

Acute stretching debate approaches a consensus

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Experts still disagree about whether stretching prior to athletic activity can prevent injury and, if so, whether those benefits offset any negative performance effects. But they do tend to agree that some form of stretching is probably a good idea for most athletes.

By Cary Groner

In the background stands a medieval fortress; in the foreground, large men with horned helmets assume awkward-looking positions. The caption notes wryly that of course the Vikings were always careful to stretch out before storming a castle.

If it sounds familiar, you've probably seen it; it's a "Far Side" cartoon, and it pointedly deflates a commonplace wisdom of modern athletics—that diligent stretching is crucial to athletic performance and injury prevention. As Gary Larson wryly reminds us, people managed to lead vigorous lives for millennia without routinely bending over their hamstrings. On the other hand, those who advocate stretching might point out that our distant ancestors had to accomplish all this activity fairly early, because most of them were old at 35 and dead by 40.

Elite modern athletes compete at a level unprecedented in human history and many nonathletes live active lives well into their 70s and 80s. As a result, interventions such as stretching become attractive in their apparent promises of better performance, fewer injuries, and long-term staying power. Nevertheless, clinicians and researchers continue to debate the relative merits of different approaches to stretching. At the annual meeting of the American College of Sports Medicine (ACSM) this May in San Francisco, two of the issue's most opinionated partisans went at it in a literal debate early enough on a Saturday morning that it invoked some of that old Viking fortitude.

The good news is that these days the issues are better defined than they were a few years ago. The combatants disagreed cordially about the finer points—when to stretch, how, and for how long—but a consensus is emerging that some form of stretching is probably a good idea for most athletes, after all, and that research indicating otherwise is flawed to various degrees.

Habitual stretching after workouts, competitions, or performances (commonly called chronic stretching) isn't particularly controversial. Most athletes do it, particularly if they're involved in sports conducive to muscle strains, such as soccer and football, or in gymnastics, dance, or hurdling, in which extensive range of motion (ROM) is critical to success. Where the camps primarily diverge is in their view of acute stretching before a workout, even as part of an overall warm-up.

Injuries

"Should we be stretching?" asked Malachy McHugh, PhD, during the ACSM debate. McHugh is director of research at the Nicholas Institute of Sports Medicine and Athletic Trauma at Lenox Hill Hospital in New York. "I would argue that stretching plays a role in injury prevention. Stretching makes the muscle more compliant, which gives it a greater functional range of motion. That greater range gives you more overlap in the cross-bridges, which means

you can generate more force at the longer length. The biggest criticism I have of the literature on stretching's role in injury prevention is that the dose [i.e., the time spent stretching before workouts] is inadequate."

McHugh's debate opponent, Ian Shrier, MD, PhD, who practices sports medicine at the Sir Mortimer B. Davis Jewish General Hospital in Montreal, suggested that pre-activity stretching is unlikely to affect injury risk because most strains—the injuries commonly targeted by stretching strategies—happen within normal ROM and are associated with eccentric contractions.

"Acute stretching weakens the muscle, partly because it absorbs less force," he said. "Muscle tears when the force you apply is more than it can absorb; it's not about length."

Shrier added an important caveat, however.

"If you stretch regularly [i.e., chronically, after workouts], over weeks," he said, "you can get more range of motion and you have increased strength."

The literature is so scattershot that it can be used to draw just about any conclusion. For example, McHugh pointed out a study from Japan that included stretching both before and after military training, and showed a 66% lower incidence of musculotendinous injuries in those who stretched than in controls.¹

"I conclude that the positive results are due to the stretching before activity," McHugh said. "Ian can conclude that they were due to stretching after. They did twenty minutes of stretching and five to ten minutes of warm-ups and had sixty-four percent fewer muscle strains than controls; so there is some efficacy there. I think this shows that pre-exercise stretching and warm-up can reduce the incidence of muscle strains if sufficient time is allocated to the intervention, and if the athletes are in activities with a high prevalence of muscle strains."

"The big difference is which component of the pre-activity intervention you think is important, and I think it's the warm-up," Shrier replied. "We know that stretching causes some damage, and once you're getting weaker, you've changed your proprioception; your muscles aren't absorbing as much force in the right ratio."

"The larger question is whether stretching that's sufficient to cause a prolonged decrease in passive stiffness confers any benefit with respect to injury prevention that might outweigh potential impairments in muscle function," McHugh pointed out. "When you stretch before a sporting event the decrease in resistance to stretch is due to decreased muscle viscosity. When you stretch regularly for many months, your flexibility improves and there is decreased resistance to stretch. I think both effects are beneficial, but the mechanisms are not the same."

