Simultaneous Proximal Femoral Rotational and Distal Femoral Varus Osteotomies for Femoral Retroversion and Genu Valgum

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Abstract

Whereas excess femoral anteversion and its related symptoms have been described many times, excess femoral retroversion is less well documented.

We report the case of a 30-year-old woman who had a history of chronic bilateral hip and knee pain and evidence of excess femoral retroversion, genu valgum, early-onset lateral and patellofemoral compartment osteoarthritis of both knees, and hip arthritis. She experienced symptomatic relief after undergoing staged bilateral simultaneous proximal femoral rotational and distal femoral lateral opening wedge osteotomies.

Although this combination of alignment problems is not an infrequent clinical occurrence, we have found no literature on this condition or treatment. The patient provided written informed consent for print and electronic publication of this case report.

Excess femoral anteversion has been associated with the early onset of osteoarthritis and patellofemoral syndrome (patellofemoral malalignment).[1,2,3] The term *miserable malalignment* has been used to describe a collection of symptoms involving excess anteversion and its related bony alignment abnormalities.[4] While excess femoral anteversion has been studied frequently, there seems to be much less information discussing patients with decreased femoral anteversion or relative femoral retroversion.

A 30-year-old woman with a history of chronic bilateral hip and knee pain had evidence of excess femoral retroversion, genu valgum, early onset lateral and patellofemoral compartment osteoarthritis of both knees, and hip arthritis. The patient had been previously treated with steroid injections in both hips and multiple arthroscopies of both knees. She experienced symptomatic relief after undergoing staged bilateral simultaneous proximal femoral rotational and distal femoral lateral opening wedge osteotomies.

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Case Report

A 30-year-old woman presented with a 19-year history of worsening bilateral hip and knee pain, limiting her ability to perform as a family medicine resident. She was first evaluated for anterior knee pain, swelling, and popping, without antecedent trauma, at age 11. Although serology was negative, she received a diagnosis of juvenile rheumatoid arthritis. Groin pain and popping began at age 14. Intermittent knee aspirations and injections resulted in symptomatic improvement for several months. Knee arthroscopy was performed on both knees roughly 4 times to "clean out the joint."

On presentation, pain was worse in the left groin than in the right groin, and worse in the right knee than in the left knee. The right knee pain was located over the anterior and lateral joint lines. The patient described episodes of popping, catching, and giving way in both knees, along with recurrent effusions. In addition, she described the feeling that the patella was going to dislocate.

On physical examination, the patient walked with a level gait and there was no evidence of increased foot progression angle. There was full range of motion in both hips bilaterally but pain at the extremes of flexion and rotation. In the supine position, the right hip had 35° of internal rotation and 45° of external rotation, and the left hip had 32° of internal rotation and 50° of external rotation. There was no pain with resisted muscle function around the hips. The feet could be externally rotated 85° bilaterally and internally rotated 70° bilaterally. Thigh foot angle was 20° external rotation on the right and 10° external rotation on the left. There was a gross valgus deformity of the knees on inspection, and the tibial tubercle appeared laterally displaced relative to the trochlea. Both knees demonstrated full range of motion, and there was no evidence of knee instability or increased patellar translation on examination. The right knee had a positive McMurray test.

Anteroposterior (AP) and false-profile radiographs showed no bony abnormalities of either hip. Knee radiographs showed normal joint space, mild valgus deformity, and mild patellar tilt and translation (Figure

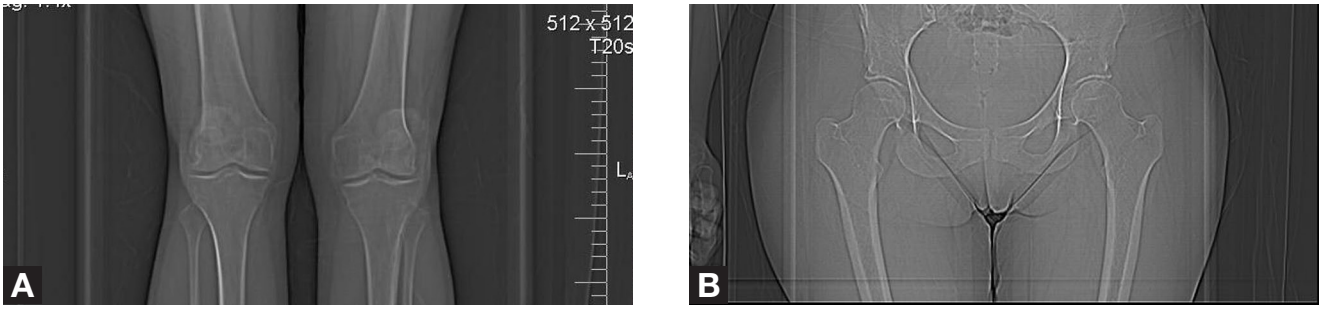

Figure 1. Anteroposterior radiographs of bilateral knees (A) and hips (B).

