AGILITY

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WHAT IS AGILITY?

Agility is a common term used in strength and conditioning and is often considered an essential element of many sports and activities. A boxer dodging a punch, a ballet dancer completing a pirouette, or a wrestler finishing a take-down could all be considered examples of agility. However, individuals involved in the development and improvement of sports performance often regard agility as a locomotor skill whereby an athlete changes direction. This type of movement is frequently observed in most field and court sports such as soccer, basketball, football, and lacrosse. In this light agility is commonly defined as an effective and quick coupling of braking, changing directions and accelerating again while maintaining motor control in either a vertical or horizontal direction (6, 16, 20). An athlete that displays good agility will most likely possess other qualities such as, dynamic balance, spatial awareness, rhythm, as well as visual processing (7). So while agility can be simply defined as an ability to quickly stop and re-start motion, there is a high degree of complexity to this motor skill. This article will briefly discuss the importance of agility training and present appropriate developmental strategies for instructing athletes.

IMPORTANCE OF AGILITY

Agility is a specific athletic attribute (14) that is fundamentally important to sports performance for three reasons. First, developing agility will provide a strong foundation for neuromuscular control and motor skill function, thereby establishing overall athleticism. Second, changing directions is a common cause of injury, so by teaching individuals proper movement mechanics we may be able to reduce injury risk. Finally, as an athlete matures, a heightened ability to quickly change directions will enhance overall performance in both proactive offensive and reactive defensive circumstances.

Stages of Development

Learning to become agile requires the development of appropriate movement patterns. Children begin to develop locomotor skills at an early age as can be observed when a playful child attempts to elude a parent chasing them around the yard. It can be clearly seen however that movement efficiency is poor, oftentimes associated with awkward arm motion, overall unbalanced posture, and a general lack of timing and coordination. Implementing strategies to teach appropriate motor skills can be initiated around 5 years of age with critical periods of development occurring between 9 and 12 years of age (6). It must be kept in mind that individuals will develop

at different rates and subtle gender differences exist for critical periods, so that the age ranges provided below should serve as a temporal guide, not as a steadfast rule.

Nevertheless, in order to appropriately develop agility both general and specific drills are used within particular windows of time. For example, between 5-8 years of age versatility should predominate, whereby a variety of general movement patterns are utilized in an effort to develop a large foundation of motor skills. Including basic arm and leg movements in a stationary position, performing rhythmic jumps in place, or implementing locomotor drills that incorporate spatial orientation can all be beneficial during this stage of development. Simply learning temporal characteristics of movements in a controlled environment is helpful before initiating more specific drills or activities. Planned (also called closed) exercises should predominate during this period, which will provide structure to learning movement patterns, timing, and coordination.

During the next stage of development (between 9-13 years of age) mastery should be the primary focus. Children involved with athletics should be able to perform the general drills implemented during the previous phase with minimal flaws. In addition, while athletes can move more quickly, for reasons of safety and injury prevention they should initially perform drills at sub-maximal speeds. Agility exercises should not yet include sharp changes in direction, but rather involve rounded patterns. This might include weaving between a set of linear cones, running a figure eight pattern, or learning how to stop-jump- and land in a controlled environment. Performing sharp changes in direction at high running speeds will prevent appropriate execution of a drill, especially during the early developmental stages when mastery has not yet been achieved (2, 18). Planned drills should still dominate, however un-planned (or open) drills can be implemented sparingly to provide a reactive component to an external stimulus (e.g., visual, audio).

During the pubertal growth spurt alterations in body size, structure, and weight will significantly impact a child's coordination. During this stage (14-16 years of age) it is appropriate to re-perfect many of the movement skills that have already been developed (6). In other words, learning and mastery will start anew. As an athlete becomes more comfortable with their 'new' body then greater difficulty can certainly be added to their training regimen. Up through this stage sport-specificity should be avoided as it may retard overall athletic development. This goes against the current practice of many sports performance professionals, however training athletes should follow appropriate motor skill developmental stages rather than conventional wisdom.

More complexity and specificity are the focus during later teenage years (17+ years of age)(6). Sport-specific drills may now be utilized regularly during training. Adding greater complexity to existing drills is common. Different field conditions, using a partner, implementing an

area or time restriction are all acceptable methods to increasingly challenge an athlete's ability to change directions effectively (6). Movement speeds should be kept moderate to high as slower movements can drastically alter muscle activation patterns (15). Using un-planned (open) drills can be used more readily while minimizing closed drills. However, performing open reactive exercises at high speeds can increase rotational loads with minimal changes in the magnitude or patterns of muscle activation, suggesting more stress is placed on the joints compared to performing closed drills (1, 2). This has the potential to decrease performance or increase injury risk.