McHugh's position

In a 2008 paper, McHugh concluded that stretch-induced strength loss was dependent on muscle length; strength declined when the muscle group was in a shortened position, but not when it was lengthened. A stretch-induced preservation of strength with muscle in the lengthened position could theoretically help resist injurious muscle elongation during athletic activity, in other words.²

In another article the following year, McHugh more comprehensively outlined his views about pre-activity stretching and injury performance based partly on a literature review.³ He noted, first, that stretching before an event is intended to ensure sufficient joint ROM for optimal performance and to decrease muscle stiffness or increase compliance, theoretically lowering injury risk.

One study cited in McHugh's paper showed that four 30-second stretches led to a 12% drop in passive stiffness of the plantar flexors, but that the effect lasted less than 10 minutes.⁴ Stretching for longer durations had more

prolonged effects; for example, effects of a four-minute stretch were still apparent after 10 minutes, suggesting that may be the minimal lasting stretch duration.

"It would take in the region of 20 minutes to effectively stretch both the agonist and antagonist muscle groups bilaterally," McHugh wrote. "If two or three sets are to be stretched...total stretch durations would be 40 to 60 min. This is clearly well in excess of typical preparticipation stretching practices with the possible exception of elite ballet dancers."

McHugh went on to note that decrements in performance measures are generally smaller than those gauging strength, often averaging less than 5%. He emphasized that several studies have reported that while stretch-induced strength loss occurs at short muscle lengths, it does not at longer lengths.^{2,5,6}

"These findings imply that acute stretching does shift the angle-torque relationship, thereby counteracting stretch-induced strength loss at longer muscle lengths," he wrote.

In the article, McHugh also pointed out that strength and power loss are partly due to neural effects, and that other neural inputs typically occur before performance, particularly when stretching is done as part of an overall warm-up. Such factors complicate the picture and limit the extent to which experimental results can be extrapolated to the real world of performance or competition.

"I think the performance impairment research is overstated," McHugh told *LER*. "In laboratory experiments strength is consistently decreased; part of this is neuromuscular inhibition, but part is simply a shift in the operating length of the muscle, not actual strength loss. In most sports, a lot goes on between the time the stretching ends and when the athlete takes the field. The residual neuromuscular inhibition may be overridden by a range of excitatory stimuli related to subsequent practice drills, pregame psychological stress, and motivational speeches. I'm pretty confident that any neuromuscular inhibition due to prior stretching is the least of their problems."

Shrier's vantage

Of course, Ian Shrier has published a few papers of his own, and his conclusions often differ from those of McHugh.

In a literature review published in the *Clinical Journal of Sports Medicine*, Shrier looked at 23 articles examining the effects of pre-activity stretching on subsequent performance. Of those, 22 suggested there was no benefit for isometric force, isokinetic torque, or jumping height. One found that stretching benefited running speed, one reported that it was detrimental, and two were equivocal. By contrast, research into regular chronic stretching found that it improved force, jump height, and running speed (though not running economy).⁷

"The clinical evidence strongly suggests that pre-exercise stretching decreases force production and velocity of contraction for at least part of the range of motion, and that running economy is improved," Shrier concluded. By contrast, he wrote, "regular stretching improved force production and velocity of contraction but has no effect on economy of motion."

Shrier noted that, because stretching decreases muscle viscoelasticity, less energy is required to move the muscle, which would help explain the positive effect on running economy. The force and velocity of contraction probably dropped due to the minor muscle damage associated with stretching, he wrote.

Shrier has also noted that pre-activity stretching doesn't appear to prevent injuries. In this case, his literature review found that of 17 studies using a control group, only seven suggested beneficial effects, and in most of those cases

the stretching was included among co-interventions, making it impossible to determine which actually produced the effect.⁸

Terminology issues

This leads to another conundrum facing researchers, namely, that not all studies use the same terminology to mean the same things. “Passive,” “static,” and “isometric” are sometimes used interchangeably (and, just for good measure, the literature even contains references to “static passive” and “static active” stretching).⁹ “Ballistic,” which involves gentle bouncing, has fallen out of favor but still occasionally appears in research under other names (e.g., dynamic).¹⁰ And although “dynamic stretching” usually refers to maneuvers such as sagittal plane leg swings to stretch hip flexors and hamstrings, both McHugh and Shrier believe that the term should be discarded because the action is really a warm-up rather than a stretch.

Proprioceptive neuromuscular facilitation (PNF) is another popular approach that includes contracting, then relaxing, the muscle to be lengthened.¹¹ But, as McHugh noted, this too is closely tied to an overall warm-up routine, and teasing out its effects in isolation becomes almost impossible.

