms extended in front of you. Perform walking lunges forward, rotating your arms in the opposite direction during each lunge (Figure 13). Maintain an erect torso during each lunge, minimizing spinal flexion. Knees should track in line with the center of the foot. See Supplemental Digital Content 11a for full execution (Video, http://links.lww.com/SCJ/A47).

11b. Walking lunge rotation with medicine ball. Start in a standing position with arms extended in front of you holding a medicine ball. Perform walking lunges forward, rotating your arms in the opposite direction during each lunge. Maintain an erect torso during each lunge, minimizing spinal flexion. Knees should track in line with the center of the foot. See Supplemental Digital Content 11b for full execution (Video, http://links.lww.com/SCJ/A48).

12a. Single leg hip adduction/abduction. Stand on one leg with the other leg flexed slightly at the hip and hands on waist. Slowly lower the pelvis on the non–weight-bearing side toward the floor and then elevate the pelvis back to the starting position without flexing the weight-bearing knee (Figure 14). Maintain pelvic control throughout the exercise. See Supplemental Digital Content 12a for full execution (Video, http://links.lww.com/SCJ/A49).

Figure 13. Walking lunge rotation.

Figure 14. Single leg hip adduction/abduction.

12b. Single leg hip adduction/abduction on half foam roller. Stand on one leg on a half foam roller, with the other leg flexed slightly at the hip and hands on waist. Slowly lower the pelvis on the non–weight-bearing side toward the floor and then elevate the pelvis back to the starting position without flexing the weight-bearing knee. Maintain pelvic control through the exercise. See Supplemental Digital Content 12b for full execution (Video, http://links.lww.com/SCJ/A50).

SETS/REPETITIONS/REST

Choose 4 of the BAPS exercises for the functional warm before each session, rotating the exercise options. The 4 selected BAPS exercises should be performed as a circuit. Novice athletes should perform 1–2 sets with 6–8 repetitions with 60 seconds between circuits. Intermediate athlete should perform 2–3 sets with 8–10 repetitions with 60 seconds between circuits. Advanced athletes should perform 3 sets with 10–12 repetitions with 60 seconds between circuits.

PRACTICAL APPLICATIONS

BAPS exercise is a worthwhile adjunct to the usual warm-up of pre-elite youth athletes (8,10,12,17). However, it should be emphasized that they do not take the place of other conditioning activities, such as strength training. As suggested by Myer et al. (12), integrative neuromuscular training is part of a comprehensive strength and conditioning program but not the sole component. The BAPS exercises presented have been successfully implemented as a movement preparation strategy in the functional warm-up before strength training. Using a variety of BAPS exercises and progressions in functionally integrated movement patterns will allow athletes to be "turned on" and "ready to train" by promoting enhanced dynamic core stability and postural control.

