What the Latest Research Says About Static Stretching.
By Ken Kontor, Publisher, Performance Conditioning Inc.
Recently I talked with a national director of coaching who revealed to me that in his younger days he spent 45 minutes a day on static stretching. In today's "economy of time" society, this practice would equate to spending half of a practice session on one component, flexibility. This time-consuming activity was designed to prevent injury and improve performance. But, today the latest research has shown that not only is this type of activity as part of warm-up before practice or a game is a waste of time, but it probably does more harm than good. As a coach or serious athlete who takes conditioning seriously, we believed it important to reveal the truth about static stretching and why dynamic mobility training as part of a comprehensive warm-up activity will not only save valuable practice time, but also improve performance.

What Research Says: Passive Static Stretching Reduces Strength
Here's an edited version of an abstract that concludes strength is reduced up to one hour after static stretching. For the complete research go to Journal of Applied Physiology, 2000 Sep;89(3); 1179-88, by Fowles JR, Sale DG, MacDougallJD, Department of Kinesiology, McMaster University, Hamilton, Ontario, Canada L8S 4Kl.
The purpose of this study was to assess strength performance after an acute bout of maximally tolerable passive stretch (PS(max)) in human subjects. Ten young adults (six men and four women) underwent 30 minutes of cyclical PS(max) (13 stretches of 135 seconds each over 33 minutes) and a similar control period (Con) of no stretch of the ankle plantar flexors. Measures of isometric strength (maximal voluntary contraction) were assessed before (Pre), immediately after (Post), and at five, 15,30,45 and 60 minutes after PS(max).
Compared with Pre, maximal voluntary contraction was decreased at Post (28 percent) and at five (21 percent), 15 (13 percent), 30 (12 percent), 45 (10 percent) and 60 (9 percent) minutes after PS(max). Motor unit activation and electromyogram were significantly depressed after PS(max), but had recovered by 15 minutes.
These data indicate that prolonged stretching of a single muscle decreases voluntary strength for up to one hour after the stretch as a result of impaired activation and contractile force in the early phase of deficit and by impaired contractile force throughout the entire period of deficit.

What the Gymnasts Say: Strengthening and Dynamic Stretching Enhances Flexibility
Recognizably, as a group of athletes, gymnasts are most concerned with flexibility. The nature of the sport relies on the ability of the athlete to produce maximum degrees of flexibility within functional strength parameters. Here's an edited version of an article "Enhancing Flexibility in Gymnastics" that concludes that strengthening and dynamic non-static stretching enhances flexibility more effectively. This article appeared in the May 2000 issue of Technique, Vol. 20, No.5.
The authors are William A. Sands, Ph.D., USA Gymnastics Director of Research and Development and Vice Chair of Research, US Elite Coaches Association for Women's Gymnastics; and Jeni R. McNeal, MS, CSCS, Department of Exercise and Sport Science, University of Utah.
Most gymnastics coaches would agree that flexibility is an essential aspect of gymnastics training and performance. Flexibility is frequently included in talent identification and screening measures for gymnasts, divers and dancers. In spite of a fairly universal recognition of the need for flexibility in gymnastics, surprisingly little research has been done on enhancing flexibility among elite performers.
The simple answer to how one develops flexibility (i.e., range of motion) is to stretch. However, the problem of increasing flexibility to enhance gymnastics performance may be more complicated. Clearly, because the rules of assessment in gymnastics performance call for deductions when a gymnast cannot achieve a specific position, the role of flexibility training to achieve certain positions is important.
Some years ago, Dr. Gerald George provided a thought-provoking lecture regarding the expression of strength and flexibility, starting with these characteristics as separate and finally

showing conceptually that they were very similar. That range of motion is dependent on both strength and flexibility is commonly understood, but how to train both qualities for the elite gymnast in particular has not been well researched. Interestingly, stretching activities of various types may be the single exercise activity in gymnastics that consumes the greatest percentage of conditioning time. In spite of this, our gymnasts are often viewed as being inflexible when evaluated by the National Coaching Staff and judges.

Training elite gymnasts with regard to flexibility proves problematic for at least two reasons. First, highly trained athletes usually are near their performance ceiling in many physical abilities (ceiling effect) and therefore are unable to show consistent improvement of large magnitude. Second, flexibility training has consisted almost exclusively of stretching exercises, with little attention devoted to strengthening the prime movers in the extreme ranges of motion (one dimensional thinking). Perhaps only proprioceptive neuromuscular facilitation techniques (PNF) have found much of a following in elite gymnastics training.

The research literature on flexibility has offered paradoxical results when compared to typical coaching understanding of flexibility. For example, Russell compared six methods of stretching and found that passive stretching approaches were superior to active stretching approaches in increasing hip flexion range of motion. Another study by Cornelius and Hayes showed that when using PNF techniques, multiple maximal contractions at the extreme range of motion were not better than a single contraction. Hutton showed that much of the current understanding of the neuromuscular activity during stretching (i.e., PNF) was poorly understood or simply incorrect. In a comparison of pelvic position and static versus PNF stretching techniques, Sullivan, et a!., found that pelvic position was more important than the stretching technique in improving hamstring flexibility. Our current simple understanding of "flexibility" as the range of motion of a joint or a related series of joints may be misguided and betray a more complex mechanism.

