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STRETCHING AND FLEXIBILITY: A RANGE OF MOTION FOR GAMES AND SPORTS

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Abstract:
Flexibility is understood as the range of motion of a joint. Specifically, structured stretching exercises are used to improve flexibility. Exercising stretching is commonly practiced before any athletic activity takes place. To avoid sport injury, the range of motion is maintained, and muscle strength requires regular flexibility training. The present study, on the whole, reviews the respective literature sources. For this reason, the purpose of this study is to uphold the types and nature of stretching that produces the flexibility required for the performance of games and sports. Researchers collected scientific evidence through online databases: PubMed, Google Scholar, Google Advance Search and also searched sensibly via offline sources: recognized journals, articles, books, theses, and related literatures. After analyzing the stretching and flexibility in detail the authors suggested some specific stretchings that centered not just on flexibility but also on strength, balance and core stability. Through the discussion, the muscle is reported to be stretched properly, the underlying joints are made more flexible, and the range of motion is increased.

Keywords: flexibility, stretching, eccentric, dynamic, static, proprioceptive, range of motion

1. Introduction

Flexibility is the ability to shift muscles and joints through their full range of motion (Nakamura et al., 2014). It is also defined as the ability to perform movement with greater

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range of motion or large amplitude (Uppal, 2009). In contrast, stretching refers to the process of elongating connective tissues, muscles, and other tissues (Jelvéus, 2011). Earlier research has proven that flexibility does not exist as a general characteristic (Reese & Bandy, 2010) but is specific to a particular joint and joint action (Merni et al., 1981); that is, range of motion is specific to each joint in the body.

Range of motion is the sum of joint movement accessible (Keogh et al., 2019), while flexibility is the tendency of soft tissue of structures such as muscle, tendon and connective tissue to elongate across the extent of joint movement available (Konin, 2012). For instance, an athlete may be flexible in the hips but rigid in the shoulders, or tight in the right hip but flexible in the left hip. Attempts to associate flexibility to body proportions, body surface area, skinfold, and weight have yielded inconsistent results (Alter, 2004).

Researcher Alter (2004) postulates that flexibility is specific to a given group of sports (Gummelt, 2015) as well as to a given joint, and a given speed. Even within sport groups, particular patterns of flexibility are related to frequent or unique joint movements (Medeiros et al., 2013) in those activities, events or positions (*Understanding Flexibility | Advantage Sports Massage*, 2015). For example, a baseball pitcher's dominant shoulder possesses an increased range of external rotation over his other shoulder (Cook et al., 1987; Hellem et al., 2019). Earlier research found that throwing velocity was significantly related to the range of external shoulder rotation (Sandstead, 1968; Nodehi-Moghadam et al., 2013). Similarly, Cohen et al. (1994) established that numerous flexibility measures including dominant wrist flexion, dominant shoulder forward flexion, and dominant shoulder internal rotation at zero degrees of abduction are directly related to tennis serve velocity (Alter, 1990). Therefore, flexibility training focusing on improving a joint's ROM (Range of Motion) (*Understanding Flexibility | Advantage Sports Massage*, 2015) must be specifically tailored to the needs of the individual sportsperson and the sport in which he or she is participating (Alter, 2004).

Flexibility is developed when connective tissues and muscles are elongated through regular, proper stretching (Ambrose, 2004). So, it is seeming to be a very close connection between flexibility and stretching but flexibility applies to a specific joint's range of motion. An individual's degree of flexibility is determined by the muscles and connective tissues (Pate et al., 2012). However, stretching is a type of exercise which can result in greater flexibility (Esco, 2005). So, flexibility is the capacity to stretch muscles. In contrast, flexibility diminishes over time when these tissues are not stretched or exercised regularly (Alter, 2004).

2. Methods

2.1 Acquisition of Evidences

In this methodical review study, a comprehensive online searching technique was applied for acquisition of evidences. The electronic databases PubMed, Google Scholar were sensibly searched to reviewing the literatures. The computer databases provided access to biomedical and sport-related peer reviewed journals, recognized publications,

books, theses, conference papers, and related research published since 1962. This review did not include publications not published in English and/or in scientific journals.

