Proximal Tibial Osteotomy for Genu Recurvatum
A Review and Case Report

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ABSTRACT: Genu recurvatum may be due to weakness of the muscles that stabilize the knee, with secondary bone changes. The more common etiology is primary bone deformity of the proximal tibia, which may result from multiple causes. An operation is described for the anatomical correction of the latter type. A corrective opening wedge osteotomy is maintained with full thickness bicortical iliac triangular wedges. This technique has been successfully used in one patient who has been followed for 12 years. Key indexing terms: tibia; knee; recurvatum; osteotomy; deformity; graft.

Genu recurvatum may result in an abnormal gait, fatigue, instability, pain, and eventual degenerative arthritis.1,2 It may be caused by either abnormal bone development in the proximal tibia or by complete or partial paralysis of the muscles stabilizing the knee, with late capsular stretching.3 In the normal knee, the proximal tibial articular surface slopes downward slightly posteriorly as seen on the lateral roentgenogram. In genu recurvatum of the bony type, this is reversed and the proximal tibial articular surface slopes downward and anteriorly (Fig. 1). This deformity frequently results from interference with proximal physeal growth, which normally ceases between 17 and 19 years of age.4,5 Since approximately 30% of lower extremity growth in length occurs at the proximal tibia, there is considerable potential for significant deformity when growth is arrested anteriorly or stimulated posteriorly.6 Even trauma at a distance has been reported to cause differential growth resulting in recurvatum at the proximal tibia.7,14 This has been attributed to changes in the local blood supply of the proximal tibia with hyperemia accelerating growth posteriorly and ischemia retarding growth anteriorly.10,15,16 This phenomenon, however, has seldom been encountered in clinical practice.

Genu recurvatum has seldom been reported to result from major trauma about the knee, as the proximal tibial physis is said to be involved in under 1% of all physeal injuries.17 This low incidence is attributed to the broad attachment of medial and lateral collateral ligaments and patellar tendon to the proximal tibia, the angular moment arm, and the anatomic configuration.11,14,18 Avulsion injuries of the tibial tubercle infrequently lead to arrest.5,11,19 Genu recurvatum, however, is a known complication of a Hauser procedure when performed before the completion of skeletal growth.20-24 It has been infrequently associated with Osgood-Schlatter's disease.16,25,26

Smillie has conjectured an association between genu recurvatum and patella alta, equinus tendo achilles contracture, and the use of high-heeled shoes by young women, as the result of abnormal mechanical forces that force the knee into hyperextension for prolonged periods of time.14,27 This is said to lead to differential loading with consequent changes in blood supply and an abnormal growth of the proximal physis.3,14,16

Recurvatum has also been reported to occur in osteomyelitis, osteomalacia, Blount's disease, and iatrogenically by epiphyseodesis, osteotomy, placement of tibial pins for skeletal traction, the harvesting of tibial bone grafts, and prolonged plaster immobilization in knee hyperextension.9,11,14,28,29

Osteotomy to correct genu recurvatum has been previously reported by Lexer30 and Brett,31 who used a transverse osteotomy just below the articular surface of the tibia. The anterior cortex was wedged open and multiple bone chips were used to maintain correction. Sutherland used metal wedges of various sizes to maintain correction, improving the surgical exposure by elevating the tibial tubercle.32 Campbell used an anteriorly opening osteotomy just distal to the tibial tubercle, with strong cortical wedges obtained locally from the tibia to maintain correction.33 Irwin used a closing wedge osteotomy, maintaining the reduction by Steinmann pins and hip spica.3 and Storen modified this technique by using a Charney compression device.34 Both Bohm and Smillie have reported a total of three patients treated with a technique similar to ours.35,36

Method

The patient is supine with a bolster under the ipsilateral hip. A transverse incision is made 2 cm distal to the knee joint either lateral or medial to the tibial tubercle, depending upon whether varus or valgus deformity must also be corrected. In the lateral approach the origin of the anterior tibial muscle is elevated from the tibial flare and the patellar tendon is retracted anteriorly. The proximal fibula may be divided if it inhibits opening of the osteotomy. Under image intensifier x-ray control a Steinmann pin is inserted across the proximal tibia to mark the level of a projected osteotomy. An oscillating saw is used to perform the
osteoectomy except for the posterior cortex, which is divided carefully with a thin osteotome with the knee in flexion to protect the neurovascular structures. A lamina spreader is used to open the osteotomy anteriorly. The more lateral the spreader is placed, the more valgus deformity may be corrected. A varus deformity is corrected by a medial approach and placement of the lamina spreader medially. The base of the opening wedge is measured in at least two separate places, one under each condyle. If only recurvatum exists, the opening wedge bases are equal. If valgus or varus is to be corrected, the bases are of unequal size and bicortical iliac bone grafts of different sizes will be needed.