1). Full-length radiographs did not show the clinically observed valgus deformity, even with the feet internally rotated in an attempt to show the deformity in profile. Each tibia appeared to have a gentle valgus bow, though this did not appear to be the case on visual inspection.

Magnetic resonance imaging (MRI) of the right knee, performed before the office visit, was consistent with a partial lateral meniscal tear. MRI of the pelvis showed a small cyst in the right femoral head.

At that time, arthroscopy performed on the right knee to try to resolve the patient's mechanical symptoms revealed diffuse grade 2-3 articular cartilage damage of the lateral femoral condyle, grade 2 changes of the lateral tibial plateau, and grade 2 changes of the lateral facet of the patella. The rest of the joint was in good condition and there was minimal synovitis.

After the arthroscopy, rotational computed tomography (CT) of the lower extremity was used to objectively measure femoral rotation. Relative femoral retroversion was 20° on the right and 10° on the left. In addition, CT showed 10° of valgus at the knees. The diagnosis made on the basis of the physical examination, radiographic, MRI, and arthroscopic findings was bilateral femoral retroversion and knee valgus deformities causing overload and early arthritis in the hips and knees.

Treatment

Left proximal femoral internal rotational osteotomy and distal femoral lateral opening wedge osteotomy were performed. With the patient in the supine position on a radiolucent table, and with the use of image intensification, a standard lateral approach to the hip was made. A Kirschner wire (K-wire) was inserted to guide placement of a seating chisel. The chisel was positioned to create slight adduction, as the patient appeared to have a mild valgus neck-shaft angle. K-wires were placed to determine initial rotation and the proposed site for the osteotomy. A transverse osteotomy was made just superior to the lesser trochanter, and a 95° angled blade plate was placed. The femur was then internally rotated 20° to create the normal 15° of anteversion. At this point, the greater trochanter was on level with the center of the femoral head, and the rotation appeared correct. An articulated tensioning device was used to compress the osteotomy site. Then, a standard lateral approach was made to the distal femur and a 95° angled blade plate was used to stabilize the opening wedge osteotomy. A Bovie cord used as a plumb line was placed from the center of the femoral head to the center of the ankle; it crossed the knee just medial to the medial eminence. The resulting gap was filled with crushed cancellous allograft. Preoperative and immediate postoperative photographs appear in Figure 2, and postoperative radiographs in Figures 3 and 4.

Outcome

One month after surgery, the patient was allowed to be fully weight-bearing and she returned to work at her residency program. The osteotomy sites healed, and there was substantial improvement in symptoms, but the patient reported mild discomfort and popping around the plates. One year later, she underwent the same 2-level osteotomy of the right femur with 2-level hardware removal of the left femur. The right femur osteotomy sites healed uneventfully, and again, there was marked improvement in symptoms. Outpatient hardware removal on the right was performed 1 year later. Now, 4 years after the last operation, she was satisfied with the results. Her activities were unlimited, she had no effusions or mechanical symptoms, and she had no pain in either knee or the left hip. The right hip, the site of the femoral head cyst, was having intermittent pain, which was relieved with steroid injections at 6-month intervals.

Discussion

The medical literature includes many reports of torsional abnormalities of the lower extremity. Specifically, excess femoral anteversion has been associated with patello-

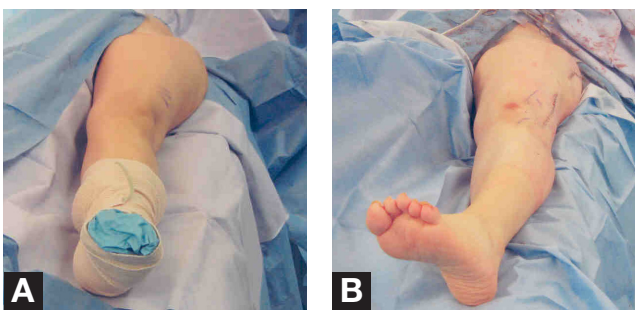

Figure 2. Preoperative (A) and postoperative (B) photographs show correction of genu valgum.

