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Human Kinetics
CRITICALLY APPRAISED TOPIC

Self-Mobilization Using a Foam Roller Versus a Roller Massager: Which Is More Effective for Increasing Hamstrings Flexibility?

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Clinical Scenario: Increasing the length of the muscle–tendon unit may prevent musculotendinous injury. Various methods have been proposed to increase muscle–tendon flexibility, including self-mobilization using foam rollers or roller massagers, although the effectiveness of these devices is uncertain. This review was conducted to determine if the use of foam rollers or roller massagers to improve hamstrings flexibility is supported by moderate- to high-quality evidence. ***Clinical Question:*** Are foam rollers or roller massagers effective for increasing hamstrings flexibility in asymptomatic physically active adults? ***Summary of Key Findings:*** The literature was searched for studies on the effects of using foam rollers or roller massagers to increase hamstrings flexibility in asymptomatic physically active adults. Four randomized controlled trials were included; 2 studies provided level 2 or 3 evidence regarding foam rollers and 2 studies provided level 2 or 3 evidence regarding roller massagers. Both roller-massager studies reported increases in hamstrings flexibility after treatment. Data from the foam-roller studies did not demonstrate a statistically significant increase in hamstrings flexibility, but 1 study did demonstrate a strong effect size. ***Clinical Bottom Line:*** The reviewed moderate-quality studies support the use of roller massagers but provide limited evidence on the effectiveness of foam rolling to increase hamstrings flexibility in asymptomatic physically active adults. Flexibility gains may be improved by a longer duration of treatment and administration by a trained therapist. Gains appear to decline rapidly postrolling. Neither device has been shown to confer a therapeutic benefit superior to static stretching, and the effectiveness of these devices for preventing injury is unknown. ***Strength of Recommendation:*** Grade B evidence supports the use of roller massagers to increase hamstrings flexibility in asymptomatic physically active adults.

Keywords: myofascial, muscle length, range of motion

Clinical Scenario

Prevention of injury is an important consideration for people participating in sports and other physical or athletic endeavors. It has been postulated that musculotendinous injury can be prevented by increasing the length of the muscle–tendon unit.[1] Various methods have been proposed to increase muscle–tendon flexibility, including stretching and soft-tissue mobilization. Self-mobilization of soft tissues using foam rollers or roller massagers is increasingly common, although the effectiveness of these devices to enhance muscle–tendon flexibility is uncertain. This review was conducted to determine if the use of foam rollers or roller massagers to improve flexibility is supported by moderate- to high-quality evidence. The hamstrings were selected as the muscle group of interest since increasing hamstrings flexibility to prevent injury is a goal for many physically active adults.

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Focused Clinical Question

Are foam rollers or roller massagers effective for increasing hamstrings flexibility in asymptomatic physically active adults?

Summary of Search, "Best Evidence" Appraised, and Key Findings

- The literature was searched for studies on the effects of using foam rollers or roller massagers to increase hamstrings flexibility in asymptomatic physically active adults.
- Four randomized controlled trials (RCTs) were included; 2 studies provided level 2 or 3 evidence regarding foam rollers and 2 studies provided level 2 or 3 evidence regarding roller massagers.[2–5]
- Both roller-massager studies[2,5] reported increases in hamstrings flexibility after treatment. Data from the foam-roller studies[3,4] did not demonstrate a

statistically significant increase in hamstrings flexibility, although 1 study[3] did demonstrate a strong effect size.

Clinical Bottom Line

The reviewed moderate-quality studies support the use of roller massagers but provide limited evidence on the effectiveness of foam rolling to increase hamstrings flexibility in asymptomatic physically active adults. Massage duration may be positively correlated with hamstrings flexibility gain. These gains may decline rapidly postrolling. In addition, administration of the rolling technique by a trained therapist may be more effective than self-application. Until further data are available, it appears that roller massagers can be preferentially recommended over foam rollers to increase hamstrings flexibility.

