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for CECS Level II Coaches

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SPECIFIC THEME: Methods of flexibility training

GENERAL THEME: The basics of flexibility

Specific Theme

METHODS OF FLEXIBILITY TRAINING

1 Introduction

During the last two decades, informed coaches' attitudes have changed, first with relation to the value of flexibility and second with regard to the way it should be done. Today, flexibility training is an essential component of any training program. The old-fashioned approach was to stretch to the point of pain and with inadequate build-up. It is important for coaches to understand that stretching cannot be rushed and that it takes several years of flexibility training for an athlete to become proficient in carrying out these exercises (Bloomfield & Wilson, 1998, p. 266).

To obtain muscle benefits from a training program to enhance range of movement (ROM), participants must know the capabilities and limitations of the program and how to differentiate between various types of programs (Alter, 2004, p. 5).

2 Definition of a flexibility-training program

A flexibility-training program is defined as a planned, deliberate, and regular program of exercises that can permanently and progressively increase the usable ROM of a joint or set of joints over a period of time (Alter, 2004, p. 5).

Often the term flexibility exercise is used synonymously with stretching exercise (Pezzullo & Irrgang, 2001, p. 113). However, Kisner and Colby (2002) emphasize that "stretching and ROM exercises are not synonymous terms. Stretching takes soft tissue structures *beyond* their available length to *increase* ROM. ROM exercises stay within the limits of tissue extensibility to *maintain* the available length of tissues." (p. 187)

3 Methods used to increase flexibility

3.1 Ballistic stretching

Traditional stretching exercises which have been used in sport have generally been ballistic in nature. Although they have been in use for over 50 years, they were rarely questioned until about 25 years ago, when sport scientists and sport medicine specialists began to report that they may lead to injury and muscle soreness.

3.1.1 Disadvantages of ballistic stretching

Alter (2004, p. 158) suggests that there are several reasons why ballistic stretching is not the best system to use:

- When connective tissue is rapidly stretched it does not have time to adequately adjust and this can result in soreness and injury.
- If a sudden stretch is applied to a muscle, a reflex action occurs which causes the muscle to contract. This then causes muscle tension to increase, making it more difficult to stretch the connective tissue. Further, with the muscle being stretched and contracted at the same time, the likelihood of injury is reasonably high.
- It has also been found that a quick stretch does not allow time for neurological adaptation to take place when one compares it to a slow stretch. This in itself will be a limiting factor in the improvement of flexibility.

3.1.2 Advantages of ballistic stretching

Some coaches still support ballistic stretching because they maintain that many movements in sport are ballistic in nature. Its supporters suggest that it is specific to sport and provided it is done with caution and the athlete does not overstretch, it can be an effective way to increase flexibility. When the sport has a strong agility component and the development of elastic energy is necessary, there is no reason why a certain number of exercises cannot be ballistic in nature, especially if they are specific to the sport. However, it is of great importance that the musculature is thoroughly warmed up prior to performing ballistic stretching (Bloomfield & Wilson, 1998, pp. 260-261).

3.2 Static stretching

This method involves holding a static position for a period of time after the limb has already been stretched and it has become very popular over the last decade because it is both effective and relatively safe. Simply put, static stretching involves a slow stretch (to inhibit the firing of the stretch reflex) almost to the point of resistance, where it is then held for 20-30 sec or even up to 60 sec if necessary. During this time the tension partially diminishes (due to the inverse stretch reflex) and the athlete slowly moves into a deeper stretch and repeats the above (Bloomfield & Wilson, 1998, p. 261).

3.2.1 Advantages and disadvantages of static stretching

Currently there is a strong support for static stretching among sport scientists and coaches and it is difficult to find any good reason why static stretching should not make up the majority of any worthwhile flexibility program. The advantages of static stretching are first that it gives very good results and second that it results in less muscle soreness and injury. Furthermore, slow stretching allows muscle relaxation to occur as a result of the firing of the Golgi tendon organs (GTOs), if the stretch is performed over a reasonable time (Bloomfield & Wilson, 1998, pp. 261-262).