From the ipsilateral iliac crest two separate bicortical triangular shaped grafts are taken with the measured base along the iliac crest, the depth and angle corresponding to the intraoperative measurements (Fig. 2). These wedges are then positioned in the osteotomy so that equal loading on each is achieved for stability. If necessary, they may be keyed in to prevent displacement. The operator can confirm that recurvatum has been corrected by lifting the extremity by the ankle. Remaining gaps are filled with cancellous bone chips taken from the ilium (Fig. 3). Final x-rays are taken prior to wound closure.

If significant valgus deformity has to be corrected, section of the fibular neck may be necessary and exposure of the peroneal nerve may be desirable to prevent nerve stretch palsy. Postoperatively, one must observe for vascular and neurological embarrassment. The bicortical wedges fit snugly and are held in place by soft tissue tension so that internal fixation is not necessary. A long leg cast is applied with the knee in slight flexion. Partial weight bearing is allowed after six weeks with immo-

bilitation continued until there is x-ray evidence of consolidation of the bone grafts.

**Case Report**

A 16-year-old girl complained of recurvatum and knock-knee deformity on the left with symptoms of pain in the knee with exertion (Fig. 4). At the age of ten years she had undergone a Hauser transfer of the tibial tubercle in the management of recurrent patellar dislocation. A screw had been used to fix the
tibial tubercle in its new position (Fig. 5). Anterior proximal tibial epiphyseal growth arrest caused genu valgum and recurvatum. When this became apparent at about the age of 12 she was fitted with a brace, which she used for two years with relief of symptoms. At the time she was seen by us she also had recurrent dislocation of the opposite patella, which was subsequently treated by soft tissue patellar realignment. This patient did not have generalized ligamentous laxity or hyperelasticity, and there was no family history of knee deformity or soft tissue relaxation. Examination showed slight pelvic tilt to the involved side due to one inch of shortening of the left lower limb. There was a full range of knee motion. X-ray examination confirmed the valgus and recurvatum noted on physical examination (Fig. 6). The joint surfaces were congruous.

An opening wedge osteotomy was performed using bicortical autogenous iliac wedge bone grafts to correct the deformity in both planes. In this case, a Z-lengthening of the patellar tendon was necessary to restore normal patellar femoral contact. Imobilization, non-weightbearing in a long leg cast with the knee slightly flexed was continued for six weeks. For another six weeks she wore a straight long leg weightbearing cast (Fig. 7). The bone graft was satisfactorily incorporated and normal activities resumed at three months postoperatively. Four years later the patient underwent surgery to realign a dislocating contralateral patella and while ambulating on crutches had no difficulty with the osteotomized leg. Followup examination 12 years after corrective osteotomy of the left knee for genu recurvatum showed normal leg alignment, full range of knee motion, symmetrically developed musculature, and no complaint of difficulty (Fig. 8, 9). The patient was employed as an accountant and had recently married.

Discussion

An opening wedge osteotomy of the proximal tibia to correct genu recurvatum deformity is an example of a classic orthopedic procedure to straighten a crooked bone. The operative procedure herein described is not original, with the authors reporting a technique derived from that previously reported by Lexer and Brett and modified by Smillie and Bohn. The placement of the tibial osteotomy above the patellar ligament insertion follows the experience of Conventry and others in the management of osteoarthritis of the knee.37,39 Osteotomy through cancellous bone at this level can be relied upon to heal rapidly. Correction of leg length discrepancy and angular deformity is optimally obtained by placing the osteotomy at the site of maximum deformity.

With the eradication of poliomyelitis in this country, paralytic genu recurvatum is no longer the most common form of that deformity of the knee. Trauma and ill-timed surgical intervention in the growing proximal tibia, as well as some poorly understood genetic and metabolic conditions, are the factors producing genu recurvatum today.41-43 Failure to correct genu recurvatum can increase the work of walking, leading to fatigue and eventually reduced activity by the patient. The bony malalignment and ligamentous instability that result may be progressive and eventually lead to degenerative joint disease in later adult life.

The case reported here shows excellent anatomical correction without residual knee stiffness or deformity, with the patient symptomatically improved. The potential complications inher-
ent in high tibial osteotomy of compartmental syndrome, intraarticular fracture, neurovascular compromise, delayed union or nonunion did not occur, nor have they been reported by other authors using this or similar techniques.

References


Fig. 9: Radiographs 12 years after osteotomy show normal alignment. Note normal patellofemoral relationship.


**Editorial Discussion**

*Orthopedics: This is an excellent overview of the current status of genu recurvatum, including a very good bibliography. The authors' surgical technique is well-described and illustrated, and their cautions about neuromuscular complications are appropriate and well-stated. Perhaps they would comment on the appropriateness of their operation for those instances of genu recurvatum due to muscle imbalance rather than epiphyseal injury or other osseous causes.*

**Dr. Froimson:** We do not recommend the osteotomy described in this article for the correction of recurvatum due to muscle imbalance alone.

**Orthopedics:** Is there an optimal time for correction? What if the epiphyseal plate has not closed?

**Dr. Froimson:** The optimal time for correction is after completion of skeletal growth, since it is not recommended until the epiphyseal plate is closed.