Neither foam rolling nor roller massaging has been shown to confer a therapeutic benefit superior to static stretching, but a multifactorial approach may result in greater gains in hamstrings flexibility. The relationship between rolling techniques and the prevention of injury in physically active adults has not been investigated. Given that the physiological mechanisms of foam rolling, massage rolling, and stretching may differ, it is possible that these techniques may differ in the extent to which they prevent musculotendinous injury. More high-quality studies on the topic are needed.

Strength of Recommendation: Grade B evidence supports the use of roller massagers to increase hamstrings flexibility in asymptomatic physically active adults but suggests that foam rollers are minimally effective for this purpose.

Search Strategy

Terms Used to Guide Search Strategy

- **P**atient/Client Group: (*healthy* or *asymptomatic*) and *adults*
- **I**ntervention: *foam* and *roll**
- **C**omparison: (*roll** and *massage**) or [(*self-myofascial* or *myofascial*) and *release*]
- **O**utcome(s): *ROM* or *range of motion* or *flexibility*

Sources of Evidence Searched

- Medline
- PubMed
- EBSCOhost
- PEDro
- Google Scholar
- CINAHL Plus
- Cochrane Collection Plus
- SPORTDiscus
- MD Consult
- Hand search of reference lists of all papers on foam rollers or roller massagers

Inclusion and Exclusion Criteria

Inclusion Criteria

- Limited to peer-reviewed articles
- Limited to English language
- Limited to adults (>18 y of age)
- Limited to asymptomatic or healthy adults
- Studies including hamstrings flexibility or range of motion as a primary or secondary outcome measurement, either with the hamstrings isolated or as a composite measurement (eg, sit-and-reach test)

Exclusion Criteria

- Studies using massage tools that did not include a foam component
- Myofascial-release techniques other than massage rollers

Results of Search

Seven studies[2–8] were located that were relevant to the topic. Three of these studies[6–8] were not included in this critically appraised topic (CAT) because they were not published in peer-reviewed journals. The 4 peer-reviewed studies were categorized by level of evidence[9] (Table 1) based on the 2014 Centre for Evidence Based Medicine criteria.

Best Evidence

Two level 2 studies and 2 level 3 studies[2–5] that met our inclusion criteria were identified as the best evidence and were included in this CAT (Table 2).

Table 1 Summary of Study Designs of Articles Retrieved

Level of evidence	Study design	Number located	Reference
2	RCT	2	Jay et al[2]
			Mohr et al[3]
3	RCT	2	Macdonald et al[4]
			Sullivan et al[5]

Abbreviation: RCT, randomized controlled trial.

Table 2 Characteristics of Included Studies

	Jay et al[2]	Mohr et al[3]	Macdonald et al[4]	Sullivan et al[5]
Study design	Randomized controlled trial	Randomized controlled trial	Randomized controlled trial	Randomized controlled trial
Participants	22 men (34 ± 7 y) not regularly participating in sport or fitness activities. *Exclusion criteria:* History of knee, low back, or neck injury; contraindications to strength training, blood pressure over 160/100 mm Hg, or other potentially harmful cardiovascular conditions. Block randomization to RM (n = 11) or control (n = 11) group. RM-group participants were randomly assigned 1 leg to massage, with the other leg acting as within-participant control. No group differences in demographics, baseline pain rating on a VAS, PPT, or hamstrings flexibility existed before the intervention. All participants completed the study.	40 participants (21.3 ± 2.8 y), gender not reported, recreationally active, engaging in physical activity 1–5 h/wk, with <90° of passive hip-flexion ROM with the knee straight. *Exclusion criteria:* Lower-extremity injuries or spine injuries within the past 6 mo; participation in lower-extremity flexibility training, conditions affecting hamstrings flexibility, or circulation problems. Randomly assigned to 1 of 4 groups: control (n = 10), static stretching (n = 10), foam rolling (n = 10), or static stretching and foam rolling (combo; n = 10). No group differences in demographics. Baseline hamstrings flexibility of the 4 groups was not reported. All participants completed the study.	20 men (24.6 ± 3.2 y), physically active, participating in resistance training ≥3×/wk. *Exclusion criteria:* None listed. Randomly assigned to control (n = 10) or FR (n = 10) group. No group differences in demographics, 1RM squat, or baseline muscle soreness existed. Baseline hamstrings flexibility, evoked contractile properties, and vertical-jump height were not reported. Two participants failed to complete the study because they could not complete 100 repetitions of back squats. It is not clear whether these subjects were included in data analysis; their group assignment was not indicated.	17 (22.6 ± 3.4 y; 7 male, 10 female) recreationally active university students, participating in physical activity an average of 3×/wk, with no prior experience using a roller massager. *Exclusion criteria:* History of neurological disease or musculoskeletal injury in the previous year. Randomly assigned to control (n = 9; 3 male, 6 female) and RM (n = 8; 4 male, 4 female) groups. Baseline comparison of group demographics or hamstrings flexibility was not reported. No group differences in baseline maximum voluntary contraction force, evoked twitch force, and electromechanical delay existed. All participants completed the study.