3.2.2 Comparison of ballistic and static stretching

De Vries (1962) compared ballistic and static stretching methods and found that each type resulted in significant improvements in flexibility. He also found that neither system was better than the other in terms of the amount of mobility achieved, but stated that static stretching offers three advantages over the ballistic method:

- (1) There is less danger of exceeding the extensibility limits of the tissues involved.
- (2) Energy requirements are lower.
- (3) Although ballistic stretching is apt to cause muscular soreness, static stretching will not; in fact some sport scientists hold that the latter relieves soreness (De Vries, 1962, p. 228; see also *IAAF @-Letter 4/04*).

3.3 Proprioceptive neuromuscular facilitation (PNF)

This method is primarily based on Herman Kabat's (1958) PNF theory which was first adapted for use in physiotherapy, then later in sport. It was hypothesized that an increased ROM was promoted through "the principles of successive induction, autogenic inhibition and active mobilization of connective tissue" (Holt, 1974, p. 33). Specifically it was suggested that greater muscle relaxation occurs after a significant contraction of the muscle. This relaxation may occur as a result of a reduced discharge of the muscle due to increased GTO activity.

There are many different combinations of PNF stretching, but the most common technique which is currently used in sport is the contract-relax-contract technique.

3.3.1 Contract-relax-contract technique

Sometimes known as scientific stretching for sport (3S), the contract-relax-contract technique is the most utilized method of the PNF techniques within the sport community and has been used with good results. For each exercise the muscle is initially placed in a lengthened position, then isometrically contracted against the immovable resistance of a partner for 6 sec. This is followed by a *very brief* period of relaxation, after which the athlete contracts the appropriate muscle group, placing the body part into a new position. This movement is aided by the partner with *light pressure* which allows for a greater ROM to be achieved than in a static stretch.

The exercise is then repeated three or four times.*

3.3.2 Advantages and disadvantages of PNF

The supporters of PNF stretching claim that this technique increases the range of motion in a shorter time than the other techniques. This claim has been strongly supported by research performed by Wallin, Ekblom, Grahn and Nordenborg (1985, p. 265) who reported that PNF stretching increased flexibility to a greater extent than ballistic stretching methods. The second advantage appears to be that there is a *slight* gain in strength at the same time that the ROM is being increased.

However, critics of PNF suggest that there is an increased chance of injury if the partner applies too much pressure (Bloomfield & Wilson, 1998, p. 264).

3.4 Other stretching techniques

3.4.1 Active stretching

Here, the athlete alone is responsible for the stretching without the assistance of any external force. Active stretches should be carried out slowly so that the stretch reflex is not initiated. When using this method there is no need for the athlete to stay at the full range of the stretch for more than 3 or 4 sec.

*It should be noted that a special computer-controlled flexibility system known as *FlexSys* has been developed to carry out the exercises without the assistance of a partner.

3.4.2 Passive stretching

For athletes who need an extreme range of flexibility in certain joints, passive stretching is of great value. During passive stretching the athlete stays relaxed and makes almost no active contribution to the stretch, which should be done slowly and with care, because if it is carried out jerkily outside the athlete's normal ROM an injury could occur. An external force is usually created by a partner; however, it can also be created with a variable resistance strength training machine, which can place the muscle on passive stretch, with a slight change in posture near the end of each repetition. The advantages of passive stretching are as follows:


- It allows the individual to stretch *well beyond* the active limit.
- It is effective when the agonist is too weak to initiate a movement which will move the limb through the full ROM.
- Passive stretching done in pairs creates an enjoyable social atmosphere for the participants (Bloomfield & Wilson, 1998, p. 265).

The best stretching routine is one that is easy to complete, is so repeatable that it becomes almost automatic, and includes the major joints and muscle groups used in the athlete's special discipline (Martin & Coe, 1997, p. 293).

