

Are you S T R E T C H I N G your limits?

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Flexibility and strength are the great combination for a successful gymnast. The athlete needs to be flexible enough to place body parts in positions necessary to complete a trick. However, when the body is stretched out too much, or in the wrong manner, it could contribute to a lack of stability at a joint that is necessary to prevent injury and maintain strength. The following article will discuss some general anatomy and movement of the knee and the elbow, and offer tips on stretching properly while avoiding injury.

Picture the Anatomy

Picture a hinge, such as a door and its frame. The door only swings on one side of the door frame, it is stopped by the frame (or the wall on the other extreme). Now picture the elbow or the knee joint. The knee should only bend one way (mainly by use of the hamstrings in the back of the thigh) just as the elbow only bends one way (by use of the biceps to move the hand closer to the shoulder). Both of these motions are referred to as flexion. The other muscle that performs the opposite action (the triceps in the elbow and the quadriceps in the knee located in the front of the thigh) bring the joint, being the elbow or the knee, back to zero degrees of a bend, or baseline. We were not anatomically built for these joints to go beyond this “zero” line. If we did, think about how much energy and concentration and coordination it would take to keep our legs “straight” without having the luxury of locking them out, or having our bodies create a natural “stop”. Think simply about walking- on our legs or in a handstand through our arms. The body is smart in its configuration in that we have natural built in “stops” including bone barriers, ligaments to prevent motion, muscles, and a joint capsule which surrounds many of these parts to keep them in line and packed together.

Bone articulations, various cartilage, tendons and ligaments whose jobs are to keep the joint from “hyperextending”. When there are undue stresses placed on these joints, these flexible structures are overcome by outside forces and are stretched. Muscles are contractile, so they can eventually return by re-tightening, or stretching more if need be (think of a rubber band). However, when a contractile structure is continually stretched, it loses its elasticity and therefore does not return to the baseline, or in other words, gets longer and stretched out. But the others are non-contractile structures (think of clay or play dough) and once stretched, stay that way. Bony structures, too, will eventually adapt to this by smoothing themselves down, chipping away, or “squishing” and possibly fracturing to accommodate (stress fractures). Your body, like you, follows what it was born for and meant to do, but if you push it, it will follow new instructions. One of the basic concepts, then, for body alignment and consequent re-alignment is simple: **Form follows function.**

Anatomical Motions

If you think about a joint, there are three possible motions: flexion/extension (such as the elbow and knee), side to side motion as in splaying fingers in the hand or hip straddling and legs coming back together (abduction away and adduction to midline) and circumduction (circular motions, similar to ball and socket like the shoulder or the “knuckle” which combines these motions). These joints are only created to do what they were meant to. The lower the amount of motion allowed, the more the stability intended. Those with only one plane of motion are limited to allow for stability, which helps us in everyday tasks by giving us the blocked motion naturally. Those joints that are more flexible are made for function and increased options for motion (the shoulder, can reach overhead in a variety of ways or the ankle which is made to accommodate to uneven surfaces and weight transferring). We are just going to concentrate on the elbow and the knee today, seeing as these are the two most overstressed and consequently overstretched joints

What keeps us in line?

The elbow and the knee both have ligaments on the “inside” or medial side, and the “outside” or lateral side to limit this secondary plane of motion, otherwise known as the Medial Collateral Ligament (MCL) and Lateral Collateral Ligament (LCL)-see (FIGURE 1). When one attempt to move the ankle away from the body while keeping the thigh stationary (decreasing the outside angle), the inside, or MCL is stretched. This is called valgus stress (vaLgus- left leg looks like an L when you look at it from the front!). Valgus stress is often accompanied by a rotation of the knee toward the midline of the body or a “roll” of the entire leg inward while the ankle is stationary. Functionally and actively, for example, this is shown when a gymnast lands with her ankles shoulder width apart and tries to support body weight while bringing knees together (FIGURE 2). Varus stress is placed on the LCL, or outside, when the ankle is torqued toward midline of the body. (va'R'us - legs are more rounded to form an oval shape). This often happens functionally when the line of gravity, or body weight, falls on the outside of the ankle (FIGURE 3).