(continued)

Table 2 *(continued)*

	Jay et al[2]	Mohr et al[3]	Macdonald et al[4]	Sullivan et al[5]
Intervention investigated	Effect of RM on postexercise muscle soreness, PPT, and hamstrings flexibility. DOMS was induced via 10 sets of 10 repetitions of stiff-legged deadlifts with a kettlebell with 30 s between sets. Kettlebell weight was progressively increased from 12 kg to 32 kg. 48 h after exercise, baseline outcome measures were repeated; then experimental and control treatments were administered by a trained study investigator. Outcomes measurements were repeated at 0, 10, 30, and 60 min posttreatment. The assessor measuring outcomes was blinded. Participants and study investigators were not blinded.	Comparison of FR, static stretching, FR before static stretching, and control on hamstrings flexibility. Participants self-administered the FR treatments. An investigator administered the stretching treatments. Hamstrings flexibility was measured pre- and posttreatment during 6 sessions separated by at least 48 h. Hip-flexion ROM with the knee straight was measured on the dominant leg with the nondominant leg strapped down onto a table. Participants, study investigators, and assessors were not blinded.	Effect of FR on postexercise muscle soreness, voluntary and evoked contractile properties, vertical jump, and flexibility of the hamstrings and quadriceps. Session 1: 1RM of back squats was determined. Session 2: Pretest measurements followed by a 5-min cycle-ergometer warm-up and EIMD consisting of 10 sets of 10 repetitions of back squats at 60% of 1RM weight with 2 min of rest between sets. Control and FR treatments administered by the participants followed by posttest measurements. Session 3 at 24 h post-EIMD, session 4 at 48 h post-EIMD, and session 5 at 72 h post-EIMD: 5-min cycle-ergometer warm-up, then test measurements followed by control or FR treatments. Participants, study investigators, and assessors were not blinded.	Effect of RM on strength and flexibility of the hamstrings. 5-min warmup on a Monark cycle ergometer before testing and treatment. Massage using a roller apparatus and control treatments were administered. Hamstrings flexibility using a 1-legged sit-and-reach test, electromyography, maximum voluntary contractile force, and evoked contractile force measurements taken pretreatment and 3 min posttreatment. Participants, study investigators, and assessors were not blinded.
Control group	The control group rested in prone for 10 min.	The control group rested 5 min between the pre- and posttreatment measurements.	The control group completed the 5 testing sessions but did not participate in the FR sessions afterward.	The control group sat quietly for 5 min between pre- and posttests.
Experimental group	The hamstrings muscles of the experimental leg were massaged for 10 min using a TheraBand roller massager, with the participant in prone. Constant, distal-to-proximal massage was performed at 1–2 s/stroke using moderate pressure.	The FR group completed three 1-min rolling sessions (~30 s between), with body weight on a 15-cm-diameter Cando EVA foam roller, rolling from ischial tuberosity to popliteal fossa at 1 s inferior and 1 s superior using a metronome. The stretching group completed three 1-min stretches (30 s rest between). An investigator passively stretched the hamstrings. The combo group received both treatments.	The right and left anterior, lateral, posterior, medial thigh, and gluteal muscles were each rolled for 2 repetitions of 60 s using a custom-made foam roller consisting of 1 cm of neoprene foam surrounding a 10.16-cm polyvinyl chloride pipe. The participants placed their body weight on the foam roller, working proximally to distally in small undulating movements to the knee followed by a fluid motion to return to the starting position.	A TheraBand roller massager installed in a custom constant-pressure roller apparatus massaged the hamstrings from the popliteal fold to the gluteal fold using 13 kg of pressure at 1 cycle/s. Four interventions were assessed: 1 set of 5 s, 1 set of 10 s, 2 sets of 5 s, or 2 sets of 10 s of rolling. Each participant in the treatment group received each of the 4 interventions on 2 visits separated by 24 h, with 1 intervention per leg per session separated by 30 min to avoid neural crossover effects.

