Are You At Risk for Patellofemoral Syndrome?

Six risk factors for *patellofemoral pain syndrome* (PFPS) in young athletes have been identified in this study. Some of them are *modifiable*, which means they can be changed. And that means this painful knee condition may possibly be prevented. That's good news since PFPS is one of the most common painful and chronic knee problems faced by military recruits and athletes elsewhere.

What is patellofemoral pain syndrome? The *patella*, or kneecap, can be a source of knee pain when it fails to function properly. Alignment or overuse problems of the patella can lead to wear and tear of the cartilage behind the patella. This produces pain, weakness, and swelling of the knee joint. Several different problems (including PFPS) can affect the patella and the groove it slides through in the knee joint.

It is believed that PFPS occurs because of altered biomechanics between the patella and the *femur* (thigh bone). The patellofemoral joint is where the kneecap moves up and down over the lower end of the femur. If the patella doesn't track up and down over the femur where it should, uneven wear and tear can occur. The protective cartilage behind the patella can get torn and shredded. Patellofemoral pain syndrome is most noticeable when kneeling, squatting, or during other activities that require bending the knee. That's because altered hip and knee motion increase the pressure from contact between the patella and femur during these motions.

Patterns of movement like this are referred to as *kinematics*. With patellofemoral pain syndrome altered kinematics is a key problem. Stress on the patellofemoral joint is made worse by rotations of the lower leg during weight-bearing activities. And altered kinematics combined with repetitive actions during weight-bearing load (e.g., running and jumping-landing) can result in patellofemoral pain syndrome.

To find out what might put some people at risk for this problem, athletic trainers studied over 1500 military recruits (men and women) at the United States Naval academy. They collected baseline data about these individuals the summer before their freshman (first) year at the academy. Three-dimensional (3-D) motion analysis was done during jumping and landing, leg muscle strength was tested, and two tests of postural alignment were evaluated and measured (*navicular drop*, *Q-angle*).

Navicular drop refers to the position of a bone (the navicular) in the foot. A drop in the position of this bone reduces the arch of the foot, which can then change the angle of the knee. *Q-angle* is the angle of pull of the *quadriceps* (thigh) muscle on the patella. If either of these anatomical alignments are off, it changes how the patella tracks and how the knee moves. And that may contribute to the development of patellofemoral pain syndrome.

That all sounds so very technical. The bottom-line is that the pain can be severe enough to limit physical activities. And if you are a military recruit or athlete in training, you need to be able to run and jump without thinking about it and certainly without being in pain. The midshipmen who participated in this study were all required to participate in military training including daily physical conditioning exercises and intramural or varsity sports.

Using special computer software, the researchers analyzed joint angles, peak vertical ground-reaction force, and internal joint movements for the hip and knee. These values were compared using body weight and height for comparison of one recruit to another. Then the authors looked at kinematics, muscle strength, and alignment variables for recruits with and without patellofemoral syndrome (PFPS). They found six risk factors for PFPS: 1) decreased knee flexion angle, 2) decreased vertical ground-reaction force, 3) increased hip internal rotation angle when landing jumps, 4) decreased muscle strength (quadriceps and hamstrings),
5) increased hip external rotator strength, and 6) navicular drop.

Even one change in postural alignment or knee angle or the way a person moves can set off a chain of reactions or responses that make the problem worse. Muscle weakness or imbalance changes the stress points on the patella as it moves up and down over the femur. Other muscles may step in and try to compensate for the loss of function in the weak areas. The result may be a slight improvement in the knee angle but less ability to handle the ground reaction-forces when landing a jump. Hip muscle weakness can alter the knee alignment from above, again changing the contract stress on the patellofemoral joint.

Finding risk factors has been the focus of many other studies. Figuring out why some people develop PFPS while others don't could help prevent some folks from developing this problem. Other studies have identified factors that are mostly nonmodifiable, which means there's nothing that can be done to change them. But this study was able to identify some biomechanical factors that can be changed. Of course, the next step in research will be to see if changing any of these factors (and which ones) makes a difference.

For now, the authors suggest a good place to start is strengthening the quadriceps and hamstring muscles and teaching proper techniques for activities that are painful. Active young adults such as military recruits and athletes can be assessed before engaging in physical activities that could potentially lead to the development of patellofemoral pain syndrome. Anyone with modifiable risk factors can be trained to change the way they move and perform dynamic tasks such as knee flexion and jump/landing. Changing the hip angle (less internal rotation) and knee angle (more knee flexion) might make a difference in these active groups of people.

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