The back portion of the knee (or posterior portion) is also supported by ligaments such as the Anterior Cruciate Ligament, bony approximations, and other soft tissue structures, such as the capsule. In other words, the knee is not supposed to bend “up,” only backwards to approximate the heel to the buttock. The elbow and the knee are very similar in anatomy. The top portion of the elbow (actually anterior) just faces the opposite way! When people are hyperflexible in the elbow, people coin them as being “double jointed”. This means that the joint does not “block” itself at zero, or 180 degrees of extension. In the knee, this is “swayed” knees, or genu recurvatum (Figure 4). This can happen from being born with various anatomy differences but can be created or emphasized by poor posture, stretching, and weight-bearing activities.

Overstretching your bounds

Defining extension is making the elbow straight (humerus and radius/ulna in a line). The leg is extended when the femur and the tibia/fibula are in a straight line. Flexion is simply bending the joint in the manner physiologically born to do. Going beyond the zero degree (bending the wrong way) is considered hyperextension. This is what we want to avoid so as to not a)snap ligaments and other joint structures, b) fracture bones that approximate, and c) not overstretch muscles. The most common ways to injure the knee in both the hyperextension and valgus stress is through splits/oversplits. (FIGURE 5). The forces that act as external pushes are body mass, which when combined with the force of gravity becomes weight, and any overpressure (coach, positioning, etc.).

Situation 1: Back of knee

When the foot is placed on a lower surface than the hips, gravity takes the hips down to the level of the feet, or beyond (to or past 180 degree of split). Bottom line: things will bend if they can...when the force is placed downward, both knees and both hips want to bend. The two feet serve as points of contact with the floor. Most of the time, done incorrectly, the back knee is bent to have the entire lower leg in contact with the floor. If done properly, the quadriceps is tightened to keep the back leg straight and just the ankle on the floor. The undue stress is on the muscles are either a) gravity or b) another person, coach or gymnast, applying pressure placed on the back of the knee of the front leg. Think about the goal of splits: to stretch the *thighs and hips*, NOT the knee!. So, a solution, you may think, as we solved the problem of the back knee, would be to tighten, in this case, the hamstrings to keep the knee from hyperextending. But, *this* is the muscle that we want to stretch, so tightening it would counteract our goal, essentially. So, making the point of contact *at* the knee would eliminate the external forces wanting to bend! So, as seen in figure 8, we place the leg on a raised surface, or put a foam roll underneath to give a more proximal point of contact.

Situation 2: Valgus stress on inside of knee

To stretch the inside of the thighs (the adductor muscles-those that pull the legs together) we often have our gymnasts to center splits, inside of ankles touching floor, stomach on ground or upper body weight supported by arms. The inside of the knee is stressed because of the force to bend the “wrong” way. So, if we bend the knees (referred to be gymnasts as ‘frog stretches’) we can get the adductor muscle stretch and also avoid overstressing the knee joint by making it the most distal point of contact (FIGURE 6). We can also support the knee joint while stretching the inner thigh muscles through a wedge mat or incline (FIGURE 7) or stretch the hamstring and other muscles in the back of the knee which function, when they contract, to bend the knee and extend the hip (FIGURE 8).

Situation 3: Hyperextended elbows

Think about how many tricks or portions of tricks are performed relying on locked out elbows in order to more effectively use the shoulder and upper back...vault blocks, handstands on any event, free hips (bars in general!) tumbling front and backwards. We see coaches frequently stretching gymnast’s “arms” while they were in splits, with grip on the distal arm, near the wrist (FIGURE 9). I assume that coaches are attempting to stretch the shoulders into extension to get the athlete to open armpit region and possibly the upper back, for dance presentation, bar flexibility or general stretch. However, many of these gymnasts consequently have hyperextended elbows by at least 10-15 degrees. The pressure was being transmitted through the elbows. When they were stretched and finally hit a “tight” point, then the more proximal joint of the shoulder receives the stretch. However, the stress on the elbow joint is unnecessary. To fix this: eliminate the elbow joint in the stretch, have the gymnast concentrate on keeping her arms a straight, and place pressure on the humerus (upper arm) so only one joint, the shoulder, is effected. (FIGURE 10).

Another way to prevent hyperextension at the elbows is to change a fairly common stretch: sliding the arms out behind the gymnast in sitting. Because the gymnast is thinking about stretching her shoulders, the arm muscles are relaxed and the elbow is allowed to bend the wrong way, falling toward the mat, or hyperextend (FIGURE 11). The elbows take most of the force generated because they are the distal joint, having a longer lever arm from body weight and gravity. The goal of the stretch is to loosen the shoulder girdle and chest muscles. So, to fix the problem, the gymnast simply bends her elbows (flexion) to support her weight and not allow the elbow joint to take all the weight. As the gymnast allows the arms to bend more, the angle

between the side of the body and the arm (humerus) is increased, increasing the stretch (FIGURE 12). The stretch can also be altered by rocking side to side, creating an increased stretch to the front of the shoulder capsule and the outside (lateral) arm muscles.