2.2 Selection Procedure of Review Articles

On the basis of qualifying requirements, a total of 188 publications with complete text are evaluated. The purpose of this study was identifying after literature survey, out of which only 94 studies were selected. After that, only 74 studies explicitly meet the requirements of this study, used as a reference on this study. Present researchers were tried to explore the allied area of static stretching, dynamic stretching, proprioceptive neuromuscular facilitation, ballistic stretching, range of motion, eccentric stretch, isometric stretch, TRX stretching, physiology of stretching, and flexibility. The final databases searches were conducted on 28 September 2020. Articles were assessed on the basis of eligibility criteria first at the level of the title, abstract, source and then the full text article.

3. Stretching Metabolism

Several types of adaptation result from proper and regular flexibility training (Page, 2012). When a muscle is suddenly stretched, the stretch reflex is initiated and the muscle being stretched contracts. However, through training, the critical point at which the stretch reflex is initiated can be "reset" to a higher level. Consequently, muscles relax further into the stretch (Alter, 2004). Research in the field of neurophysiology has demonstrated adaptive plasticity in the central nervous system (Wolpaw & Carp, 1990). Specifically, the magnitude of the spinal stretch reflex can be uptrained (increased), downtrained (decreased), or even trained to reverse the changed response. Wolpaw and Carp (1990) have even substantiated the hypothesis that altered reflex activity eventually modifies the plasticity of the spinal cord neural circuits. In addition, with increased stretching over time, the number of sarcomeres is thought to increase in series. These new sarcomeres are added onto the end of the existing myofibrils. Research has substantiated that an addition of sarcomeres is responsible for an increase in muscle length (Goldspink, 1968; Pearson, 1990). Similarly, with increased stretching over time the fascial sheaths encasings muscles- the epimysium, endomysium, and perimysium may undergo semi-permanent change in length. Other tissues adapting to the stretch are the tendons, ligaments, fascia, and scar tissue. However, in the concern of specific hamstrings muscle, stretching exercises are known to increase passive range of motion and extensibility of the hamstrings. Presumably, research has also shown that stretching exercises do not make short hamstrings less stiff. Rather, increased extensibility is attributed to an increase in stretch tolerance (Halbertsma & Göeken, 1994; Halbertsma et al., 1996).

Further research suggests that muscles cells may control and modulate stiffness and elastic limit coordinately by selective expression of specific titin isoforms (structural variants) (Wang et al., 1991); that is, muscles that express greater titin isoforms tend to initiate tension at longer sarcomere lengths, reach their elastic limit at higher sarcomere lengths, and develop the lowest tension. Such control and modulation may be influenced by training. Stretching is thought to stimulate the production and retention of gelter and

hyaluronic acid, lubricate connective tissue fibers, maintaining critical distance between them. This prevents the fibers from touching on another and sticking together. As a result, excessive cross-linkages (Zhang et al., 2013) are not formed (Akeson et al., 1980). Dancing is also a type of athletic activity and one x-ray studies (Nikolić & Zimmermann, 1968) have confirmed that training can modify the bone and joint structure in dancers; hence, range of motion can be enhanced and stretching is one way to do this. A recent study suggests that mechanical stimulation (e.g., stretching or resistance training) of muscle and connective tissues likely to be affect gene expression (Simpson et al., 1994). This, in particular, would modulate variants of the tissue and thereby affect the extensibility of muscle and connective tissue.

4. Stretching Techniques

There are various types of stretching techniques that are used, often depending on athlete choice, training program, and the type of sport. An earlier review of stretching indicated that four different methods are commonly used for sport activities: static, dynamic, ballistic, proprioceptive neuromuscular facilitation (PNF) (Weerapong et al., 2004).

4.1 Static Flexibility, Dynamic Flexibility and Ballistic Stretching

Static flexibility is characterized as the available range of motion (ROM) for a joint or series of joints (Plowman & Smith, 2008; Weerapong et al., 2004). Typically, static flexibility measures are performed while the contestant is instructed to relax. However, it is sometimes difficult to distinguish between a reduced ROM caused by a short muscle versus a tight joint capsule or arthritic joint. However, the difference between a reduced ROM induced by a short muscle and a tight joint capsule or arthritic joint is often difficult to determine. Dynamic flexibility refers to the ease of movement within the obtainable ROM (Gleim & McHugh, 1997). The difference between static and dynamic stretching is limited to one basic thing: movement. In fact, a static stretch is any position athletes hold often at the limit of the range of motion of a particular joint maximize the flexibility. In this state no bounce, changing of position, or repeated movement (Remsberg, 2019). Ballistic stretching stretches or pushes a portion of the body (or parts) beyond its (their) range of motion. A hyperextended stretch is achieved by hopping and utilizing the energy. Ballistic stretching is performed by basketball players and other competitors to increase strength and boost jump momentum (Biswas, 2020).