(continued)

Table 2 *(continued)*

	Jay et al[2]	Mohr et al[3]	Macdonald et al[4]	Sullivan et al[5]
Outcome measures	*Primary:* VAS rating of hamstring-muscle soreness. *Secondary:* PPT of the hamstrings; flexibility of the hamstrings using a 1-legged sit and reach test.	*Primary:* Change in hamstrings flexibility between the pretreatment measurement during session 1 and the posttreatment measurement during session 6 using an inclinometer to measure hip ROM with the knee straight.	*Primary:* Muscle soreness on a numerical rating scale, hamstrings passive and dynamic flexibility determined by hip ROM with knee straight; quadriceps passive and dynamic flexibility determined by knee ROM during a kneeling lunge; evoked and voluntary contractile properties, vertical-jump height. *Secondary:* Thigh girth.	*Primary:* Hamstrings flexibility using a 1-legged sit-and-reach test, maximum voluntary contraction force using a strain gauge, evoked twitch force using a strain gauge, electromechanical delay using electromyography.
Main findings	48 h after DOMS-inducing exercise, hamstrings flexibility was lower ($P < .001$) across both legs and all participants. Flexibility was 2.60 cm greater (95%CI, 0.21–5.00) in the massaged leg than in the control leg at 0 min posttreatment ($P = .03$, Cohen $d = 0.91$). Flexibility was 3.55 cm greater (95%CI, 0.34–6.76) in the massaged leg than in the control group at 10 min posttreatment ($P = .03$, Cohen $d = 0.92$). Comparisons of flexibility were not significantly different ($P > .05$) between groups at any other time point. (massaged leg compared with control group at 0 min [2.04 cm greater (95%CI, –1.17 to 5.25), Cohen $d = 0.53$], 30 min [3.07 cm greater (95%CI, –0.14 to 6.27), Cohen $d = 0.80$], and 60 min [2.25 cm greater (95%CI, –0.96 to 5.46), Cohen $d = 0.59$], massaged leg compared with control leg at 10 min [2.21 cm greater (95%CI, –0.18 to 4.60), Cohen $d = 0.77$], 30 min [2.19 cm greater (95%CI, –0.21 to 4.58), Cohen $d = 0.76$], and 60 min [1.69 cm greater (95%CI, –0.71 to 4.08), Cohen $d = 0.59$]).	Passive hamstrings flexibility increased between pretreatment during session 1 and posttreatment during session 6 regardless of treatment ($P = .001$). Hamstrings flexibility increased 23.55° (95%CI, 15.57–31.53) in the combo group, 12.26° (95%CI, 2.62–21.83) in the static-stretching group, 6.88° (95%CI, 2.07–15.84) in the FR group, and 3.74° (95%CI, -.037–7.85) in the control group. The increase in the combo group was greater than the increase in the static-stretching group ($P = .04$, Cohen $d = 2.92$), the FR group ($P = .006$, Cohen $d = 4.45$), and the control group ($P = .001$, Cohen $d = 7.06$). There were no differences ($P > .09$) between the static-stretching and FR groups (Cohen $d = 1.32$), static-stretching and control groups (Cohen $d = 2.63$), or FR and control groups (Cohen $d = 1.81$).	