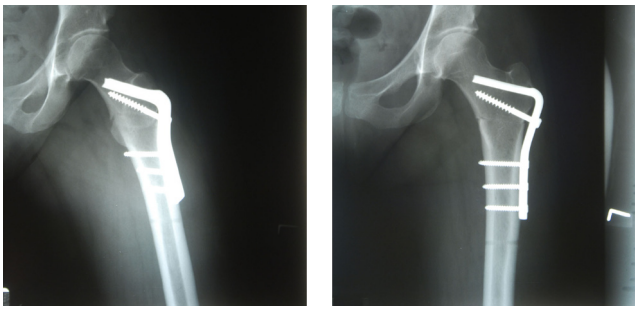

Figure 3. Multiple postoperative radiographs of left hip.

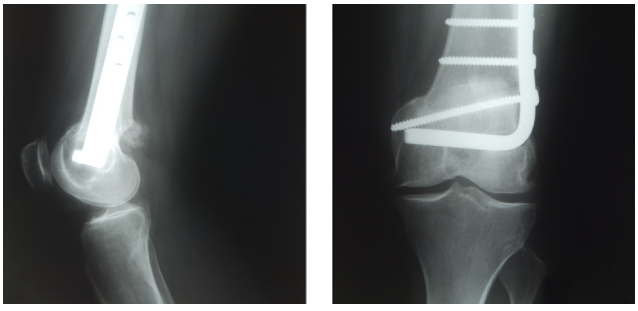

Figure 4. Multiple postoperative radiographs of left knee.

femoral syndrome and osteoarthritis of both the hip and the knee.[1-3] Whereas excess femoral anteversion and its related symptoms have been described many times, excess femoral retroversion is less well documented.

Anteversion

Femoral anteversion has been defined as the "angle between the transverse axis of the knee joint, which is best indicated by a line drawn tangential to the maximum posterior convexity of both femoral condyles, and the transverse axis of the femoral neck."[3] The normal range of anteversion was said to be 15° to 20° by Tönnis and colleagues[3] and 13° by Yoshioka and Cooke.[5] The exact etiology of abnormalities of version is unknown, but there is some evidence that this is a congenital defect related to intrauterine position.[6] Ultimately, this is a torsional problem that may cause disruption of normal axial loading and result in pain.

Anteversion and Hip Osteoarthritis

Whether excess femoral anteversion is associated with osteoarthritis of the hip is debatable. Kitaoka and colleagues[7] used a modified CT technique to measure the femoral anteversion angles in 16 patients with primary osteoarthritis of the hip and 18 control patients. They found no significant difference between the groups. In a similar study, Giunti and colleagues[8] used the Dunlap method to measure anteversion angles in 30 patients with hip osteoarthritis and 10 control patients. Angles were statistically significantly larger in the group with osteoarthritis than in the control group ($P<.01$). In addition, severity of osteoarthritis correlated with degree of anteversion. The discrepancy in the results of these studies could stem from the different methods used to measure anteversion. In both studies, the investigators discussed the idea that the etiology of primary osteoarthritis of the hip is most likely multifactorial.

Anteversion and Knee Pain or Patellofemoral Syndrome

The term *patellofemoral syndrome* has been used to describe pain or dysfunction originating at the anterior knee.[9] Patients usually present at an early age with anterior knee pain, evidence of chondromalacia patella, and patella instability. Although the exact etiology of this syndrome is unknown, deficiencies in skeletal, muscular, ligamentous, or cartilaginous components may play a role.[10] Poor functioning of these components is thought to disrupt the homeostasis of the tissue and potentially result in pain and arthrosis. Specifically, excess femoral anteversion (a skeletal component) has been linked to anterior knee pain similar to that found in patellofemoral syndrome. This association has been reported in multiple studies. Using CT measurements, Eckhoff and colleagues[11] found mean anteversion of 23° in patients with anterior knee pain and 18° in a similar, asymptomatic control group. Other investigators have proposed a link between patellofemoral arthritis and anteversion. Takai and colleagues[4] found 22.7° more femoral internal torsion in patients with isolated patellofemoral arthritis than in patients with isolated medial compartment osteoarthritis.