In general, critical periods of development exist which correspond to certain chronological ages. And while these should serve as a guide for appropriate athletic development it should be understood that when selecting drills or exercises a young athlete's training age should also be taken into consideration. In other words, it might be appropriate to use a large variety of closed drills with a 16 year old that has less than one year of training experience. On the other hand, it may be appropriate to include a greater proportion of open drills with a 13 year old that has four years of consistent training experience. Care should be given to understanding each individual athlete, which will ultimately provide the strongest rationale for exercise prescription.

Injury Prevention

Teaching athletes appropriate movement strategies is important for preventing injuries. Compared to linear running, rotational loads on the legs are increased at least 100% when changing directions (2, 3). It appears the neuromuscular system has a built-in injury prevention mechanism, where pre-activation of muscles prepares for ground contact and is primarily responsible for stabilization of the joints when the foot is in contact with the ground (1, 2). Nevertheless, appropriate deceleration mechanics are essential for injury prevention.

In light of the epidemic of non-contact ACL injuries in female athletes several training programs have been designed to specifically target this area of agility training, namely injury prevention (5, 8, 11, 19). The aim of these programs is to alter mechanical flaws when changing directions in both vertical and horizontal directions. For example, instructing athletes to land from a jump by bending their knees and hips rather than landing straight legged; or using multiple small steps to decelerate compared to stopping linear motion with one large step are the key tenets that will reduce injury risk when changing directions. By landing more 'softly' the overall landing forces are reduced and a multiple step stop will decrease the shearing forces placed on the knee.

Performance Enhancement

The ability to change directions quickly and efficiently is advantageous for many athletes. The foundation for maximizing the ability to change directions will couple linear sprinting and

appropriate deceleration techniques. A progression for linking linear locomotion with deceleration and ultimately re-acceleration in a new direction has been outlined elsewhere (4). Briefly, the sequence of drills includes:

Linear acceleration transitions: Using 5-10 yard increments an athlete can transition between linear walking, jogging and eventually sprinting. Progress with sub-maximal speeds during the first two developmental stages and then implement faster movements as the child gets older and becomes more skilled. This will allow an athlete to distinguish between various speeds of locomotion, but more importantly it provides a simple drill to learn how to accelerate, decelerate, and re-accelerate. Attention should be directed at linear acceleration and deceleration mechanics.

Jog-Stop-Turn-Jog: Next linear locomotion and deceleration are coupled with a deliberate change in direction. Instruct an athlete to jog to a cone placed 5-10 yards in front of her/him. When the athlete reaches the cone, they will come to a complete stop by planting the foot opposite to the new direction. Instruct the athlete to bend their knee and hip when the foot contacts the ground while maintaining a slight lean forward with their upper body. The position should resemble a semi-squat position, where the chest remains over the feet. Rotation of the torso and proper arm action will occur while stepping with the foot nearest to the new direction before resuming the drill (4).

Increased Speed then Angle: Regardless of the drills implemented in a training program a sound developmental progression will include: slower to faster speeds, more general movement patterns to increasingly greater complexity and specificity, and more rounded changes in direction to sharper angles. The ultimate goal is to develop an athlete that can perform velocity specific transitions with no loss of control. It must be stressed that this progression should be completed over several years as outlined in the developmental stages above.

ASSESSMENT OF AGILITY

Movement skills are often sport- and sometimes position-specific (10, 12, 17, 21), suggesting that test selection should be related to sport-specific characteristics or position-specific movement patterns. Typical agility tests include the 505 agility test (7), T-test, and the Edgren side step test (9). Other tests commonly used are the Illinois agility test (13), pro-agility test (sprint and shuffle), 3-cone test, and spider test. It is beyond the scope of this article to detail each protocol, therefore the reader is referred to references (7, 9, 12, 13) for descriptions and illustrations of the tests listed.

CONCLUSIONS AND PRACTICAL APPLICATIONS

The aim of this article was to briefly describe the importance of agility in developing overall athleticism, reducing injury risk, and enhancing performance. Creating and implementing drills only requires an open field or court and a few cones, in addition to instructing proper acceleration and deceleration mechanics. Providing appropriate direction during critical periods of development will endow your athlete with a sound athletic foundation.