Passive hamstrings flexibility increased 3.4° (83% likelihood; 95%CI, –1.62 to 8.42) from pretest to posttest at 72 h in the FR group vs the control group (Cohen $d = 0.62$). No other between-groups differences in passive hamstrings flexibility between pre- and posttest were observed (% likelihood <75%) at 24 h [1.5° increase (95%CI, –3.07 to 6.08), Cohen $d = 0.31$] or 48 h [0.04° increase (95%CI, –4.8 to 4.71), Cohen $d = -0.01$). Dynamic hamstrings flexibility increased 3.9° (79% likelihood; 95%CI, –2.43 to 10.22) from pretest to posttest at 24 h in the FR group compared with the control group (Cohen $d = 0.57$). No other between-groups differences in dynamic hamstrings flexibility between pre- and posttest were observed (% likelihood <75%) at 48 h [3.03° increase (95%CI, –4.68 to 10.75), Cohen $d = 0.37$] or 72 h [2.75° increase (95%CI, –3.96 to 9.46), Cohen $d = 0.39$]. No P values were reported.	Hamstrings flexibility increased 1.36 cm from pre- [31.32 cm (95%CI, 28.90–33.74)] to posttreatment [32.68 cm (95%CI, 30.30–35.06)] across all groups ($P = .0001$, Cohen $d = 0.65$). Hamstrings flexibility increased in the treatment group from pre- to posttest for all 4 interventions ($P < .0001$), but not within the control group ($P = .68$). Group means were not provided, and effect sizes and confidence intervals could not be calculated.
Level of evidence	CEBM level 2	CEBM level 2	CEBM level 3	CEBM level 3
Validity score	PEDro score: 7/10	PEDro score: 6/10	PEDro score: 5/10	PEDro score: 5/10
Conclusion	Ten minutes of massage using a roller massager improved hamstrings flexibility in a group of young healthy men with experimentally induced DOMS.	Hamstring flexibility increased after 6 sessions of FR combined with static stretching, although 6 sessions of FR alone did not increase hamstrings flexibility.	Repeated FR of the hamstrings over 72 h after EIMD improved passive or dynamic hamstrings flexibility in young, resistance-trained men.	Hamstrings flexibility improved after use of a roller massager at a constant pressure for 1 or 2 sets of 5–10 s in a young healthy population.

Abbreviations: 1RM, 1-repetition maximum; DOMS, delayed-onset muscle soreness; EIMD, exercise-induced muscle damage; FR, foam rolling; PPT, pain-pressure threshold; RM, roller massage; ROM, range of motion; VAS, visual analog scale.

Implications for Practice, Education, and Future Research

Musculotendinous injury occurs when the muscle–tendon unit is stretched beyond its limits of flexibility to the point of failure and can be prevented by increasing the flexibility of the muscle–tendon unit.[1] To prevent injury, physically active adults commonly engage in activities to improve muscle–tendon flexibility. One such activity that recently has gained popularity is self-mobilization using a foam roller or roller massager. The studies reviewed in this CAT suggest that these devices can be used to improve flexibility of the hamstrings in asymptomatic physically active adults. It is important to note that the construct of flexibility was defined differently in the reviewed studies. Mohr et al[3] and Macdonald et al[4] (foam rollers) measured hip-joint range of motion in degrees, while Jay et al[2] and Sullivan et al[5] (roller massagers) used a sit-and-reach test to represent flexibility.