Cardinal Rules for Performing Stretching Exercises

(Bloomfield & Wilson, 1998, pp. 267-268; Martin & Coe, 1997, pp. 293-294)

- **The area where the stretching exercises are performed should be reasonably comfortable and warm. This means that non-restrictive clothing should be worn, the individual should be in a relaxed state and warmed up before the exercises commence. At least a mild sweat must be reached before the stretching routine is started. Otherwise an injury could occur.**
- **When stretching to improve the ROM for any skill, the individual should carry out the stretch in the same postural position, the same plane of motion and through the same range of movement as the skill, if all of these are possible.**
- **The athlete should neither bounce nor jerk, but rather gradually induce the stretch. He should not hurry the stretching routine and must carefully monitor the amount of tension developed in the muscles.**
- **The actual stretching of the muscle group can be done for 20-30 sec; however, this can last for up to 60 sec if several 'small relaxations' are felt during the stretch. Each time one of these occurs the athlete is then able to stretch a little further.**
- **Athletes should slow down their breathing rate and increase the depth of each breath for the first five or six breaths in each exercise. A steady light pattern should follow the slightly deeper and longer breathing technique for the remainder of each exercise.**
- **Between four to eight repetitions can be carried out for each exercise; however this will depend on the amount of mobility training the athletes have already done during their competitive career.**
- **The athlete should stretch the muscles on both sides of his or her body.**
- **Although stretching exercises will produce a degree of discomfort, the threshold for pain must not be exceeded. If the muscle vibrates or quivers and pain is present, then the athlete should cut down the force applied or limit the ROM. To force a joint past the point of discomfort will finally result in an injury.**

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- **If ballistic stretching is performed, then the stretch should be done in a similar way and at 75-80% of the speed of the skill which the athlete wants to improve by the stretching exercise, but only after the muscle groups involved have first been warmed up and then stretched by the static method.**
 - **The number of training sessions per day will be determined by the amount of improvement the athletes wish to make. One session a day, depending on its length, will result in an improvement in flexibility; however, two sessions are needed if any significant improvement is to be made in the short term. One of these is usually done in the morning and the other in the afternoon unless other training arrangements are more suitable. Once the appropriate level of flexibility has been achieved, one intensive training session per week has been shown to be adequate to maintain an established level of flexibility.**
 - **Short warm-up and warm-down stretching sessions are not regarded as flexibility training per se, unless they are carried out for a prolonged period of time. They are in fact done as a preparation for normal training but in some cases, where a high degree of flexibility is not needed in the sport, they will provide athletes with enough stretchability to enable them to relax when needed.**
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General Theme

THE BASICS OF FLEXIBILITY

1 Defining flexibility

The word *flexibility* can be defined in several different ways depending on the discipline or the nature of the research. For example, the term may be applied to both animate or inanimate objects. The word is derived from the Latin *flectere*, “to bend,” and is defined as “the ability to be bent, pliable.”

Another, alternate definition of flexibility has been offered by Halbertsma, Bolhuis and Göeken (1996) – it should refer to extensibility rather than ROM: “Extensibility is [...] the ability of a muscle to allow elongation, more specifically the ROM over which the limb can be passively moved (the maximum angle).” (p. 976)

2 “Normal” flexibility

Little agreement can be found on the definition of so-called normal flexibility. In physical education, sports medicine, and allied health sciences, perhaps the simplest definition of flexibility is the range of motion (ROM) available in a joint or group of joints (see e. g. Hebbelinck, 1988, p. 213). For others, flexibility also implies

- freedom to move (e. g. Metheny, 1952, p. 117),
- “the ability to engage a part or parts of the body in a wide range of purposeful movements at the required speed” (Galley & Forster, 1987, p. 152),

- “the total achievable excursion (within limits of pain) of a body part through its potential range of motion” (Saal, 1998, p. 85),
- “normal joint and soft tissue range of motion in response to active or passive stretch” (Halvorson, 1989, p. 355),
- “the ability to move a joint smoothly through its complete range of motion” (Kent, 1998, p. 195),
- “the ability to move a single joint or series of joints smoothly and easily through an unrestricted, pain-free ROM” (Kisner & Colby, 2002, p. 172), and
- “the ability to move a joint through a normal range of motion without undue stress to the musculotendinous unit” (Chandler, Kibler, Uhl, Wooten, Kiser & Stone, 1990, p. 134).