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REFERENCES

1. Bien DP. Rationale and implementation of anterior cruciate ligament injury prevention warm-up programs in female athletes. *J Strength Cond Res* 25: 271–285, 2011.
2. Bouisset S and Do MC. Posture, dynamic stability, and voluntary movement. *Neurophysiol Clin* 38: 345–362, 2008.
3. Cressey EM, West CA, Tiberio DP, Kraemer WJ, and Maresh CM. The effects of ten weeks of lower-body unstable surface training on markers of athletic performance. *J Strength Cond Res* 21: 561–567, 2007.
4. Ebben WP, Carroll RM, and Simenz CJ. Strength and conditioning practices of National Hockey League strength and conditioning coaches. *J Strength Cond Res* 18: 889–897, 2004.
5. Gamble P. Lumbopelvic 'core' stability. In: *Strength and Conditioning for Team Sports: Sport-Specific Physical Preparation for High Performance*. Gamble P, ed. Abingdon, OX: Routledge, 2009. pp. 120–138.
6. Gee TI, Olsen PD, Berger NJ, Golby J, and Thompson KG. Strength and conditioning practices in rowing. *J Strength Cond Res* 25: 668–682, 2011.
7. Hartwich K. 'Bowling prehab': An innovative approach to injury prevention and rehabilitation for fast bowlers. *Sport Health* 27: 23–27, 2009.
8. Hazime FA, Allard P, Ide MR, Siqueira CM, Amorim CF, and Tanaka C. Postural control under visual and proprioceptive perturbations during double and single limb stances: Insights for balance training. *J Bodyw Mov Ther*, 2011. In press. doi: 10.1016/j.bbr.2011.03.031.
9. Hori N, Newton RU, Nosaka K, and Stone MH. Weightlifting exercises enhance athletic performance that requires high-load speed strength. *Strength Cond J* 27: 50–55, 2005.
10. Hrysomallis C. Balance ability and athletic performance. *Sports Med* 41: 221–232, 2011.
11. Myer GD, Faigenbaum AD, Chu DA, Falkel J, Ford KR, Best TM, and Hewett TE. Integrative training for children and adolescents: Techniques and practices for reducing sports-related injuries and enhancing athletic performance. *Phys Sportsmed* 39: 74–84, 2011.
12. Myer GD, Faigenbaum AD, Ford KR, Best TM, Bergeron MF, and Hewett TE. When to initiate integrative neuromuscular training to reduce sports-related injuries and enhance health in youth? *Curr Sports Med Rep* 10: 155–166, 2011.
13. Myer GD, Ford KR, Palumbo JP, and Hewett TE. Neuromuscular training improves performance and lower-extremity biomechanics in female athletes. *J Strength Cond Res* 19: 51–60, 2005.
14. Noyes FR, Barber-Westin SD, Smith ST, and Campbell T. A training program to improve neuromuscular indices in female high school volleyball players. *J Strength Cond Res* 25: 2151–2160, 2011.
15. Oliver GD and Brezzo RD. Functional balance training in collegiate women athletes. *J Strength Cond Res* 23: 2124–2129, 2009.

16. Pasanen K, Parkkari J, Pasanen M, and Kannus P. Effect of a neuromuscular warm-up programme on muscle power, balance, speed and agility: A randomised controlled study. *Br J Sports Med* 43: 1073–1078, 2009.
17. Paterno MV, Myer GD, Ford KR, and Hewett TE. Neuromuscular training improves single-limb stability in young female athletes. *J Orthop Sports Phys Ther* 34: 305–316, 2004.
18. Rasool J and George K. The impact of single-leg dynamic balance training on dynamic stability. *Phys Ther Sport* 8: 177–184, 2007.
19. Simenz CJ, Dugan CA, and Ebben WP. Strength and conditioning practices of National Basketball Association strength and conditioning coaches. *J Strength Cond Res* 19: 495–504, 2005.
20. Trojian T. An injury prevention warm-up program for teenage women's soccer. *Clin J Sport Med* 19: 509–510, 2009.
21. Verhagen E, Van Der Beek A, Twisk J, Bouter L, Bahr R, and Van Mechelen W. The effect of a proprioceptive balance board training program for the prevention of ankle sprains. *Am J Sports Med* 32: 1385–1393, 2004.
22. Yauss B and Rotchstein A. The acute and chronic benefits of movement prep for the soccer athlete. *NSCA Perform Train J* 10: 11–16, 2011.
23. Zazulak B, Cholewicki J, and Reeves NP. Neuromuscular control of trunk stability: Clinical implications for sports injury prevention. *J Am Acad Orthop Surg* 16: 497–505, 2008.
24. Zazulak BT, Hewett TE, Reeves NP, Goldberg B, and Cholewicki J. Deficits in neuromuscular control of the trunk predict knee injury risk. *Am J Sports Med* 35: 1123–1130, 2007.
25. Zazulak BT, Hewett TE, Reeves NP, Goldberg B, and Cholewicki J. The effects of core proprioception on knee injury: A prospective biomechanical-epidemiological study. *Am J Sports Med* 35: 368–373, 2007.
26. Zech A, Hubscher M, Vogt L, Banzer W, Hansel F, and Pfeifer K. Neuromuscular training for rehabilitation of sports injuries: A systematic review. *Med Sci Sports Exerc* 41: 1831–1841, 2009.