Despite these differences, comparison of the statistical results of the studies in this CAT suggests that both rolling techniques improve muscle–tendon flexibility in asymptomatic physically active adults, with roller massagers providing a greater improvement in flexibility than foam rollers. The 2 reviewed studies on roller massagers by Jay et al[2] and Sullivan et al[5] reported significant improvements in hamstrings flexibility, while the 2 studies on foam rollers by Mohr et al[3] and Macdonald et al[4] did not. However, statistical significance partially depends on sufficiently large sample sizes, and significant treatment effects may exist in the absence of statistical significance. With a small sample, a difference between groups may need to be quite large to be statistically significant. All 4 studies had small samples, with treatment groups consisting of 8 to 11 participants. Lacking large samples, effect sizes can be used to assess between-groups differences. The roller-massager study by Jay et al[2] provided sufficient data to allow the calculation of effect sizes, demonstrating moderate (≥0.5) to strong (≥0.8) effects of rolling on hamstrings flexibility at all posttreatment time intervals. Despite reporting statistical significance, the roller-massager study by Sullivan et al[5] did not publish sufficient data to allow effect-size calculation. In the study on foam rolling by Mohr et al,[3] the authors reported a strong treatment effect size.[3] In the other foam-roller study, Macdonald et al[4] reported effects ranging from nil (<0.2) to moderate (≥0.5) at varying posttreatment time intervals. It is possible that foam rolling may produce clinically meaningful improvements in hamstrings flexibility in some individuals, although larger samples are needed to determine when or if between-groups differences reach statistical significance.

While the use of either rolling device may improve flexibility, these gains may be short-lived. Increases in flexibility are known to decline rapidly after a bout of static stretching, and the results of this CAT suggest a similar trend after rolling. Jay et al[2] reported significant increases in flexibility at 0 and 10 minutes after roller-massager treatment, but at 30 and 60 minutes posttreatment hamstrings flexibility had returned to baseline. Similarly, treatment effect sizes demonstrated a gradually declining trend from 0 to 60 minutes postrolling.[2] Sullivan et al[5] also reported flexibility measurements within several minutes posttreatment, with significant changes in flexibility. Among the foam-roller studies, Mohr et al[3] reported significant effect sizes when flexibility was measured immediately posttreatment, but Macdonald et al[4] measured flexibility 24 hours after treatment and reported no statistical differences and the smallest effect sizes of the 4 studies. This suggests that physically active adults should use rolling techniques immediately before bouts of physical activity to ensure the greatest gains in flexibility.

There also may be a direct correlation between treatment duration and hamstrings flexibility gain, with longer treatment duration associated with greater flexibility gain. In comparing the 3 studies that measured flexibility immediately after treatment, the roller-massager study by Jay et al[2] provided the strongest statistical results. This study also had the longest treatment duration, 10 minutes versus 10 to 20 seconds in the other roller-massager study and 2 to 3 minutes in the foam-roller studies. Likewise, Mohr et al[3] suggest that combination treatment, consisting of 3 minutes of static stretching plus 3 minutes of foam rolling, was more effective for improving hamstrings flexibility than 3 minutes of either treatment alone. However, the physiological mechanisms of static stretching and rolling may differ, confounding the effects of treatment duration and multifactorial treatment.

A forceful or uniform pressure being transmitted through the massage tool into the muscle may be desirable to achieve improved outcomes in flexibility. Foam rollers and roller massagers both use compression and thus confer a similar potential therapeutic effect. In contrast, the body segment is moved over the device when foam rolling, while the inverse is true with roller massagers. Thus, differences in compressive force and contact area between the devices may contribute to disparities in tissue compression during a typical application. Treatment application also differed between the foam-roller and roller-massager studies. In the foam-roller studies, participants performed self-treatments while under the supervision of a researcher by applying body weight to the foam rollers, while in the roller-massager studies, treatments were performed by either a trained investigator or a mechanized roller apparatus. It is possible that the roller-massager treatments were applied more forcefully or with more uniform force, which may have influenced treatment outcomes.