Flexibility is synonymous with *mobility* (Corbin & Noble, 1980, p. 23).

3 Differences among “flexibility”, “hypermobility”, “joint laxity”, and “joint instability”

The terms *flexibility*, *hypermobility*, *joint laxity*, and *joint instability* are not synonymous. *Flexibility* commonly refers to ROM of a joint. In contrast, *laxity* refers to the stability of a joint (Saal, 1998, p. 85). Excessive joint laxity can be a result of a chronic injury or a congenital or hereditary condition, such as Ehlers-Danlos syndrome (EDS). Joint derangement and dysfunction resulting from a loss of joint stability is referred to as *joint instability*. Often, the terms *joint hypermobility* and *joint instability* are

used interchangeably, and there is no standard definition of these terms. Clinical joint instability must be distinguished from hypermobility. *Hypermobility* is associated with an increased ROM, normal ratio of translational movements, whereas *joint instability* is characterized by increased or normal ROM, increased proportion or aberrant translational movements, and aberrant coupled movements.

Flexibility refers to the degree of normal motion; *laxity* refers to the degree of abnormal motion of a given joint; *hypermobility* refers to the ROM in excess of the accepted normal motion in most of the joints or excessive length of a tissue (Alter, 2004, p. 4).

4 Nature of flexibility

In addition to cardiorespiratory endurance, strength, and muscular endurance, flexibility is an important part of the total development of physical fitness.

Flexibility does not exist as a general characteristic but is specific to a particular joint and joint action (Bryant, 1984, p. 171; Corbin & Noble, 1980, p. 23). Adequate ROM in the hip does not ensure adequate ROM in the shoulder. Similarly, sufficient ROM in one hip may not mean sufficient ROM in the other hip. In short, "no flexibility test can be used to evaluate total body flexibility" (American College of Sports Medicine, 2000, p. 86). The differences in ROM reflect genetic variation, personal activity patterns, and specialized mechanical strains imposed on connective tissue.

Contrary to the common belief that if athletes are flexible in one joint, then they will have a similar range of movement in others, an individual is a composite of many joints, some of which may be unusually flexible, some inflexible and some average (de Vries, 1986). Flexibility therefore is joint-specific and depends not only on the 'tightness' of the ligaments, muscles, tendons and joint capsules, but also on the size and shape of the bones and how they are articulated (Bloomfield & Wilson, 1998, p. 244-245).

5 Factors affecting flexibility

5.1 Age

Research at this time is divided on whether there are periods in individual's lives when they are more flexible than at other times. Corbin and Noble (1980, p. 24) suggested that flexibility increased in a child until adolescence, when there appeared to be a plateau effect, followed by a steady decrease in mobility as the individual aged. Research by Phillips, Bookwalter, Denman, McAuley, Sherwin, Summers and Yeakel (1955) and Kirchner and Glines (1957) did not support this finding and both stated that elementary school aged children became less flexible as they grew, reaching a low point between 10 and 12 years of age. From this time on, flexibility appeared to slightly improve until late adolescence. There seems to be no dispute in the literature, however, about the fact that from young adulthood there is a steady decline in flexibility until death. If a well-planned intervention program aimed at increasing flexibility is carried out during

childhood and adolescence, then extreme ranges of mobility can be obtained particularly in females; however, these ranges are more difficult to achieve in post-adolescence (Bloomfield & Wilson, 1998, p. 247).