4.2 Proprioceptive Neuromuscular Facilitation (PNF) Stretching

Throughout the 1940s, Dr. Herman Kabat invented Proprioceptive Neuromuscular Facilitation (PNF) stretching, according to the International PNF Society, as a way of managing neuromuscular control (Barta, 2017). Although various PNF stretching strategies exist, they all rely on stretching a muscle to its maximum (Hindle et al., 2012). It triggers the inverse myotatic reflex to activate, a protective response that calms the muscle to avoid injury (Barta, 2017). PNF is a stretching strategy used to increase muscle

elasticity and has been found to have a beneficial impact on active and passive motions (Funk et al., 2003; Lucas & Koslow, 1984; Wallin et al., 1985; Hindle et al., 2012).

Within the literature two methods are used more commonly than most, PNF's contract-relax method (CR) and contract-relax-antagonist-contract method (CRAC). The CR method included the target muscle (TM) being lengthened and held in that position while the athlete contracted the TM so it's maximum isometrically for an allotted amount of time (Etnyre & Abraham, 1986). The CRAC approach adopted the very same protocol as the CR method but was still progressed. Instead of merely extending the TM actively, the researcher contracted the antagonistic muscle to the TM for another allocated time span (Hindle et al., 2012; Etnyre & Abraham, 1986). PNF is actually very applicable in modern sports science to prevent uncontrolled muscle stretchability.

5. Some Suggestive Exercise

Agility, change of course and straight sprints are the important fitness characteristic of various athletic sport (Islam & Kundu, 2020). Present researchers believe that all types of stretching (based on the games) are required to improve athletic skill. Along with these exercise method researchers have recommended some stretching related to strength, balance, flexibility, and core stability.

5.1 Eccentric Hamstrings Stretching

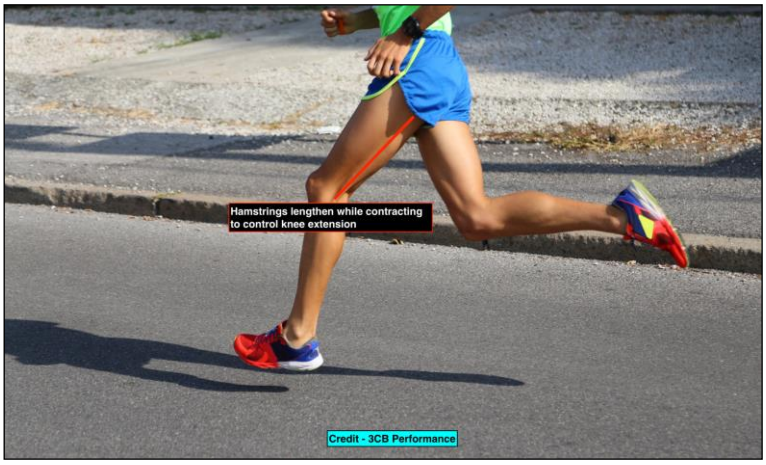

Figure 1: Hamstrings contract eccentrically before the landing of foot
Image Credit: 3CB Performance (Brar, 2018)

Hamstring strains are the most prevalent hamstring-related injury resulting in loss of time for athletes at all levels of competition (Erickson & Sherry, 2017; Sherry, 2012; Sherry et al., 2015). There is an increased likelihood of severe hamstring strains in activities requiring professional sprinting, kicking, jumping or high-speed movements, such as football, soccer, rugby, basketball, and track and field (Sherry & Best, 2004; Heiderscheit et al., 2010; Dalton et al., 2015; Sherry et al., 2011; Brooks et al., 2006; Silder et al., 2013; Cross et al., 2013; Feeley et al., 2008; Opar et al., 2014; Ekstrand et al., 2011;