Exercise warms muscle and surrounding tissue; therefore, preceding rolling with warm-up exercises should allow for greater gains in muscle flexibility than rolling without a warm-up. However, the limited evidence provided by these studies did not allow analysis of this relationship. Of the foam-roller studies, only the study by Macdonald et al[4] included warm-up exercises, but that study also separated treatment and flexibility measurement by 24 hours. Macdonald et al[4] reported weaker effect sizes than the study by Mohr et al,[3] which lacked a

warm-up and, despite using similar hamstrings flexibility measurements, reported smaller gains in flexibility. Of the roller-massager studies, only the study by Sullivan et al[5] included a warm-up, but the statistics and data reported by the authors did not allow for an effective comparison with the study by Jay et al.[2]

Both devices likely confer therapeutic effects via the same physiological mechanism of compression; however, many theories exist regarding how the effects occur. One theory purports that increases in extensibility are associated with increases in muscle temperature, which allow structural deformation of fascial adhesions between muscle layers.[5] As the muscle cools to its initial temperature, it returns to its original length.[5] Another theory purports that the therapeutic effect of roller massagers or foam rollers may be attributable to activation of the diffuse noxious inhibitory control (DNIC) mechanism.[10] With the DNIC, a painful mechanical stimulus perceived as nonharmful causes the brain to release pain-relieving endorphins and enkephalins down the spinal cord.[10] These chemical messengers inhibit the painful stimuli that are responsible for increased muscle stiffness, guarding, and altered movement patterns, thus allowing an improvement in flexibility.[10]

Although purely speculative, these theoretical mechanisms of increased muscle flexibility differ from those involved with static stretching. Static stretching is unlikely to change tissue temperature, and as stretching is performed below the level of pain thresholds, it may not activate the DNIC mechanism.[10] Thus, physically active adults who fail to make flexibility gains through static stretching may benefit from using a roller device to facilitate flexibility gains via other physiological mechanisms and/or the additive effects of multifactorial treatment. It is important to note that while static stretching has been shown to reduce muscle–tendon injury rate,[1] to our knowledge, injury rate has not been studied postrolling. Due to differences in physiologic mechanisms, it is possible that the increases in flexibility gained through rolling are not associated with a reduction in injury rates.

Other differences between static stretching and the 2 rolling techniques may be of interest to those attempting to increase muscle flexibility. For example, static stretching has been associated with a reduction in neuromuscular performance during certain athletic events, while there is some evidence that similar performance is not impaired after the use of rolling techniques.[4,5]

In addition, note that the effects of rolling on symptomatic individuals or athletes may differ from the effects observed in the asymptomatic physically active adults included in these studies. No research studies uncovered in this review specifically assessed athletes; however, the results of this CAT may be generalizable to adult athletes, as this subpopulation is considered physically active.

Future research is necessary to gain clarity on which self-mobilization technique is more efficacious for improving flexibility of the hamstrings. A standardized protocol for foam-roller and roller-massager treatment should provide a better basis for comparison of these devices. The warm-up, the duration of treatment, the time elapsed between treatment and assessment, and the method of measuring flexibility or range of motion should all be equalized between comparative studies. Additional comparisons are needed between rolling techniques and static stretching, as are studies on the additive effects of self-mobilization and stretching techniques while controlling for treatment duration and relative ordering of treatments. Larger sample sizes may provide more compelling evidence for either technique. Future research also should address the relationship between rolling techniques and injury risk and clarify the effects of rolling on neuromuscular performance.

In summary, the evidence provided by the studies reviewed in this CAT suggests that clinicians should consider prescribing a roller massager instead of a foam roller to gain muscle–tendon flexibility of the hamstrings in asymptomatic physically active adults. The evidence also suggests that longer rolling duration, application immediately before physical activity, and use of a firm, uniform pressure may provide the greatest benefits to muscle–tendon flexibility and potentially to injury reduction.

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