A proposed mechanism for the association between anterior knee pain and increased femoral anteversion has been discussed in the literature. Post and colleagues[12] wrote that, when quadriceps contraction occurs in an inward pointing knee (ie, increased anteversion), the direction of the force on the patella becomes more lateral. This increases the strain on the medial patellofemoral ligament and on the lateral patellofemoral articulation. This force redistribution is thought to cause anterior knee pain, chondromalacia patella, and the feeling of patellar instability. Teitge[9] described an algorithm for treating patellofemoral symptoms that addresses the internal rotational abnormality. Specifically, he suggested using osteotomy to correct the rotational abnormalities and resultant anterior knee pain. Although excess anteversion has been associated with both hip and knee pathology, it has also been studied as a component of a malalignment syndrome.

The term *miserable malalignment* was popularized by James,[13] who described patients with excess femoral anteversion, squinting patella, patella alta, increased Q-angle, and excessive external tibial rotation. Other investigators studying increased femoral version have reported similar findings.[3]

Retroversion

Overall, there is little information about increased femoral retroversion. It is well known that increased retroversion is associated with external rotation of the leg. In 1959, Crane[14] reported an association in children

between femoral retroversion and out-toeing. Huguenin and Bensahel[15] reported a similar finding in 10 children (mean age, 10 years) with retroversion of the femur. The etiology of increased retroversion has been suggested to result from chronic external rotator contractures of the hip musculature. These contractures are thought to result from intrauterine positioning.[16]

There are some similarities between anteversion and retroversion in the literature. As with increased anteversion, excess retroversion has been associated with hip osteoarthritis.[17] In 1991, Tönnis and Heinecke[18] used the term *diminished femoral antetorsion syndrome* to describe a syndrome of excess femoral retroversion—similar to miserable malalignment syndrome—in a group of 59 children and adults (111 joints) who presented with increased external rotation of the hip and diminished femoral anteversion on biplane radiograph. Most (78.4%) of the patients presented with pain that had begun before age 30. Pain was over the hip in 50% of patients and at the knee in 23.7%. More specifically, 71.4% of the patients with knee pain experienced symptoms around the patella. Osteoarthritis was reported in 11 joints. Overall, there were no striking abnormalities on AP pelvic radiographs.

Signs of diminished femoral antetorsion syndrome were apparent in our patient. Pain in the inguinal region and the knee started early, by age 14. On physical examination, there was evidence of increased external hip rotation with pain elicited at the extremes of motion. In addition, AP pelvic radiographs did not show any abnormalities. All these findings were discussed by Tönnis and Heinecke.[18]

Our patient also demonstrated genu valgum, which was not originally reported in patients with diminished femoral antetorsion syndrome, but has been linked to version abnormalities. Tönnis and Heinecke[3] reported that patients with miserable malalignment (increased anteversion) had an apparent genu varum when standing with feet parallel. Given that finding, it makes sense that a patient with excess retroversion could have apparent genu valgum. Our patient's full-length alignment radiographs did not adequately document the genu valgum observed on physical examination because of the radiographic effects of the torsional deformity, despite the attempt during radiography to internally rotate the limbs to best show the deformity. The radiographs seemed to show a gentle valgus curve to the tibia that was not present on physical examination. This case is unique in that imaging does not correlate with gross inspection. It may be likely that rotational abnormalities such as this are better diagnosed through physical examination.

Our patient also presented with grade 2-3 articular changes in the lateral compartment of the knee. In a study of patellofemoral mechanics, Fujikawa and colleagues[19] found that genu varum increased the load on the medial facet, whereas genus valgum increased the load on the lateral facet. Our patient's early arthritic changes most likely resulted from her valgus deformity.

The patient's status was much improved after surgery. Use of a 2-stage proximal and distal femoral osteotomy led to an improvement in chronic symptoms. Residual pain in the right hip may have been secondary to arthritic changes that had progressed past the point of prevention through rotational osteotomy.

Femoral retroversion and the resultant external rotation of the limb lead to valgus forces on the knee during gait. Although the patient described in this case report was slender, we have noticed clinically that the combination of external rotation and valgus deformity is often found in patients who are overweight. Slipped capital femoral epiphysis is associated with obesity and causes a retroverted femoral head. Our patient's radiographs were not consistent with subclinical slipped capital femoral epiphysis. Obesity is also associated with Blount disease. It is unclear whether obesity causes the growth disturbance that can lead to valgus deformity or retroversion, or whether the deformity leads to physical inactivity and thus to obesity.

Authors' Disclosure Statement

The authors report no actual or potential conflict of interest in relation to this article.

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