The purpose of this investigation was to determine if a ballistic stretching / strengthening approach would improve already highly trained gymnasts' split leap leg positions. A simple split leap was chosen due to its fundamental nature and the fact that gymnasts rarely do a simple split leap in their typical routine training. The split leap served as a skill that all gymnasts had performed in the past, but suitably novel that improvement could still be possible.

Through the cooperation of seven gymnasts at the Olympus School of Gymnastics and their head coach, we undertook a training study using Theraband I elastic strips. The gymnasts were all Level 10 and Elite gymnasts currently training approximately 25-30 hours per week. The training lasted one month. The athletes were in the combination preparation stage of their yearly periodized program.

Following placement of the Theraband, the gymnast performed the following movements on both legs:

1. Kicks forward
2. Kicks sideward
3. Kicks rearward
4. Straddle jumps
5. Split jumps

The gymnasts began with five repetitions per set and three sets. The number of repetitions gradually increased to 15 repetitions per set for three sets. The increasing number of repetitions per set was spread over the four-week training period. We initially were concerned about potential hip flexor or other groin injuries and chose to proceed cautiously. The exercises were performed at the end of practice approximately daily, with a few exceptions due to individual and program schedules. The athletes were encouraged to "kick" rather than "lift" their leg, maintain good form and alignment and maximize their effort during the kick - trying to kick as high as possible.

## Discussion

The results of this study showed that split leap range of motion can be improved. Although no control group was used due to a perceived ethical problem of withholding useful techniques

from teammates, it is clear that these gymnasts have been stretching diligently for several years with only modest improvement, if any. The lack of a control group (which would have tested but not participated in the Theraband stretching) results in an inability to state with certainty the cause of the enhanced split leap performances. However, the cause-effect relationship is strengthened by the temporal ordering of events and the novel nature of the split leap.

Subjective observation showed that these athletes demonstrated dramatic improvement in split leaps, kicks, straddle jumps and similar skills. Perhaps the most obvious observation of improvement came on balance beam, where the different shape-jumps demonstrated dramatic increases in leg height and amplitude. Although a three to four percent improvement in performance might be considered small, among elite athletes such an improvement is large. A 3.5 percent difference at the most recent World Gymnastics Championships was the difference between first place and 20th place in the women's all-around. Further research needs to be performed with an adequate control group. A four-week training period is rather short; therefore, a longer training program is warranted and the gymnastics groups could be expanded to include less highly trained gymnasts.

What the Gymnasts Say - Static Stretching Reduces Power Production Flexibility

Still not convinced? The most important single athletic component to performance success is power production. Here's an edited version of an article "Static Stretching Reduces Power Production in Gymnasts" that concludes that static stretching reduces power production. This article appeared in Technique. The authors were I.R. McNeal, Ph.D., Eastern Washington University and William A. Sands, Ph.D., USA Gymnastics Director of Research and Development and Vice Chair of Research, U.S. Elite Coaches Association for Women's Gymnastics.

Static stretching, consisting of holding muscles at lengthened positions for typically 15 to 45 seconds, has been recommended before participating in physical activity. Gymnasts historically have performed static stretches, such as splits, during the warm-up portion of training. Recently, however, data have been presented from studies on adults which have shown that static stretching immediately prior to performing powerful activities reduces performance. The reported reductions in performance persisted over an hour following static stretching. Some athletes in sports such as track and field no longer stretch in this manner because of the detrimental effects on movement speed.

This effect of static stretching on power has not been studied in children, and in particular on gymnasts, who often use static stretching as part of their training. Therefore, we conducted a study to investigate the effects of stretching the calf muscles on the ability to perform a drop jump (punch jump). Fourteen female gymnasts, competitive levels 7-9, performed drop jumps onto a timing mat under two conditions. On one day the gymnasts were stretched statically for 30 seconds on three different exercises (stair stretch, partner supine stretch and pike stretch). These exercises were performed twice in a circuit fashion. The gymnasts then immediately performed three drop jumps. We evaluated the time on the ground for each gymnast, as well as the height she achieved in the jump.

On the second day, the gymnasts did not stretch, but performed the drop jumps after their usual warm-up activities (which did not include static stretching). The order of the conditions was randomly assigned. The results showed that the gymnasts jumped significantly lower following the stretching protocol (.246 m compared to .268 m). This difference in performance is equivalent to an average 8.2 percent loss in height. This reduction in performance could mean the difference between landing safely and under rotating a tumbling skill. Time on the ground during the jump was not changed.

Research on adult subjects has shown that static stretching reduces strength performance by reducing muscle activation as well as compromising the muscle's ability to contract at the cellular level.