Another common mistake of coaches or fellow teammates while stretching the shoulders is to 'overstretch' and force the athlete into compensatory postures. This happens in two main postures. The first is when the athlete is sitting in a pike position and reaches her arms overhead. The coach then stands behind the athlete, reaches around her arms, pulls the arms backwards while pressing the shoulder joint forward (FIGURE 13- ** Not taken yet). This forces the athlete to arch her back, in order to "feel" as though she is getting a larger stretch, and avoid the pain of the current "overstretch." The other posture that encourages this arched back posture is the standing partner shoulder stretch (FIGURE 14- *** Not taken yet). The gymnasts stand back to back, one placing her arms stretched overhead. The other athlete grabs a hold of the other's arms and bends forward, pulling the first athlete into an arch, possibly even lifting her off of the ground. Essentially, this is a back stretch, not a shoulder capsule/joint stretch. This, again, encourages the athlete to combine shoulder stretching with back extension/arch. The body learns stretching, and retains stretching, in patterns. So, if the shoulder joint is never stretched in an isolated manner, the back arch will accompany extreme shoulder range of motion. For example, when an athlete needs to reach overhead (complete shoulder flexion) for takeoff for a layout back flip on floor or a full twisting back flip, one does not want the "arch" to go along with this. To fix this problem, have the athlete stretch with tight core muscles in the stomach and back to avoid arching. Another idea is to have the athlete grip on to and stand underneath the uneven bars, straight up and down, in a tandem-foot lunge position, and lean forward, stretching the shoulder (FIGURE 15- ** not taken yet).

To reinforce this throughout training, coaches should be aware of the following:

To Prevent Knee Hyperextension, Watch For:

1. Standing with knees "locked out" - stretches back of knee
2. Landing with knees straight- possible hyperextension injuries, increased possibility of ACL tear
3. Standing with big arch in lower back (lordosis)- which may lead to naturally locking out knees
4. Hamstring weakness: most gymnast have significantly stronger quadriceps, or knee extensors, than hamstrings, or knee flexors. The hamstrings, when activated, can prevent the knee from straightening too far. Have the athlete work on plyometric exercises for landing positions, emphasizing bending the knees.

To Prevent Elbow Hyperextension, Watch For:

1. Arm "locking" when dancing- gymnast should maintain a natural low tension in arm muscles
2. Arm "locking" and resting when in front support on the bar - especially for those learning kips and cast handstands, taking a "break" on the bar
3. "Locked" arms in handstand or handstand walking- a result of weak shoulder girdle and triceps muscle (which help to stabilize the shoulder and straighten the arm). The gymnast, then, relies on hanging on the ligaments, and the weight of the body further stretches these structures on the front of the arm.
4. Hyperextension on vault blocking- the gymnast's arm muscles should be tight, and the shoulder muscles should be "set" or pre-contracted to anticipate the vault block
5. Overpressure on back bend stretching- when the athlete is asked to "push shoulders over your hands," make sure the gymnast has her arm muscles tight (isometric contraction) and is pushing

into the ground so as not to “hang” on the structures in the elbow and overstretch. This will also help to isolate the shoulder muscles.

To Encourage Proper Shoulder Stretching:

1. Make sure to isolate your stretch to the shoulder joint.
2. Do not allow the athlete to compensate (arch back) if the stretch is too extreme.
3. Stretch using manual hand contact on the closest bones to the body to avoid hyper-stretching other joints not involved.

Keeping our athletes strong and healthy is our goal. By keeping the body in line with an anatomically correct position, the body will function in its strongest capacity. If we want to avoid injuries, we need to not only watch our athletes for incorrect movements, but also teach our athletes how to monitor their own movements. When you are correcting your gymnast's postures or stretching technique, take the time to explain to them *why* the changes are being made. If the athlete truly loves the sport, and her team, you will then gain many eyes in the gym as they will begin to correct each other. Happy stretching!

*** Look forward to the next article focused on improving hip flexibility and split leap posture!

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