“In the perfect study,” McHugh said, “athletes in a sport with a high risk of muscle strain injuries, such as soccer, would be randomized into one of four groups: pre-activity stretching plus warm-up, warm-up only, stretching only, and, finally, neither one. But it’s difficult to draw any conclusions about the value of stretching alone, out of the context of a warm-up, because in practical terms it doesn’t make sense.”

Practical matters

Given that the professional debate about all this remains as intractable as it is congenial, it’s helpful to consider a few situations in which the practical applications of stretching may be clearer, regardless of which theory you believe. One distinction has to do with professional versus amateur athletes.

“A recent meta-analysis¹² found that preworkout stretching causes a five percent decrease in muscle strength and a two percent decrease in power,” said Duane Knudson, PhD, chair of the Department of Health and Human Performance at Texas State University, San Marcos. “All the conclusions lately show that if you do static stretching [before exercise] you’re going to be weaker. Now, if you’re trying to win an NBA game, that could make a difference, but for the average person it’s not a big deal. It’s probably good for people in their fifties, in fact, because you’re losing flexibility as you age and getting a little weaker doesn’t matter so much.”

In professional sports, in fact, trainers must frequently make decisions about degrees of intervention. For example, Charles Kenyon, MS, RSCC, a performance specialist with the Seattle Mariners baseball organization who travels with the Tacoma Rangers AAA team, said that the objective with stretching is not necessarily to make players more mobile.

“In baseball, it’s a long season—nine months of preparation and competition,” he told *LER*. “Our goal with these really tight guys is just to make sure they maintain the range of motion they had coming into the season, then maybe work with them in the off season on specific flexibility issues to improve deficits. If there’s an injury during the season, we mainly just try to get them back to baseline.”

Of course, in fields such as dance, gymnastics, and martial arts, flexibility and ROM are crucial to optimal performance. Michael Fredericson, MD, a professor of physical medicine and rehabilitation at Stanford University and a team physician for Stanford athletic teams, told *LER* he alters his approach to fit the sport.

“Before an athletic activity that requires power or explosiveness, I don’t suggest static stretching, but rather a more active, dynamic warm-up,” he said. “If you’re a gymnast, though, you’ll want to do some static stretching because you need to go into extremes of motion.”

Fredericson also teaches karate, and has his students do an extensive dynamic warm-up that includes leg swings, kicks, bounding, squatting, and lunging.

“You’re getting things warmed up, but you’re also starting to push the muscle to the limits of its length at the time it’s going to be stretched,” he said. “A lot of it is timing, the instantaneous turning on and off of muscle groups and co-contractions.”

He added that any proficient martial artist or dancer does extensive stretching after workouts to gain flexibility.

“I think people get confused about these studies of pre-activity stretching and conclude they shouldn’t stretch at all,” he said. “But that isn’t correct; after the activity, when you’re warmed up, it makes sense.”

Dancers, in particular, are known for needing extensive ROM—and for their dedication to stretching routines both before and after rehearsal and performance.

“Dancers are already very flexible due to the aesthetic demands of the art,” said Jeff Russell, PhD, an assistant professor of dance science at the University of California, Irvine. “Usually there’s nothing you can do to add to their hamstring flexibility, for example, but when I have them do their normal stretching as part of their regular training, I always want them to get warm first. I want them to run around the studio, do jumping jacks, get their heart rates up before they do any stretching. I also want them to do the lion’s share of it after class, not before.”

For Russell, working with dancers has unique rewards.

“They like to stretch, because it prepares them for the extreme ranges of motion they need in their performances,” he said. “They know what that range is, and the kinds of things they need to do, because they’re so in tune with their bodies.”

Holly Silvers, MPT, specializes in sports orthopedic rehabilitation and directs the Santa Monica Orthopedic and Sports Medicine Research Foundation. She was one of the developers of an intervention called PEP (prevent injury, enhance performance), a proprioceptive training program that lowered the anterior cruciate ligament injury rate in adolescent female soccer players by 88% in its first year.¹³

“I don’t think it has to be all static stretching postgame, and all dynamic pregame,” she said. “You have to think about the demands of the sport and the particular athlete.”

She noted that the professional athletes she works with do a dynamic warm-up that contains some static stretching, but that doesn’t mean this is the approach everyone should take.

“For younger and recreational athletes, we have made a philosophical switch,” Silvers continued. “For them, we think static stretching is best utilized postworkout, and a more dynamic movement-based stretch is probably more appropriate beforehand.”

Although Malachy McHugh’s ideal study will probably never be done, as ongoing research and practical experience contribute to the debate, it seems plausible that other organizations will follow a similar multimodal path.

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Questions:

List the “pros” of stretching

List the “cons” of stretching

List the evidence in favor of stretching

List the evidence against stretching