REFERENCES

1. Besier, T.F., D.G. Lloyd, and T.R. Ackland. Muscle activation strategies at the knee during running and cutting maneuvers. Medicine and Science in Sports and Exercise. 35:119-127. 2003.
2. Besier, T.F., D.G. Lloyd, T.R. Ackland, and J.L. Cochrane. Anticipatory effects on knee joint loading during running and cutting maneuvers. Medicine and Science in Sports and Exercise. 33:1176-1181. 2001.
3. Besier, T.F., D.G. Lloyd, J.L. Cochrane, and T.R. Ackland. External loading of the knee joint during running and cutting maneuvers. Medicine and Science in Sports and Exercise. 33:1168-1175. 2001.
4. Brown, T.D. and J.D. Vescovi. Efficient arms for efficient agility. Strength and Conditioning Journal. 25:7-11. 2003.
5. Caraffa, A., G. Cerulli, M. Projetti, G. Aisa, and A. Rizzo. Prevention of anterior cruciate ligament injuries in soccer. A prospective controlled study of proprioceptive training. Knee Surg Sports Traumatol Arthrosc. 4:19-21. 1996.
6. Drabik, J. Children & Sports Training: How Your Future Champions Should Exercise to be Healthy, Fit, and Happy. Island Pond: Stadion Publishing Co., 1996.
7. Ellis, L., P. Gastin, S. Lawrence, B. Savage, A. Buckeridge, A. Stapff, D. Tumilty, A. Quinn, S. Woolford, and W. Young. Protocols for the Physiological Assessment of Team Sports Players. In: Physiological Tests for Elite Athletes. C.J. Gore, ed. Champaign: Human Kinetics, 2000. pp. 128-144.
8. Griffin, L.Y. The Henning Program. In: Prevention of Noncontact ACL Injuries. L.Y. Griffin, ed. Rosemont: American Academy of Orthopaedic Surgeons, 2001. pp. 93-96.
9. Harman, E., J. Garhammer, and C. Pandorf. Administration, scoring, and interpretation of selected tests. In: Essentials of Strength Training and Conditioning. T.R. Baechle and R.W. Earle, eds. Champaign: Human Kinetics, 2000. pp. 287-317.
10. Hasegawa, H., J. Dziados, R.U. Newton, A.C. Fry, W.J. Kraemer, and K. Hakkinen. Periodized training programs for athletes. In: Strength Training for Sport. W.J.H. Kraemer, K., ed. Ames: Blackwell Science, 2002. pp. 69-134.

11. Hewett, T.E., T.N. Lindenfeld, J.V. Riccobene, and F.R. Noyes. The effect of neuromuscular training on the incidence of knee injury in female athletes. A prospective study. American Journal of Sports Medicine. 27:699-706. 1999.
12. Kirkendall, D.T. Physiology of Soccer. In: Exercise and Sports Science. W.E. Garrett and D.T. Kirkendall, eds. Philadelphia: Lipincott, Williams, & Wilkins, 2000. pp. 875-884.
13. Lacy, A.C. and D.N. Hastad. Measurement and Evaluation in PHysical Education and Exercise Science. (4th ed). New York: Benjamin Cummings, 2003.
14. Little, T. and A.G. Williams. Specificity of acceleration, maximum speed, and agility in professional soccer players. J Strength Cond Res. 19:76-78. 2005.
15. Neptune, R.R., I.C. Wright, and A.J. van der Bogert. Muscle coordination and function during cutting movements. Medicine and Science in Sports and Exercise. 31:294-302. 1999.
16. Plisk, S.S. Speed, Agility, and Speed-Endurance Development. In: Essentials of Strength Training and Conditioning. T.R. Baechle and R.W. Earle, eds. Champaign: Human Kinetics, 2000. pp. 471-492.
17. Pollitt, D.J. Sled dragging for hockey training. Strength and Conditioning Journal. 25:7-16. 2003.
18. Rand, M.K. and T. Ohtsuki. EMG analysis of lower limb muscles in humans during quick change in running directions. Gait Posture. 12:169-183. 2000.
19. Silvers, H.J. and B.R. Mandelbaum. Preseason conditioning to prevent soccer injuries in young women. Clin J Sport Med. 11:206. 2001.
20. Verstegen, M. and B. Marcello. Agility and Coordination. In: High Performance Sports Conditioning. B. Foran, ed. Champaign: Human Kinetics, 2001.
21. Vescovi, J.D. Evaluation of work and rest for female collegiate volleyball games. International Journal of Volleyball Research. 7:2-7. 2001.