5.1.1 Critical training periods

The literature is confusing on this subject, with some researchers maintaining that it is during childhood and early adolescence that the best flexibility training results are obtained, while others disagree with this. Regardless of the exact time for optimal benefit, flexibility exercises can be done at any period in an athlete's life and are not dangerous, provided certain safeguards are adhered to (Bloomfield & Wilson, 1998, p. 247).

5.1.2 Childhood and adolescence

Because individuals are undergoing rapid growth during childhood and adolescence, the coach must be careful not to overstress the musculo-skeletal system of a young athlete. Early in a child's life, the bones have not yet fully formed and the bone modelling process is rapidly occurring. This means that cartilage, which is steadily being replaced by bone, is very vulnerable to overuse syndromes and trauma. Well-planned strength and flexibility training will not cause injuries, but overtraining will. It should also be noted that during periods of rapid growth a loss of flexibility can occur, as the bones may grow at a faster rate than the muscles around them. Consequently it is often necessary for children to perform flexibility exercises during the adolescent

growth spurt, to maintain reasonable levels of flexibility at this time (Bloomfield & Wilson, 1998, p. 247).

5.1.3 Post-adolescence

As the individual ages, muscles, tendons and connective tissue shorten and calcification of some cartilage occurs, with a resultant loss in the range of movement. This usually appears first in the lumbar region, followed by the knees, then in other joints. It can be minimized with a well-planned stretching and strength-training program, provided the individual does not overstress the musculo-skeletal system (Bloomfield & Wilson, 1998, p. 248).

5.2 Gender

Research by Phillips et al. (1955) and Kirchner and Glines (1957) found that elementary school aged girls were more flexible than boys of a similar age. From adolescence onward, females appear to be more flexible with smaller bones and less musculature than males; however these observations, made by a large number of health professionals, teachers and coaches, have not been conclusively supported by research at this time (Bloomfield & Wilson, 1998, p. 248).

5.3 Environmental conditions

There is general agreement that a warm-up must precede flexibility exercises (e. g. a stretching session). When soft tissue, particularly the musculo-tendinous unit is heated, it can promote relaxation which allows safe flexibility exercises to be per-

formed. In facilitating flexibility, warming up has the effect of reducing muscular injury and enhancing the performance of athletic activities. A warm-up also increases the elasticity of the musculature. Asmussen, Bonde-Petersen and Jorgensen (1976, p. 88, Table III) reported that the height achieved in maximal vertical jumps was reduced from 42 cm to 30 cm when the muscles of the lower limb were cooled by immersion in cold water.

6 Types of flexibility

6.1 Static flexibility

Static flexibility relates to ROM about a joint with no emphasis on speed. Two examples of static flexibility are slowly bending to touch the floor or performing a "split". Since the limits of static flexibility tests are subjectively defined by either the subject or the tester such tests cannot be truly objective (Alter, 2004, p. 4).

6.2 Ballistic flexibility

Ballistic flexibility is usually associated with bobbing, bouncing, rebounding, and rhythmic motion. Another term somewhat related to rhythmic motion is *dynamic flexibility* (an alternative term of which is *functional flexibility*), which refers to the ability to use a range of joint movement in the performance of a physical activity at either normal or rapid speed (Corbin & Noble, 1980, p. 23). Hence, dynamic flexibility does not necessarily denote ballistic or fast types of movement. However, a rigorous definition of dynamic flexibility has not yet been universally accepted (Hubley-Kozey,

1991, p. 309). Dynamic flexibility accounts for about 44-66% of the variance of static flexibility. However, Knudson, Magnusson and McHugh (2000, p. 3) acknowledge that "there is insufficient research to determine whether static and dynamic flexibility are two distinct properties or two aspects of the same flexibility component."

Obviously, most athletic events involve dynamic flexibility. Here too, the type of flexibility is specific to the type of movement (speed and angle) of a given discipline and thus is not necessarily related to just ROM. Siff and Verkhoshansky (1999, as quoted by Alter, 2004, p. 4) break down functional stretching conditioning into three components:

- (1) *flexibility-speed*, the ability to produce efficient full ROM at speed,
- (2) *flexibility-strength*, the ability to produce efficient, powerful static and dynamic movements over a full ROM, and
- (3) *flexibility-endurance*, the ability to repetitively produce efficient full ROM under static and dynamic conditions.

