Sleeve Fractures of the Kneecap in Children

You may not be familiar with the termsleeve fracture of the patella (kneecap). That's not surprising since this is a very rare injury. Of all the bone breaks children have, the kneecap is only involved in about one per cent of the cases. And sleeve fractures make up about half of those patellar injuries.

What's a sleeve fracture? A little anatomy will help explain what happens. The patella or kneecap sits in front of the knee joint. It isn't attached by a piece of bone or bone bridge. Instead, it moves freely up and down, gliding along a set pathway or patellar track. The kneecap is held in the track by the quadriceps tendon.

The quadriceps tendon is wrapped around the kneecap to hold it in place. At the upper end, the tendon is attached to the large four-part quadriceps muscle along the front of the thigh. Its job is to straighten the knee. The quadriceps tendon continues down below the kneecap where it inserts or attaches to the tibia (lower leg bone).

With a sleeve fracture, the quadriceps tendon is torn so severely, it separates from the muscle and takes a piece of the cartilaginous patella with it. It also takes the top layer of bone called the periosteum. When the periosteum is peeled away with a fragment of the underlying bone still attached, it is called a sleeve avulsion.

Sleeve fractures of the patella can actually occur at the top of the kneecap (called the superior pole) or at the bottom (inferior pole). Most sleeve fractures involve the inferior pole.

With an inferior pole injury, the trauma occurs when the knee is bent or flexed. Superior pole sleeve fractures are more likely to be caused by a sudden, forceful contraction of the quadriceps while the knee is bent but trying to straighten. This movement is called an eccentric contraction (a fully contracted muscle is releasing). Direct trauma to the tendon can also cause this type of fracture.

In children who are not fully grown yet (we say they are skeletally immature), the patella is still more cartilage than bone. The softer cartilaginous patella in the skeletally immature child tears more easily than solid, hardened bone in a skeletally mature individual.

Sleeve fractures were first described in the literature in 1979. Boys are affected five times more often than girls. Most are between the ages of eight and 16 years old. Increased high-intensity sports activity may be one reason this type of injury has started to show up. Like this report, most articles published in medical journals on this topic involve isolated cases (only one child affected). There's been only one article based on a group of 47 cases.

The case that led to this report and review of the literature involved a 10-year-old-boy who slipped while jumping off a diving board. In the process, his knee was flexed and moving toward extension (eccentric contraction) when he felt a "pop" and immediate, severe pain. A physical exam, X-rays, and MRI confirmed the diagnosis of a superior pole sleeve fracture of the patella.

The authors used this case to describe sleeve fractures, discuss how they are diagnosed, and offer suggestions for treatment. All other cases of sleeve fractures were reviewed and summarized as well. The results of the various cases, as well as the final outcome for this child were also presented.

It's important to note that X-rays don't always tell the whole story. In many cases, it wasn't until further
imaging studies (CT scans, MRIs, ultrasound) were done that the full extent of the injury was discovered. And the surgeon really needs all the details of the injury to form the best plan for each child.

Surgery is usually needed to bring the pieces of the patella back together (reduction) and hold them in place with pins or screws (internal fixation) until healing takes place. The procedure is called open reduction and internal fixation or ORIF. The leg is put in a cast with the knee straight for about six weeks. Physical Therapy begins as soon as the cast is removed. Restoring full knee motion and strength are the two main goals of therapy.

The authors conclude that with careful placement of the sleeve fracture during surgery, normal quadriceps function is possible. Improper treatment can result in deformity and poor timing of the quadriceps' ability to contract and release normally.

Conservative (nonoperative) care may be possible in skeletally mature patients if there is no change in the fragment position as the knee bends and straightens. In order to know if the fragment moves, the knee must be observed under fluoroscopy, a special type of 3-D X-rays that allow the surgeon to see the joint as it moves.

Without surgery, the patella may end up shifting location (moving up or down depending on which type of sleeve fracture occurred). The quadriceps may develop an extensor lag and start toatrophy (weaken and waste away). An extensor lag means the quadriceps tendon that straightens the joint doesn't pull back far enough to get full knee extension. The knee remains slightly flexed no matter how hard the person tries to straighten it.

Most children (including the boy in this report) are able to recover fully. They resume full participation in all activities and sports. There may be some occasional knee pain with certain activities like running and jumping. But for the most part, the fracture heals, the kneecap tracks normally, and the quadriceps muscle bulks up again.