Although we have been recommending the discontinuance of intense static stretching in favor of dynamic stretching as part of the warm-ups for gymnasts, coaches and athletes have seemed slow to accept this recommendation. While static stretching is beneficial and important for a

gymnast's flexibility development, this type of training should not be placed before activities in which the gymnast must be strong or powerful (i.e. before or during gymnastics training). Based on the data presented here, coaches should reevaluate their warm-up practices and consider the effects of static stretching on their gymnasts' ability to produce powerful movements. As athletes in other sports have found, dynamic stretches such as leg kicks are probably a better choice for preparing gymnasts for training explosive movements.
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## Something to Think About

By Ken Kontor, Publisher, Performance Conditioning Inc.

You've seen it countless times. A group of athletes or team gathers around for the traditional ritual known as pre-activity stretching. Do you know why athletes stretch? Conventional wisdom tells us that stretching lengthens the soft tissue around the joints to prepare the body for the upcoming activity and to help prevent injury. However, much of this wisdom may be a result of tradition rather than proven fact.

Consider the following story told by American Football Coaches Association Executive Director Grant Teaff. A small girl comes into the kitchen on Easter Sunday morning where her mother is preparing the traditional Easter ham dinner. The girl notices that her mother is cutting the ends of the ham off and asks her why she was doing that. Her mother said "That's the way my mother did it every Easter." Later that day, the girl's grandmother came over, so the little girl asked her the same question and got the same answer. Finally, great grandmother arrives for dinner and the little girl had to ask the matriarch of the family why the ends of the ham were cut off. The old lady smiled weakly and looked into the little girl's eyes and said, "Why honey, back then I only had a small pan in which to cook the ham. So to fit it in I had to cut the ends off." The moral of the story: why do we continue to do what has been done for years without asking the appropriate questions? In the August 31, 2004, issue of British Medicinal journal, a longitudinal study of literature by a group of Australian sports science researchers concluded that there is no scientific evidence that stretching prevents injuries. Nevertheless, many athletes and coaches spend up to 20 minutes a day stretching. They have seen the ham ends cut off too many times. An important question is, if you stretch a muscle group to improve the range of motion and muscle elasticity, how long does the effect last? No one knows for sure. If it's for a few seconds, why do it?

Today, stretching in some circles has evolved into a warm-up protocol that involves dynamic movement using a combination of sports and specific athletic skills. This "big pot" approach even goes as far as to develop strength and power in the latter stages of the warm-up activity. In our limited time society, this dynamic movement type "stretching" is an excellent way of getting the "whole ham." It is time to take a hard look at the way we stretch and start asking the difficult questions that fly in the face of tradition.

## Passive Stretching Program in Training Camp Increases Injuries on the Field

By Ashley Reece-Podgorski, MS, PT

A while back, I read an article about yet another Chicago Bears player put on the injured roster. The regular season had just started. What do they do with these guys in pre-season? Actually, having worked with several Bears players in the past, I know exactly what they do in pre-season. The team puts these players through a common but dangerous stretching program that damages joints and creates small tears in the muscles and ligaments.

During the off-season, professional football players train with weights and use a form of aerobic activity (such as running) to stay fit. They enter training camp healthy and hopefully at a level of moderate fitness. The coaches and trainers then work with the players to prepare them for the upcoming season.

But every year, I watch as player after player gets injured before the preseason is over. I keep waiting and wondering when these teams will realize that the reason the players are getting hurt is because something is wrong with the training program. If NFL (and all) coaches would

just change the players' stretching routine, they would see a number of injuries dramatically decrease.

When I traveled around the country a few years ago with the Austin NFL scout camps (a pre-draft test session for draft eligible athletes) and the WLAF draft, I took each player through a specially designed warm-up program before the testing began. The programs used active rather than passive range of motion. Out of thousands of players, only two from this group sustained muscle pulls. Those two were recurrent injuries for those two players.

When I returned to the Austin camps after that first year, several players who had continued to use the program came to me and told me they had not had a single muscle pull. Not only that, they no longer experienced soreness after an exercise bout. The only part of the fitness program that changed was the stretching routine.

After almost 15 years as a physical therapist working with professional teams and athletes of all ages and abilities, I can attest to the fact that active stretching dramatically decreases the number of injuries a player will experience. This applies to all athletes, regardless of their sport or fitness level.

Active stretching uses the muscles themselves to create the movement rather than momentum, gravity or some other assistive force. Active warm-ups work with the body and not against it, whereas passive stretching can create tears in ligaments and muscles in the muscle group being "stretched" before a player goes on to the field.

I would like to pose a challenge to all of the coaches and trainers reading this article, whether you are involved in club, high school or college. Incorporate active stretching into the fitness regime as the only form or stretching and see what happens. I guarantee your athletes will experience fewer muscle pulls and enjoy a healthier, less injury-plagued season.

Editor's note: Ashley Reece-Podgorski, MS, PI, is a licensed physical therapist and president of her own physical therapy clinic, Ultimate Performance Therapy in Barrington, Ill. She has written two books on strength training and improved muscle performance, lectures on active v passive stretching. She holds monthly fitness assessment and strength conditioning programs for athletes. For more information, see the Ultimate Performance System website at www.uptherapy.com.