6.3 Passive flexibility

Passive flexibility is a measure of the ROM in the absence of active contraction (i. e., voluntary muscular effort). Instead, a partner or special equipment often maintains the ROM. Passive flexibility can also be applied to oneself by having one part of the body exert a stretching force on another part, such as pulling the thumb back with the opposing hand or using the weight of upper torso when

stretching forward to touch the toes while seated on the floor.

Passive ROM is more difficult to measure reliably than active ROM. Passive movements are extremely difficult to reproduce, because the stretching of soft tissues at the limit of motion depends on the force applied to the limb, which must, therefore, be carefully controlled (Alter, 2004, p. 5).

Two examples of static flexibility are slowly bending to touch the floor or performing a "split". Since the limits of static flexibility tests are subjectively defined by either the subject or the tester such tests cannot be truly objective (Alter, 2004, p. 4).

7 The specificity of flexibility

Above (chapter 4) it was already mentioned that flexibility is specific to a given group of sports as well as to a given joint, a given side, and a given speed. Furthermore, even within sports groups, particular patterns of flexibility are related to frequent or unique joint movements. Those joints demanding flexibility are characteristic of a given sport and of each subgroup within a sport. As some sports and disciplines require the development of specific flexibility patterns, flexibility training should be prescribed accordingly (Alter, 2004, p. 5; Zernicke & Salem, 1996, p. 49).

8 Flexibility and injury

It is well known by elite-level coaches that highly flexible joints and musculo-tendinous units will help reduce severe muscle strains or joint sprains when they are accidentally over-

stretched. This mechanism has also been described by Shellock and Prentice (1985) who stated: "... flexibility is important for injury prevention. There are many situations in sport where a muscle is forced to stretch beyond its normal active limits. If the muscle does not have enough elasticity to compensate for this additional stretch, it is likely injury will occur to the musculo-tendinous unit." (p. 272)

Such an injury would occur in most individuals if they were to jump up and land in the splits position. However, if very high levels of flexibility were achieved, the performance of this movement would not result in injury. Thus it is important that coaches and athletes are able to judge the extreme ROM which their athletes will need in their sports and work towards this in training.

Many muscle injuries which are related to flexibility do not occur as a result of overextension during an activity. For example, the majority of ruptures of the pectoralis major muscle occur during the performance of the bench press lift, an exercise which is performed within relatively normal movement ranges. Similarly, pulled hamstring muscles commonly occur in athletes with poor flexibility; however, they are generally not caused by an overextension of the lower limbs. Thus it is apparent that a second mechanism underlying the relationship between flexibility and injury may exist.

Such a mechanism was proposed by Wilson, Wood and Elliott (1991) who observed a significant relationship between flexibility and muscular stiffness. Wilson et al. demonstrated that

individuals who were inflexible tended to possess stiff musculotendinous units. As external forces were imposed upon these units they were less able to attenuate the forces and consequently the incidence of muscular injury was greater, when compared to more flexible individuals who possessed musculo-tendinous units which were more elastic. Wilson et al. stated that "the musculo-tendinous unit represents the link between the skeletal system and muscular structures. As an external force is imposed on the musculature, a compliant system will extend to a greater extent allowing the applied force to be absorbed over a larger distance and greater time as compared to a stiff system. As such, the cushioning effect of a compliant system reduced the trauma on the muscle fibers decreasing the incidence of muscular injury as compared to a stiff musculo-tendinous system" (Wilson et al., 1991, p. 407).

Thus, the second mechanism underlying the relationship between flexibility and muscular injury is based on the significant association between flexibility and the elasticity of the musculo-tendinous unit, and the effect that this elasticity has on the incidence of muscular injury.

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