Erickson & Sherry, 2017; Liu et al., 2012). Eccentric muscle contractions create high forces with low energy cost (Ortega et al., 2015) that are now well-established properties of eccentric contractions (Hody et al., 2019). Developing eccentric contractions can decrease the tempo of hamstring injury (Opar et al., 2013). In fact, most of the hamstring injuries occur when muscle is eccentrically overstretched, typically during the late swing phase of sprinting (Chumanov et al., 2012). Research by Islam and De (2018) suggest that if the hamstring muscle is eccentrically not prepared enough than its lengthening capacity would be less and tight. Tight hamstring also can limit the forward motion of pelvis and bring the pelvis back slightly along with straighten the lower spine (Islam & De, 2018). As a consequence, the athlete would be susceptible to hamstring injury. The Nordic Hamstring Exercise (NHE) has been shown to be an effective tool (Cuthbert et al., 2020) for developing higher maximal eccentric hamstring strength torques when compared with regular hamstring curl (Mjolsnes et al., 2004). Researchers Kim and Pieter (2020) emphasize the study of eccentric hamstrings to concentric quadriceps ratios at different angular velocities (Coombs & Garbutt, 2002).

5.2 Total Resistance Exercises (TRX)

Figure 2: TRX Exercise
Image Credit: (Core Workout, Strength Building, 2017)

TRX is a type of suspension training, utilizing stretched body weight exercises to concurrently improve flexibility, strength, balance, and core stability (Gaedtke & Morat, 2015). A whole body exercise is a difficult way to do. The exercises and progressions are practically without constraint. The accompanying TRX workout is only one of the approaches to execute a routine on full-body suspension; these are: TRX Low Row, TRX Chest Press, TRX Mountain Climbers, TRX Single Leg Squat, TRX Cross Balance Lunge, TRX Biceps Curl, TRX Triceps Press, TRX Crunch, TRX Side Plank (Leal, 2019).

6. Excessive Flexibility and Injury

For some sportspersons, excessive flexibility may destabilize joints (Blalock et al., 2015) and may actually increase the likelihood of ligament injury and joint separation or dislocation. Another argument is that stretching may lead to joint hyper mobility (Nathan et al., 2018). Hyper mobility is said to be present when the joints are unduly lax and the range of motion is in excess of the accepted norm in most of the joints (Alter, 2004). In turn, hyper mobility may be a factor in decreased positional sense (proprioceptive acuity), which may increase the risk of acute or chronic injury (Pacey et al., 2014; Fatoye et al., 2009).

7. Discussion

Flexibility as a component of physical and/or motor fitness plays a significant role in enhancing performance in games and sports. Seeing how the performance of games and sports may not rely solely on flexibility, certain motor fitness components are also essential for the success of games and sports performance. In addition, apart from having a direct connection to improving performance through gaining mastery of the skills, this function indirectly helps to develop other essential motor components, namely strength, speed and endurance. Its role in minimizing injuries and reducing the expenditure of energy while performing movements cannot be disputed. It is supposed that the flexibility exercises suggested for athletes would go a long way towards enhancing the flexibility of all the body's essential muscles, thereby ensuring their performance improvement. While selecting the flexibility exercises, it is necessary to bear in mind the sequence of skill movements and the muscles involved in performing certain movements of the selected games and sports.

8. Conclusion

Stretching can optimize a sportsperson's learning, practice, and performance of many types of skilled movements. Similarly, flexibility can increase a sportsperson's mental and physical relaxation. Its promoting development of body awareness; reduce the risk of joint sprain, muscle strain, back problems, muscle soreness, and tension. There can be no doubt that stretching exercises are thought to prevent injury and improve performance in a number of sports. Although, only stretching exercises should not be considered a solution. It is proposed that stretches of Proprioceptive Neuromuscular Facilitation (PNF), Nordic hamstring curl (for hamstring), and Total Resistance Exercises (TRX) should also be used to build flexibility. Hence, muscle stretch ability would be strengthening on specific joint or body part. For all counts, and with proven findings, it is no wonder that the optimum flexibility (properly stretched) can facilitate proper development of other motor components and helps a sportspersons to minimize the effort while doing a movement thus saving energy.

8.1 Recommendation

Further research can be done in the same topic with different stretching methods which can enhance games and sports performance.

Conflicts of Interest

No conflicts of interest are declared by the authors.

About the Authors

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